Computer Support for Vicarious Learning

Rachada Monthienvichienchai

A dissertation submitted in partial fulfilment
of the requirements for the degree of
Doctor of Philosophy
of the
University of London

Department of Computer Science
University College London

Submitted July 2003
Research Abstract

Previous research has demonstrated that vicarious learning is an effective pedagogic tool. The focus of this thesis is how computer support for vicarious learning (CSVL) can be implemented in the real world. A requirements specification for a CSVL system that enables educational practitioners to produce vicarious learning materials that meet students’ needs has not yet been established and justified within a pedagogic framework. This research presents a requirements specification constructed using a principled approach to selecting and combining different media to capture dialogues that take place during learning activities. It adopts the concept of CSVL as conceived and implemented by Mayes and Fowler (1999) and the Laurillard Conversational Framework (2002) as approaches to understanding processes and structures of learning activities. The main goal is to create vicarious learning materials of appropriate pedagogic and production quality, whilst minimising cost of producing such materials. It applies multimedia and television production principles to aid production of high quality vicarious learning materials for computer supported learning of system diagram construction in the field of computer science.

The principal contribution of this research is a requirements specification for a CSVL system that can efficiently support the creation of pedagogically effective vicarious learning material, expressed and justified within the context of Laurillard’s Conversational Framework. An effective CSVL system should allow creation of materials that capture both the discursive process and the interactive process of learning activities. The practical implications of this finding are presented as real-world design requirements that take into consideration socio-cultural factors that have been found to influence the successful implementation of CSVL in higher education. Additionally, the data collection methodology employed during this study demonstrates how human-computer interaction (HCI) evaluation methods can be adapted to effectively gather data for analysing student’s learning strategy.
Dialogue (Page: 406)
Di"a*logue (?; 115), n. [OE. dialogue, L. dialogus, fr. Gr. , fr. to converse, through + to speak: cf. F. dialogue. See Legend.]
1. A conversation between two or more persons; particularly, a formal conservation in theatrical performances or in scholastic exercises.
2. A written composition in which two or more persons are represented as conversing or reasoning on some topic; as, the Dialogues of Plato.
# Table of Contents

## Table of Contents

### Abstract ................................................................................................................................................. 2

### Acknowledgements ............................................................................................................................... 13

## 1 Introduction ........................................................................................................................................... 14

1.1 The focus of this research .......................................................................................................................... 14

1.2 What is vicarious learning? .......................................................................................................................... 14

1.3 Main theoretical grounding of vicarious learning ......................................................................................... 15

1.4 Research questions ...................................................................................................................................... 15

1.5 Research contributions .................................................................................................................................. 16

1.6 How this thesis is organised .......................................................................................................................... 17

1.6.1 Route of argument .................................................................................................................................. 17

## 2 Background to Vicarious Learning ............................................................................................................. 21

2.1 Recent trends in computer-aided learning ................................................................................................. 21

2.1.1 Just-in-Time educational material ........................................................................................................... 22

2.1.2 Position of this research .......................................................................................................................... 22

2.2 Vicarious learning ...................................................................................................................................... 25

2.2.1 Vicarious learning as courseware ........................................................................................................... 25

2.3 The groundings for vicarious learning ......................................................................................................... 26

2.3.1 Traditional theories of learning ................................................................................................................ 26

2.3.2 Laurillard's Conversational Framework and dialogue ................................................................................ 27

2.3.3 Dialogue as a stage of learning ................................................................................................................ 29

2.3.4 Alternative dialogue-centric models of learning ....................................................................................... 30

2.3.5 Wenger's Community of Practice model ................................................................................................. 31

2.4 Pedagogic effectiveness of vicarious learning ............................................................................................. 35

2.5 Vicarious learning and collaborative learning ............................................................................................. 38

2.6 Vicarious learning and computer science education .................................................................................. 40

2.6.1 Observing collaborative learning activity ................................................................................................. 40

2.7 What makes CSVL different from a video? ................................................................................................. 40

2.8 Implementations of CSVL ......................................................................................................................... 41

2.9 CSVL and current trends in e-learning ......................................................................................................... 44
# Table of Contents

## 3 Background to Video-based Material Production

3.1 Pedagogic Design

3.2 How to Make a Difference?

3.3 Multimedia Production Design

3.3.1 Image size

3.3.2 Audio and video quality

3.3.3 Audio-video synchronisation

3.3.4 Scene changes

3.4 Television Production Design

3.5 Post-production Design

3.5.1 Initial study: perceived quality is important

3.6 The ‘ideal production’

## 4 Research Questions

4.1 Capturing Material

4.1.1 What is important when observing dialogue for vicarious learning?

4.1.2 What are the differences between staged and real-world dialogues?

4.1.3 What are the hardware requirements for effective and efficient capture of dialogue for vicarious learning?

4.2 Producing Material

4.2.1 How much editing facilities will the lecturer need?

4.3 Accessing Material

4.3.1 How should the material be presented to the students?

4.3.2 How do students interact with the materials?

4.4 General Design Issues

4.4.1 How to design a system that meets all capture requirements but fits into the teaching/tutoring environment?

4.4.2 What are the usability issues of implementing CSVL from the points of view of those involved?

4.4.3 What impact does a CSVL system have on the teaching practice of the tutor/lecturer?

4.4.4 Are there any issues relating to the Data Protection Act?

4.5 What this Research is Not Investigating

4.5.1 Current technical restrictions
Table of Contents

4.5.2 Pedagogic effectiveness of vicarious learning.................................63

5 RESEARCH METHODOLOGY......................................................................64
  5.1 MAJOR AREAS OF ENQUIRY ...............................................................64
  5.2 SELECTION OF EMPIRICAL SETTINGS.........................................................65
  5.3 FACTORS AFFECTING PEDAGOGIC EFFECTIVENESS OF MATERIAL .......67
     5.3.1 SJU Case Study Phase 1 – Perceived Quality .......................................68
     5.3.2 UCL Case Study Phase 1 and SJU Study Phase 2 – Pedagogic
          Effectiveness..............................................................................................69
  5.4 SOCIO-CULTURAL AND USABILITY ISSUES...........................................70
     5.4.1 UCL Case Study Phase 2 – Usability of CSVL Material ....................71
     5.4.2 UCL Case Study Phase 3 – Real-world Issues and CSVL .................72

6 SJU CASE STUDY – PHASE 1 PERCEIVED QUALITY OF MATERIAL ..........75
  6.1 CONTEXT OF STUDY ................................................................................75
  6.2 STUDY GOALS ............................................................................................76
  6.3 EMPIRICAL SETTING ..................................................................................76
  6.4 STUDY SETUP .............................................................................................76
     6.4.1 Creating the test material .....................................................................77
     6.4.2 Production with respect to the Laurillard conversational framework ...79
  6.5 FOCUS GROUP FINDINGS .........................................................................80
     6.5.1 Focus group 1 ......................................................................................80
     6.5.2 Focus group 2 ......................................................................................82
     6.5.3 Focus group 3 ......................................................................................83
  6.6 SUMMARY OF FINDINGS ...........................................................................84

7 UCL CASE STUDY – PHASE 1 EFFECT ON STUDENTS’ LEARNING OUTPUT ....86
  7.1 CONTEXT OF STUDY ................................................................................86
  7.2 STUDY GOALS ............................................................................................86
  7.3 EMPIRICAL SETTING ..................................................................................87
  7.4 STUDY SETUP .............................................................................................88
     7.4.1 Physical setup.......................................................................................90
  7.5 RESULTS ......................................................................................................90
     7.5.1 Answers of graphical nature .................................................................91
     7.5.2 Elaboration of previous answers ..........................................................92
<table>
<thead>
<tr>
<th>Table of Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.5.3  Correction of previous answers ............................................................... 93</td>
</tr>
<tr>
<td>7.5.4  Addition of new answers ........................................................................ 93</td>
</tr>
<tr>
<td>7.6  ANALYSIS OF RESULTS .............................................................................. 94</td>
</tr>
<tr>
<td>7.7  CONCLUSIONS .......................................................................................... 94</td>
</tr>
<tr>
<td>8  SJU CASE STUDY – PHASE 2 EFFECT ON STUDENTS’ LEARNING OUTPUT</td>
</tr>
<tr>
<td>(CONFIRMATION) ............................................................................................... 96</td>
</tr>
<tr>
<td>8.1  CONTEXT OF STUDY .................................................................................. 96</td>
</tr>
<tr>
<td>8.2  STUDY GOALS .......................................................................................... 96</td>
</tr>
<tr>
<td>8.3  EMPIRICAL SETTING .................................................................................. 96</td>
</tr>
<tr>
<td>8.4  STUDY SETUP ........................................................................................... 98</td>
</tr>
<tr>
<td>8.5  QUESTIONNAIRE DESIGN .......................................................................... 98</td>
</tr>
<tr>
<td>8.5.1  Empirical variables ................................................................................ 100</td>
</tr>
<tr>
<td>8.5.2  Note on study .......................................................................................... 101</td>
</tr>
<tr>
<td>8.6  RESULTS ................................................................................................... 101</td>
</tr>
<tr>
<td>8.6.1  Correctness (relative to student) ............................................................. 101</td>
</tr>
<tr>
<td>8.6.2  Correctness (relative to question) ............................................................ 102</td>
</tr>
<tr>
<td>8.6.3  Quantity of students’ comments ............................................................. 104</td>
</tr>
<tr>
<td>8.6.4  Quality of students’ comments ............................................................... 105</td>
</tr>
<tr>
<td>8.6.5  Repeated exposure to MS1 .................................................................... 107</td>
</tr>
<tr>
<td>8.7  ANALYSIS OF RESULTS ............................................................................ 108</td>
</tr>
<tr>
<td>8.7.1  Pedagogic effect of capturing additional stage of the Laurillard framework .................................................................................................. 108</td>
</tr>
<tr>
<td>8.7.2  Lack of comments on social issues .......................................................... 108</td>
</tr>
<tr>
<td>8.7.3  Effectiveness of tertiary courseware ....................................................... 109</td>
</tr>
<tr>
<td>8.8  CONCLUSIONS ......................................................................................... 109</td>
</tr>
<tr>
<td>9  UCL CASE STUDY – PHASE 2 INTERACTION PATTERNS ................................ 113</td>
</tr>
<tr>
<td>9.1  CONTEXT OF STUDY .................................................................................. 113</td>
</tr>
<tr>
<td>9.1.1  Manual vs. synchronised prop access ...................................................... 113</td>
</tr>
<tr>
<td>9.2  STUDY GOALS .......................................................................................... 114</td>
</tr>
<tr>
<td>9.2.1  What data will be collected? .................................................................... 114</td>
</tr>
<tr>
<td>9.3  STUDY SETUP ........................................................................................... 115</td>
</tr>
<tr>
<td>9.4  DATA COLLECTION METHODS .................................................................. 118</td>
</tr>
<tr>
<td>9.4.1  Result from pilot study .......................................................................... 119</td>
</tr>
</tbody>
</table>
### Table of Contents

9.4.2 Capturing interaction patterns .................................................. 119
9.4.3 Post-interaction interview ....................................................... 120
9.5 DATA ANALYSIS METHODS ......................................................... 121
  9.5.1 Overlaying video streams ....................................................... 122
  9.5.2 Coding interaction sessions .................................................... 122
9.6 STUDENTS' INTERACTION PATTERNS ............................................. 124
  9.6.1 Navigational features used ..................................................... 125
  9.6.2 Prop-based vs. video-based navigation ...................................... 126
9.7 HIGH-LEVEL INTERACTION PATTERNS ........................................... 129
  9.7.1 Serialist vs. holist approach .................................................... 130
9.8 STUDENTS' PERCEPTION OF VICARIOUS LEARNING RESOURCE .......... 131
  9.8.1 Perceived usefulness of observing another student's tutorial ............ 132
  9.8.2 Willingness to share the experience .......................................... 134
  9.8.3 Perceived problems with material ............................................ 135
9.9 PEDAGOGIC DIFFERENCES BETWEEN STUDENT'S ANSWERS ............. 139
9.10 LIMITATIONS OF THIS STUDY ..................................................... 139
  9.10.1 Questionnaire-driven interaction ............................................. 139
  9.10.2 User logging method ............................................................. 140
  9.10.3 Granularity of investigation ................................................... 140
9.11 CONCLUSIONS .............................................................................. 140

10 UCL CASE STUDY - PHASE 3 IMPLEMENTING CSVL IN THE REAL WORLD .... 144
10.1 CONTEXT OF STUDY .................................................................... 144
10.2 STUDY GOALS ............................................................................ 144
10.3 CAPTURING REAL-WORLD DIALOGUES ....................................... 145
10.4 EMPIRICAL SETTING .................................................................... 145
10.5 STUDY SETUP ............................................................................. 146
  10.5.1 Video configuration ............................................................... 146
  10.5.2 Access to props ..................................................................... 147
  10.5.3 Audio configuration ............................................................... 148
10.6 DATA COLLECTION METHODS ..................................................... 149
10.7 PEDAGOGIC ISSUES .................................................................... 151
  10.7.1 Capturing experiential knowledge level activities ......................... 151
  10.7.2 Unscripted dialogue ............................................................... 151
# Table of Contents

10.8 **TECHNICAL ISSUES** ................................................................. 152
  10.8.1 Production setup ............................................................... 152
  10.8.2 Video editing ................................................................. 153
  10.8.3 Stability of video editing software ..................................... 154
  10.8.4 Viewing whiteboard contents ............................................ 154
  10.8.5 Capturing handwritten material ....................................... 156

10.9 **SOCIAL-CULTURAL ISSUES** ............................................... 158
  10.9.1 Students’ perspective ....................................................... 158
  10.9.2 Lecturers’ and tutors’ perspective ..................................... 159
  10.9.3 CSVL and the Data Protection Act .................................... 160

10.10 **LOGISTICAL ISSUES** ......................................................... 161
  10.10.1 Transferring material to hard disk for editing ................... 161
  10.10.2 Required amount of disk storage space .............................. 162

10.11 **CSVL: A TUTOR’S PERSPECTIVE** ..................................... 162
  10.11.1 Vicarious learning and phenomenography .......................... 163
  10.11.2 Personal note .............................................................. 163
  10.11.3 Laurillard Conversational Framework revisited .................. 164

10.12 **CONCLUSIONS** ................................................................. 166

11 **DERIVED REQUIREMENTS SPECIFICATION** ......................... 168
  11.1 Pedagogic framework for capturing material ......................... 168
  11.2 Capturing experiential knowledge level activities .................. 169
  11.3 Video capture facilities ..................................................... 170
  11.4 Video-editing facilities ..................................................... 170
  11.5 Material design and presentation ........................................ 172
  11.6 General design requirements ............................................. 174
  11.7 Others .............................................................................. 175
  11.8 General recommendations .................................................. 176
  11.9 Pedagogic recommendations ............................................... 177
  11.10 Summary of requirements .................................................. 184

12 **CONCLUSIONS** ................................................................. 188
  12.1 Research problems ........................................................... 188
  12.2 Research questions .......................................................... 189
  12.3 Empirical work ............................................................... 191
Table of Contents

12.4 SUBSTANTIVE RESEARCH CONTRIBUTIONS ......................................................... 191
12.4.1 Framework for developing effective vicarious learning material .......... 191
12.4.2 Requirements specification dependent on pedagogic goals and effectiveness ................................................................. 192
12.4.3 Perception of vicarious learning by students .............................................. 193
12.4.4 Student interaction with vicarious learning material ................................ 194
12.4.5 Real-world issues of implementing CSVL ................................................ 194
12.4.6 Improved mode of interaction in video editing software to enhance usability 195
12.4.7 Immediate improvements to current educational video production and delivery system in supporting vicarious learning .................................................... 196
12.5 PEDAGOGIC THEORY CONTRIBUTIONS .......................................................... 198
12.5.1 Categorisation of courseware ................................................................. 198
12.5.2 Definition of tertiary courseware ........................................................... 199
12.5.3 Purpose of tertiary courseware ............................................................... 201
12.5.4 Tertiary courseware and the Laurillard framework .................................... 201
12.6 METHODOLOGICAL RESEARCH CONTRIBUTIONS ......................................... 203
12.7 REVIEW OF RESEARCH DESIGN AND METHODOLOGY ................................... 205
12.7.1 Using two case studies ............................................................................. 205
12.7.2 Subjects for case studies .......................................................................... 205
12.7.3 Emphasis on qualitative rather than quantitative research ..................... 207
12.7.4 Student anonymity .................................................................................... 208
12.8 FUTURE WORK .................................................................................................. 208
12.8.1 Large-scale implementation of CSVL ....................................................... 208
12.8.2 How can the authoring process be optimised? ......................................... 211
12.8.3 Will support for off-line access be useful to students? .............................. 211
12.8.4 More detailed investigation of student’s interaction with material ............ 211
12.8.5 CSVL and communities of practice .......................................................... 212
13 REFERENCES ......................................................................................................... 214

APPENDIX A: SJU CASE STUDY PHASE 1 TRANSCRIPT OF FOCUS GROUPS .......... 220
APPENDIX B: SJU CASE STUDY PHASE 1 TRANSCRIPT OF VIDEO CLIP .......... 226
APPENDIX C: UCL CASE STUDY PHASE 1
EXAMPLE OF COMPLETED QUESTIONNAIRE ..................................................... 229
Table of Contents

APPENDIX D: SJU CASE STUDY PHASE 2  
EXAMPLE OF COMPLETED QUESTIONNAIRE ................................................................. 231

APPENDIX E: SJU CASE STUDY PHASE 2 STUDENTS' TABULATED ANSWERS ........ 233

APPENDIX F: SJU CASE STUDY PHASE 2 STUDENTS' RAW COMMENTS ............... 243

APPENDIX G: UCL CASE STUDY PHASE 2 STUDENTS' INTERACTION PROFILES ..... 246

APPENDIX H: UCL CASE STUDY PHASE 2 TRANSCRIPT OF INTERVIEWS ............ 261

APPENDIX I: PUBLISHED PAPER (E-LEARN 2002) .................................................. 285

APPENDIX J: PUBLISHED PAPER (LTSN-ICS 2003) ................................................ 294

TABLE OF FIGURES

Figure 1.1: Thesis structure .......................................................................................... 20
Figure 2.1: CSVL system framework adopted in this research .................................. 24
Figure 2.2: A Simplified Diagram of Laurillard's Conversational Framework (Pennel, 1996) ....................................................................................................................... 27
Figure 2.3: Laurillard's Conversational Framework derived from Laurillard (1993) .... 28
Figure 6.1: Screenshots showing the three camera angles used in the study (including PIP insert) ................................................................................................................ 78
Figure 7.1: Screenshots showing implementations of chapter facility (left) and embedded web-links (right) ............................................................. 89
Figure 7.2: Answer given by Student 3 to question 6a ................................................. 91
Figure 7.3: Answer given by Student 4 to question 6a ................................................. 92
Figure 7.4: Answer given by Student 1 to question 6 .................................................... 92
Figure 7.5: Answer given by Student 3 to question 6 ................................................... 92
Figure 7.6: Answer given by Student 4 to question 7 ................................................... 93
Figure 8.1: Screenshot of Production 1 (MS1) ............................................................... 97
Figure 8.2: Screenshots of Production 3 (MS2)............................................................ 97
Figure 8.3: Graph showing Students' Marks - 1st pass vs. 2nd pass ......................... 102
Figure 8.4: Graph showing percentage of students giving correct answers vs. each question - 1st pass vs. 2nd pass ............................................................. 103
Figure 9.1: Screenshot showing chapters implemented in a QuickTime™ video clip. 116
Figure 9.2: Screenshot showing material with manual prop access via hyperlinks .... 117
Figure 9.3: Screenshot showing material with time-synchronised prop access ......... 117
Table of Contents

Figure 9.4: Screenshot showing material with both time-synchronised and manual prop access....................................................................................................................118
Figure 9.5: Overlaid video-streams of student's session...............................................122
Figure 9.6: Colour-coded activity log..........................................................................124
Figure 9.7: Interaction profile of Student 5..................................................................127
Figure 9.8: Interaction profile of Student 11.................................................................128
Figure 9.9: Interaction profile of Student 2...................................................................128
Figure 9.10: Interaction profile of Student 8.................................................................129
Figure 10.1: Initial camera setup..................................................................................147
Figure 10.2: 1-to-1 tutorial...........................................................................................150
Figure 10.3: Group tutorials.........................................................................................150
Figure 10.4: Blurring of printed text when using a DV camera to capture content......157
Figure 10.5: Laurillard Conversational Framework showing explicit exploration of misconceptions.....................................................................................................165
Figure 12.1: Summary of empirical work.....................................................................191
Figure 12.2: VESOL's camera angles are aimed at capturing lectures.........................197
Figure 12.3: VESOL does not record at sufficiently high resolution.........................197

Tables
Table 6-1: Productions and their camera angles ............................................................78
Table 6-2: Focus groups and the productions viewed by each group.........................80
Table 9-1: Table showing what each set of material consists of.................................118
Table 9-2: Colour scheme used to code students' activities........................................123
Table 9-3: Summary of approaches adopted by students.............................................131
Acknowledgements

First and foremost, I would like to thank my supervisor, Professor M. Angela Sasse, for her invaluable guidance throughout this research. I also owe a debt of gratitude to my second supervisor, Dr. Harvey Mellar, who never tired of giving feedback on the numerous drafts of this thesis. I cannot thank both of my supervisors enough for their confidence in me from the very beginning of this research.

I am also grateful to Dr. Janet McDonnell for never refusing to evaluate and give her critique this research even when she was incredibly busy. I would like to thank my colleagues in the Multimedia Lab for their advice and willingness to offer assistance whenever it was needed, particularly Gillian Wilson, Sacha Brostoff, Simone Stumpf, Jens Riegelsberger, Mischa Weiss-Lijn, Simon Attfield and Dirk Weirich.

Thanks also to the lecturers and students, who volunteered to take part in this research, particularly Vikorn Thetsalee, whose assistance ensured exceptional access to students and equipment at Saint John’s University, Bangkok.

I would like to thank James Perry, Pierre Werner and Edmund Townend for never being too busy for a concert or two.

A special thanks to my very much better half, Catherine Edwards, for her unfailing support and patience during the preparation of this thesis. Her constant encouragement, especially when I did not have time to cook, has made the completion of this thesis possible. I promise her a lifetime of Thai food and love.

Finally, I would like to thank my family, particularly my parents, for supporting me throughout my studies in the UK. This Ph.D. is as much for them as it is for myself.

I gratefully acknowledge the sponsorship of this research by Saint John’s University, Bangkok.

Thank God for wine.
1 Introduction

The research presented in this thesis investigates how computers and video-based media can be used to effectively and efficiently support vicarious learning — a new practice in education in which computers are used to support student learning by enabling students to observe previously captured dialogues between another student and the lecturer. The contribution of this research is a set of requirements specification for computer support for vicarious learning (CSVL) in higher education. The research is grounded in the works of Mayes (Mayes and Fowler, 1999) on using computers to support vicarious learning, and Laurillard (Laurillard, 2002) on the role of dialogue in learning in higher education.

1.1 The focus of this research

In contrast to the majority of Computer-Aided Learning (CAL) projects that focus on evaluation of pedagogic effectiveness, this research aims to construct a requirements specification for using computers to support (as opposed to replace) conventional teaching practice in higher education. More specifically, while this research raises pedagogical issues concerning vicarious learning, it focuses on investigating design issues concerning provision of computer support for individual or small groups of lecturers who want to use video-based vicarious learning as a pedagogic tool.

1.2 What is vicarious learning?

Vicarious learning is learning that takes place while observing learning dialogues between a student and a tutor. The most common instances of this type of learning occurring are during lectures and group tutorials. When a student and lecturer have a discussion in front of the class, the rest of the class learns something from that discussion by observing the dialogue that goes on. The concept of vicarious learning is not new. Chronicles of dialogues have been used for conveying ideas or concepts in a wide range of disciplines for centuries — for example, religion (Poole, 1685; Anon, 1792), law (Hobbes, 1971), commerce (Butterman, 1804) and neurolinguistic programming (Bandler, 1985). On an even larger scale, television broadcasts have allowed the public to observe debates and discussions on topics ranging from current affairs to personal issues. Additionally, Social Learning Theory (Bandura, 1977)
Introduction

argues, “children and adults acquire attitudes, emotional responses, and new styles of conduct through filmed and televised modelling”.

Computer-Aided Learning has produced a multitude of primary and secondary courseware, such as online lectures and simulations (see Chapter 2.2.1: Vicarious learning as courseware for further discussion on courseware). However, there are many instances where such courseware fails to meet some pedagogic needs of the students (Mayes, 1995). When students have misconceptions following their interaction with primary courseware (see Chapter 2.2.1: Vicarious learning as courseware for further discussion on courseware), it is difficult for them to effectively apply what they have learnt when using secondary courseware. Often such misconceptions are only realised with the support of their tutors. However, such support places heavy demand on the time and effort of the tutor and, consequently, misconceptions are often realised only after the students have received feedback for an assessed piece of work.

Tertiary courseware based on vicarious learning (Mayes and Fowler, 1999) aims to fill this need by giving students access to feedback-rich educational dialogues, allowing the students to vicariously learn from the educational experiences of other students.

1.3 Main theoretical grounding of vicarious learning

As mentioned earlier, vicarious learning is based on the existence of dialogue between the lecturer and the student. While it is apparent that some form of dialogue does take place, the structure or framework of the dialogue is not so obvious. However, Laurillard’s Conversational Framework (Laurillard, 2002) provides an approach on how to view interactions between lecturer and student at higher education level. The framework suggests a relationship between the lecturer and the student at the ‘conceptual knowledge’ and ‘experiential knowledge’ levels with both parties engaging in an ongoing negotiation of concepts, task goals and actions. It is this framework that has been adopted as the central framework for analysing materials produced during this research.

1.4 Research questions

A review of literatures on vicarious learning and current CSVL systems suggests that vicarious learning does have benefits for the learner but, like any other pedagogic tool, it also has its shortfalls. However, it seems that the weak link in the chain of CSVL
implementation is not vicarious learning itself, but the design and implementation of the computer systems that support such learning. From the system design point of view, CSVL can be split into three main components: capturing, archiving and accessing dialogues.

Previous research has not established or justified the requirements specification for implementing CSVL for individual or small groups of lecturers; in particular, the following issues have not been addressed:

From the lecturer's or material author's point of view
1. What materials need to be captured in order to create pedagogically effective video-based vicarious learning material? (content)
2. What are the usability issues when capturing material for producing video-based vicarious learning material? (process)
3. How can materials be captured as efficiently as possible? (process)
4. What are the usability issues when producing video-based vicarious learning material? (process)

From the student's or material user's point of view
5. What should video-based vicarious learning material contain in order for it to be pedagogically effective? (content)
6. What are the usability issues when students access the material produced? How will the students actually use the material? (process)

1.5 Research contributions
In addressing the issues raised by the research questions as outlined above, this research aims to contribute to both the education and computer science disciplines by constructing a requirements specification for an effective and efficient CSVL system, while also adopting a pedagogic framework for evaluating the effectiveness and efficiency of the system. This cross-disciplinary approach aims to fill the gap between research studies on vicarious learning that are rooted purely in either the education or engineering discipline. Major contributions of this research include:

1. Establishing a pedagogic framework for developing effective video-based vicarious learning material.
2. Construction of a CSVL requirements specification that is dependent on pedagogic goals and effectiveness.
Introduction

3. A survey of students’ perception of vicarious learning material.
4. A detail log and analysis of students’ interaction with vicarious learning material.
5. Discovery of real-world issues that affect successful implementation of CSVL in higher education.

1.6 How this thesis is organised

This thesis has been written so that the reader does not need to read all of its content in one sitting in order to understand or follow the work completed by this research. Consequently, each chapter has a

- **Chapter Introduction:** where the issues raised in the chapter are introduced to the reader and, where appropriate, a reminder of the issues raised in the previous chapter.

- **Chapter Summary:** where conclusions of the chapter are summarised and, where appropriate, a short introduction to the issues that the following chapter will raise and how it is relevant to the current chapter.

1.6.1 Route of argument

The thesis begins with an introduction and background (chapter 1) to the current trends in Computer-Aided Learning (CAL), and where in relation to those trends the research is positioned. This places the research within the context of using CAL to support rather than replace current teaching practice in higher education.

Once the position of this research has been established, the thesis specialises in chapter 2 by focusing on vicarious learning and discussing what issues need to be tackled in terms of research in computer science and education. Issues concerning the requirements for computer support for video-based vicarious learning are discussed further in chapter 3. The main conclusion that is derived from these two chapters is that the specifics of how to create pedagogically effective video-based vicarious learning material have not been addressed by previous research, nor how the production of those materials can be made to be efficient. In particular, the literature review in these two chapters highlights the need to construct a requirements specification for a CSVL system through a pedagogic framework.
Introduction

These issues are translated in chapter 4 into concrete research questions that are addressed in this thesis. In doing so, the scope of this work is also defined. The chapter identifies two major areas of enquiry for this work. Firstly, in terms of the Laurillard Conversational Framework (Laurillard, 2002): what makes materials pedagogically effective? This question is asked in the context of user-definable production variables when capturing, producing and accessing the materials. Secondly: what are the factors influencing a successful implementation of CSVL in higher education? This question is asked in terms of the usability and socio-cultural issues that arise when an implementation of CSVL is attempted in a real-world setting. This chapter also outlines issues that this research does not tackle. This research assumes the pedagogic effectiveness of vicarious learning and does not investigate technical aspects of implementing CSVL that are not within the control of the user (e.g. the effect of bandwidth restriction and network congestion on system effectiveness). This reflects the aim of this research to adopt a balanced research approach between the education and computer science disciplines.

This cross-disciplinary approach is reflected in the choice of research methodology and data collection methods outlined in chapter 5. Readers with a computer science background will notice that many of the approaches and methods for data gathering used during this research are well-established HCI evaluation techniques. For example, in chapter 9, user interaction logging using on and off screen cameras is used to log how students interact with different implementations of vicarious learning material and in chapter 10, user observation and interview are used to investigate human factors that can affect a successful implementation of CSVL. However, such evaluations have been conducted using criteria derived from a pedagogic framework rather than the more usual technical one.

The 5 chapters that follow report on the empirical work performed to answer the research questions that have been derived. These empirical works are in the form of two case studies conducted at Saint John's University (SJU), Bangkok, and University College London (UCL).

Chapter 6 investigates factors that affect the perceived quality of vicarious learning material and finds that materials that capture the experiential knowledge level activities,
as defined by the Laurillard framework, are perceived more positively than those that do not.

**Chapter 7 and 8** investigate this factor more closely in terms of its effects on the students’ learning output and finds that the addition of the experiential knowledge level activities in the material positively affects the students’ learning output. The empirical findings up to this point indicate the importance of the experiential knowledge level activities in creating effective vicarious learning materials.

**Chapter 9** then looks at how best to present the experiential knowledge level activities when implementing vicarious learning materials. It investigates the issue of synchronising the experiential knowledge level activities with those of the conceptual knowledge level. The investigation is conducted within the context of two very different systems: The *Dissemination* tutoring system and *eClass*.

**Chapter 10** balances the focus of this research by investigating factors that can affect a successful implementation of CSVL in the real world. By observing the experience of using CSVL by both lecturers and students, the investigation finds that there are social and cultural factors that can impede a successful implementation of CSVL.

The penultimate chapter of this thesis (**chapter 11**) derives from the findings of the empirical work of the last 5 chapters, the requirements specification for computer support for video-based vicarious learning that are within the scope of this work.

The final chapter (**chapter 12**) then summarises the contributions of this work to the disciplines of computer science and education. The thesis finishes by proposing areas for further work based on issues that have been found during the course of this research but have not been fully investigated, as these issues are outside the scope of this work. Details of all the literature and web references made within this thesis can be found in **chapter 13**.

Readers who are only browsing through this work just to get an overview of its content can read **chapter 2**, where you will find the essential background on vicarious learning,
**Introduction**

*chapter 4* where the issues that are being tackled in this research work are made explicit and *chapter 12* where the contributions of this work are summarised.

Figure 1.1 shows a diagrammatical overview of this thesis.

**Figure 1.1: Thesis structure**
2 Background to Vicarious Learning

Introduction
This chapter begins by highlighting important pedagogical issues relating to this area of research with the aim of identifying design issues for a CSVL system. These design issues will form the foundation for generating a requirements specification for a CSVL system. A review of related theories that provide grounding for vicarious learning and current published works on vicarious learning by another research group on the Vicarious Learner project (http://www.hcrc.ed.ac.uk/gal/vicar/index.html) at Glasgow Caledonian University and the University of Edinburgh is given. Additionally, related implementations of video-based educational technology and alternative approaches to supporting vicarious learning are also reviewed. The chapter concludes from the literature review that the specifics on how to efficiently produce effective video-based vicarious learning material have not been sufficiently investigated and documented.

The research presented in this thesis investigates how computers and video-based media can be used to effectively and efficiently support vicarious learning—a new practice in education in which computers are used to support student learning by enabling students to observe previously captured dialogues between another student and the lecturer. The contribution of this research is a set of requirements specification for computer support for vicarious learning (CSVL) in higher education, which will then be implemented and evaluated. The research is grounded in the works of Mayes and Fowler (1999), on using computers to support vicarious learning, and Laurillard (1993, 2002), on the role of dialogue in learning in higher education.

2.1 Recent trends in computer-aided learning
In the 1990s, the trend in research in the field of Computer-Aided Learning (CAL) was to introduce the notion of teaching via means other than lectures and tutorials. The most common realisations of such a trend were implementations of computer systems for delivering content (e.g. multimedia presentations) and providing activity spaces (e.g. simulations and modelling software). Consequently, the current trend is to move away from just pushing information at students, to generating more opportunities for learning.
by enabling teaching and learning to take place outside lecture time by utilising intranets or the internet.

2.1.1 Just-in-Time educational material

The most recent trend in the development of educational materials stems from the experience of educational practitioners with the limitations of off-the-shelf CAL packages. These packages, while they were implemented to commercial technical standards, often did not meet the pedagogic needs of the students of many practitioners, especially lecturers in higher education. This was mainly due to two reasons. Firstly, off-the-shelf packages need to have a wide audience for them to be commercially viable. Consequently, these packages are often not able to meet specific needs of many educational practitioners. Secondly, the majority of these packages are in the form of primary or secondary courseware (see Chapter 2.2.1: Vicarious learning as courseware for a further discussion on courseware). These courseware again meet only some of the pedagogic needs of the students, with many lacking sufficient support for students who require learning feedback through dialogue-centric activities.

What lecturers need are materials that have been created specifically with the needs of a particular student cohort in mind, e.g. first year undergraduate language students at a particular institution, whose first language is not English, learning French having taken French Language as an A-Level. When the lecturer creates materials for this group of students, the needs of the students at a particular stage in a particular course (Just-in-Time or JIT) would be met by providing material “as needed, just in time so the learner can move efficiently from theory to application and understand both better” (Hudspeth, 1992). In such situations, materials that are created for a particular student cohort will need to be made more specific by closely tying the materials created with the learning context of that particular student cohort.

2.1.2 Position of this research

In contrast to the majority of Computer-Aided Learning (CAL) projects that focus on evaluation of pedagogic effectiveness, this research aims to construct a requirements specification for using computers to support (as opposed to replace) conventional teaching practice in higher education. More specifically, while this research raises pedagogical issues concerning vicarious learning, it focuses on investigating design
Background to Vicarious Learning

issues concerning provision of computer support for individual or small groups of lecturers who want to use vicarious learning as a pedagogic tool.

While it is important to establish groundings for vicarious learning, the main aim is not to justify the effectiveness of vicarious learning as a pedagogic tool (this would be more suited to research in the social-science discipline), but to find out how to use computers to effectively support this kind of learning. The main design problem that is being tackled is the construction of a requirements specification for a cost-effective CSVL system that can be easily implemented by individual or small groups of lecturers, as well as being adaptable to their individual needs. The investigation is centred on three specific tasks (see Figure 2.1 on the next page) that the CSVL system must support in order to create pedagogically effective vicarious learning material:

1. capturing the learning dialogue from learning activities,
2. editing the learning dialogue that has been captured and assembling it into effective vicarious learning material, and
3. delivering vicarious learning material that has been created to the student.

Exactly what computer support these tasks require depends on what the material needs to contain in order to be pedagogically effective for the student, i.e. what needs to be captured in the first place depends on what needs to be delivered to the student in the form of vicarious learning material. Additionally, another task – archiving the material – may also need to be supported if a large number of vicarious learning material is to be effectively delivered to the student. Finally, the system needs to be adaptable enough to meet requirements for installations in small rooms (e.g. for individual or small group tutorial) and take as little time and effort as possible to setup and use. Chapter 4: Research Questions presents in detail how the design problem of constructing a requirements specification for a CSVL system that can effectively support these tasks translates into concrete research questions, in light of the literature review conducted in this and the next chapter.
Why focus on implementing CSVL to support individual or small groups of lecturers? Vicarious learning can be seen to work in professional productions. Examples on television include Open University education programmes containing brainstorming and debates between lecturers and students and public debates often discussing issues concerning current affairs. However, a lecturer who wants to use such programs can face several obstacles. Firstly, the content of the programme may not suit the needs of
the students/courses that the lecturer is teaching. Secondly, the materials are not grounded or linked to the students’ own experience and thus do not make use of the benefits of the students’ episodic memory (Tulving, 1983). Such professional productions are also costly and require large amounts of time and effort from the lecturer if he or she wants to produce material of similar production quality him/herself. Lastly, not all the dialogues in these programmes are learning dialogues. In some cases, the discussion that is taking place merely consists of two or more sides stating their positions with no parties being persuaded to change their position or learn anything in particular throughout the discussion. For this reason, this research is asking whether computer support can bring the benefits of vicarious learning to individual lecturers who may have ready access to learning dialogues that are taking place between them and their students or even among the students themselves. If so, how can such support be given most efficiently and effectively? If not, what are the main obstacles?

2.2 Vicarious learning

Vicarious learning is learning that takes place while observing learning dialogues between a student and a lecturer/tutor (Stenning et al., 1999). The most common instances of this type of learning occurring are during lectures and group tutorials. When a student and lecturer have a discussion in front of the class, the rest of the class learns something from that discussion by observing the dialogue that goes on. The concept of vicarious learning is not new. Chronicles of dialogues (as opposed to continuous prose) have been used for conveying ideas or concepts in a wide range of disciplines for centuries – for example, religion (Poole, 1685; Anon, 1792), commerce (Buttermann, 1804), law (Hobbes, 1971) and neurolinguistic programming (Bandler, 1985). On an even larger scale, television broadcasts have allowed the public to observe debates and discussions on topics ranging from current affairs to personal issues.

2.2.1 Vicarious learning as courseware

So where is vicarious learning relative to other courseware that currently exist? As a broad classification, computer-based learning materials can be categorised into three categories of courseware (Mayes, 1995); primary, secondary and tertiary.

The most common of these is primary courseware, which is used for introducing concepts to students. This can be in the form of electronic books, online lectures or
electronic sources of encyclopaedic form. *Secondary courseware* is what is most closely associated with computer-based learning. Such courseware allows the student to explore concepts learnt from primary courseware in further depth and complexity through performing related tasks. Examples of secondary courseware include simulation programs, modelling tools and computer-aided assessment systems. *Tertiary courseware* uses as a learning resource the dialogues that take place within the context of the use of secondary courseware. These dialogues can be in the form of a one-to-one dialogue between a student and a tutor or a general classroom discussion on a certain topic. Consequently, the main aim of tertiary courseware is not to present new ideas, but to clarify and facilitate exploration of concepts and assist students when they have misconceptions on a topic. Examples of such tertiary courseware include dialogues captured in the form of Frequently Answered Questions (FAQs) and online discussions in computer-mediated communication (CMC) environments. With respect to this classification, materials that can effectively support vicarious learning can be classified as tertiary courseware.

What arises from this classification is the implicit relationship between each type of courseware if all learning resources are to be delivered via courseware. Tertiary courseware needs to be complemented by secondary courseware, which in turn relies on primary courseware for the initial concept presentation. Tertiary courseware can of course be used without the support of primary or secondary courseware if the pedagogic needs of the students are met through other means, such as conventional off-line teaching methods. However, it is clear that tertiary courseware can meet only some and not all the pedagogic needs of the students. In designing CSVL systems, such relationship will need to be considered in order to maximise the benefit of using such systems. In other words, the aim of tertiary courseware development should not be to replace existing effective primary or secondary courseware, but to extend the ability of existing courseware to meet the pedagogic needs of the students.

### 2.3 The groundings for vicarious learning

#### 2.3.1 Traditional theories of learning

Dialogue plays an important role in terms of traditional or well-established theories of learning. Piaget's (Piaget, 1970) and Vygotsky's (Vygotsky, 1962) theories of learning
are based on the concept that students learn through social interactions and it is these interactions that provide the content and context to the knowledge that is acquired (Mayes and Fowler, 1999). This reliance on social interaction implies that there are extensive uses of dialogues as part of the learning process. However, both Piaget and Vygotsky have only discussed the importance of dialogue with respect to social interactions, but not a specific learning framework based on dialogue. For a closer analysis of dialogue, it is necessary to refer to the Laurillard Conversational Framework.

2.3.2 Laurillard’s Conversational Framework and dialogue

As mentioned earlier, vicarious learning is based on the existence of dialogue between the lecturer and the student(s). While it is apparent that some form of dialogue does take place, the structure or framework of the dialogue is not so obvious. However, Laurillard’s Conversational Framework (Laurillard, 2002) provides an approach on how to view interactions between lecturer and student at the higher education level. The framework suggests a relationship between the lecturer and the student at the ‘conceptual knowledge’ and ‘experiential knowledge’ level with both parties engaging in an ongoing negotiation of concepts, task goals and actions. Figure 2.2 presents a simplified diagram of Laurillard’s framework.

![Figure 2.2: A Simplified Diagram of Laurillard’s Conversational Framework (Fennel, 1996)](image)

The diagram shows how the lecturer (or teacher) and the student interact with each other at the conceptual knowledge and experiential knowledge level. In terms of vicarious learning, it is the experience of the student’s peers (i.e. those who are on the same course) that is relevant pedagogically. Consequently, it is not only at the conceptual knowledge level that the model can provide a useful guide for developing systems to support vicarious learning (although this is where the majority of verbal discussions take place), but also the student’s interaction with the task set by the
Background to Vicarious Learning

A lecturer that is also of pedagogic importance. Figure 2.3 illustrates in more detail what kind of dialogue may take place between a lecturer and a student at the conceptual knowledge level and the student and the task at the experiential knowledge level.

![Laurillard's Conversational Framework](image)

**Figure 2.3: Laurillard's Conversational Framework derived from Laurillard (1993)**

Figure 2.3 differs from Laurillard's original Conversational Framework (Laurillard, 1993) mainly by the numbering scheme used for labelling each stage. Each stage of interaction has been labelled in rough chronological order from the perspective of the student. This has been done in order to highlight what the experience of the student during the learning activity might be. Additionally, stages that are internal to the
Background to Vicarious Learning

participants of the interactions are labelled alphabetically to differentiate them from stages that are externalised and can therefore be observed.

While the diagram suggests that dialogue takes place and originates at the conceptual knowledge level, such dialogues result from actions by lecturer or student at the experiential knowledge level, i.e. dialogues are contextualised around activities at the experiential knowledge level. However, the structure of the dialogue, in the verbal sense, can be seen more clearly at the conceptual knowledge level. Additionally, each dialogue can have different pedagogic purposes. These include:

- Introduction of new concept (stage 1)
- Clarification of or reflection on existing concept (stage 2)
- Correction or modification of misconceptions (stage 3 & 4)

The Laurillard Conversational Framework is only one of many possible approaches that can be taken when analysing the interaction between a student and the lecturer. However, it provides a relevant entry point to finding out what the requirements for a CSVL system are, i.e. stages 1 to 8 are those that can be more easily observed by a third party than stages A to D. It is these observable stages that can form a framework for creating pedagogically effective vicarious learning material.

Questions will be asked during empirical research concerning the accuracy of this model (or any other models that are used as framework for analysis) and whether they need to be modified in any way in light of empirical findings.

2.3.3 Dialogue as a stage of learning

Another approach to looking at dialogue in education is to see it as one of the stages of learning (Fowler and Mayes, 2000). In an effort to bridge the educational theoretical concepts and design principles of educational technology, Mayes (Mayes, 1995) presents dialogue as one of the three main iterative stages of learning:

1. **Conceptualisation**: encountering other people’s concepts.
2. **Construction**: integrating existing knowledge with those of other people into “something meaningful”.


3. **Dialogue**: debates and discussions that result from creating "something meaningful". This can trigger another iteration of this cycle of learning or re-"conceptualisation".

Again, it would be naïve to assume that this is exactly how, or the only way that learning takes place. However, like Laurillard's framework, this model is flexible enough to provide a framework that can be used and tested for designing educational software that relies on the use of dialogue as a pedagogic tool. Additionally, this model underlines the fact that tertiary courseware is not about introducing new concepts, but about facilitating deeper understanding of those concepts by contextualisation through dialogue.

### 2.3.4 Alternative dialogue-centric models of learning

An alternative but related approach to Laurillard's and Mayes' dialogue-centric approaches to modelling learning is presented by Pask (1988). While his work on a systems approach to learning can be seen to have influenced Laurillard's framework, it is his theory on lecturer's and learner's learning strategy that plays a significant role in adult education (Atherton, 2003). Pask argues that lecturer and student have preferences on how they choose to present or tackle a new concept. There are two general approaches that can be taken: serialist and holist. A serialist will take a new concept one step at a time, sequentially building up knowledge of the concept. On the other hand, a holist will first look at the concept from a broad perspective and then look at the concept in more detail. The main argument that is being presented is that a mismatch between the lecturer's and student's strategies will hinder the learning process.

The details of the two learning approaches presented by Pask are not relevant at this point. However, it is important to note that Pask's theory implies that when a person cannot understand something, it is often because the concept has not been presented to them in a way that is compatible with his/her learning approach. On this line of argument, it is possible to say that vicarious learning material, by capturing and developing the current conceptions of the students, provides alternative views of a concept that are constructed from the representational systems that the students are already using.
2.3.5 Wenger's Community of Practice model

Lee et al. (1999) reports that vicarious learning has social as well as cognitive benefits for the student. More specifically, he attributes this benefit to the exposure of peer discussion that "creates positive feelings of being part of a learning community". Lee’s observation can be contextualised within Wenger’s (1998) perspective on the manner in which learning is achieved and organised. His Community of Practice (COP) model places great emphasis on learning as the transformation of the identity of the learner with respect to a community. This concept of identity and learning is presented within the context of three *modes of belonging*:

1. **Engagement**: identifying with a community through participating in the process and negotiation of meanings within the community.

2. **Imagination**: having a common image of the world with the community and sharing its view of the past and future.

3. **Alignment**: complying with the expectation of a community through coordination of "energies, actions and practices".

It is through these modes of belonging that an individual defines him/herself to be a member of certain communities. In terms of this model, a community is a group of people who create common practice through sharing of knowledge and learning experience (Smith, 2000). In some cases, it is possible to argue that it is the sharing of knowledge that creates the community in the first place. In either case, Wenger’s concept of a community can be defined as a group of people who contribute to the success of the organisation through:

- **Sharing an interest in a topic (Domain)**: understanding what the issues are and agreeing on common approaches.

- **Interacting and building relationships (Community)**: helping each other solve problems and answer questions and networking across teams and business units (creating trust and relationship between people, allowing the community to act).

- **Sharing and developing knowledge (Practice)**: sharing information, insights, and best practices, building tools and a knowledge base (Wenger, 2002).
Background to Vicarious Learning

This model of interaction was realised in the context of the following “new learning realities” (Wenger, 2002):

1. **Information has become a commodity**: not only is knowledge developed in the context of a certain community, but your idea of knowledge also depends on your identity.

2. **The half-life of knowledge is getting shorter**: knowledge may not live very long, consequently it is more important to create an identity in the student that wants to learn – “an ongoing journey of the self”.

3. **Traditional canons are destabilized**: there is great necessity in creating an identity to allow life-long learning in the individual.

### 2.3.5.1 Learning in COP

Learning by members of the community takes place through participation of each member in the shared practice of the community. Consequently, this model of learning places more importance on providing sufficient access to the right set of communities of practice than to optimise the delivery of the information (or content) for the learner. In effect, this requires current practitioners to be involved in the process of managing knowledge. In terms of pedagogy, this model implies that competence and key knowledge are defined by the community.

Wenger’s model implies that knowledge lives in the communities and the key to managing that knowledge is connecting the experts so that they can share their expertise, experience and practice. In terms of online learning, Wenger (2002) proposes that

"...the ultimate potential of ‘online’ is about creating interactive connections across distance. It is more important to expand the reach and quality of interaction of communities than to capture all information as a goal in itself."

So far, this only accounts for learning by those already identifying themselves as part of a community. For the community to survive, it is necessary for the newcomers to be able to join the community. For individuals who already identify themselves as part of a community, learning takes the form of new knowledge for that community through shared experience. However, for individuals who do not yet identify themselves with a particular community, learning takes the form of being included in or developing the
sense of identity of belonging to the community. The process by which an individual identifies him/herself with a community involves developing or changing the three 'modes of belonging' as detailed above. The development and change take place through 'legitimate peripheral participation' in the community (Lave and Wenger, 1991). Legitimate peripheral participation (LPP) allows newcomers to have access to practices that are not the core, but parallel practice of the community as a process of further identification with the community. Such parallel practices usually do not require full engagement and commitment from the newcomers. This process can take many forms, such as vicarious experience through stories, explanations and observations of the practice of the community. It is for such a process that CSVL can be used to facilitate the integration of newcomers into a community.

However, observation alone does not constitute participation. LPP must allow the newcomer to have access to all 'dimensions' of the practice (Wenger, 1998). This raises the issue of the legitimacy of the activity engaged in by the newcomer. Often legitimacy of participation is granted to the newcomer by members of the community through participation in the practices of the community. Consequently, in this context, observation alone within the context of vicarious learning is not considered as LPP. The student's interaction with a CSVL system can be considered as LPP only if the system engages the student in the practice of the community and has an effect on the identity formation of the student. In other words, learning by observation may require more than just observation.

2.3.5.2 COP and CSVL

While Wenger's COP model places great emphasis on learning through interaction with the community (and therefore is often more closely linked with traditional learning theories of Piaget (1970) and Vygotsky’s (1962) social learning model), the model does not provide as straightforward a framework as the Laurillard framework, from which a design requirement for a CSVL system can be derived. Wenger's COP model does not contradict the Laurillard framework; instead, it presents an additional aspect of learning. In terms of CSVL, the COP model provides a framework for steering the trajectory of the student’s identity, which is missing from the Laurillard model. For example, the aim of a CSVL system, that adopts a COP approach for creating vicarious learning material for teaching systems analysis, would be to provide material that steers the
students towards belonging to a community of systems analysts. Valid assessment criteria for such material would include the ability of the material to allow the students to think that they are solving real-world systems analysis problems.

Additionally, the COP model can provide (as in the case of the Laurillard framework) some concrete topics of enquiry in terms of implementing CSVL in a community of students. Within the COP model, CSVL can be seen to be able to provide 'boundary objects' that connect students interacting with the CSVL system to the community of students. For example, on the issue of effectively capturing a learning dialogue, an enquiry originating from a COP viewpoint would ask, what does a CSVL system have to do to make the student feel identified with the students in the video clip? This points to the need to consider production variables, such as the camera angles, that are used (see Chapter 3.4: Television production design) to capture the learning activity. An over-shoulder shot of a student may allow students viewing the material to identify more with the student having the tutorial in the video clip than a wide-angle shot of the same tutorial session.

However, the change of identity in an individual may be more observable over a long time frame – months or years after interacting with multiple learning resources. This research, on the other hand, is only looking at the effect of vicarious learning material on the student’s learning output within the duration of the study session (1 to 2 hours). Within such a short time frame, it may not be possible to make reliable observations on the effects of the material on the student’s self-identity. Additionally, although the COP model provides goals for educational material in terms of what effects the material need to have on an individual’s self-identity, it is not always clear how exactly an educational resource can instigate such changes in the individual. Consequently, for the purpose of this research, the Laurillard framework has been adopted as the foundation for pedagogic enquiry, as it gives a more direct mapping onto design requirements at material-production level. However, in aiming to create vicarious learning material from real-world learning environments, the COP concept will be implicit in making materials for this research.
2.4 Pedagogic effectiveness of vicarious learning

Most arguments against vicarious learning are based on the concern that vicarious learning is not suitable for learning abstract concepts. This may be the result of viewing vicarious learning exclusively as a social learning method, where students learn about how things can or should be done within a social context, rather than learning the abstract details of concepts. This type of learning is consistent with the model of learning grounded in Social Learning Theory (Bandura, 1977) as well as Wenger's Community of Practice (see Chapter 2.3.5: Wenger's Community of Practice model). The most well known example of this theory in action is children acquiring “attitudes, emotional responses, and new styles of conduct” through watching television (Bandura, 1977). However, while this research will demonstrate that students benefit pedagogically through vicarious learning when learning abstract concepts (such as data modelling), there are also cases where the ability of vicarious learning material to teach students the social issues of topics they are learning is an essential requirement.

Another argument against vicarious learning is based on the concern that the student observing the interaction does not, and cannot, learn the same, or as much, material as the student who is actually involved in the interaction (Draper, 1997). Moreover, Draper also points out that vicarious learning as an instructional method has another handicap in that what is learned through observation depends on what that student is paying attention to, which may not be what the lecturer had intended. This is one of many issues that the design of CSVL should take into account. In another study by Schober and Clark (1989) – referenced by Lee et al. (1998) – observing dialogue was concluded to be only a useful resource for those who participated in the discussion.

However, these “shortcomings” of vicarious learning can in fact also be benefits of vicarious learning. The fact that the student may learn the social context of a material or something that the participant in the observed interaction did not can be an added bonus to this form of instruction. For example, Mayes (Mayes et al., 2001) argues that vicarious learning material not only presents the learner with a model of what it means to be an expert in a certain subject but also how to be an expert in learning that subject. Perhaps this is an area where computer-support can enhance vicarious learning by providing additional information or structure to vicarious learning materials.
Background to Vicarious Learning

Although Draper (1997) has so far been cited as presenting arguments against vicarious learning, he also sees its value in higher education. He points out that higher education is not about learning from personal experience, but from experience of others—"the basic enterprise of higher education is that of the social transmission of cultural knowledge" (Draper, 1997). This is particularly true in the case of pure science and engineering disciplines. In this sense, vicarious learning is already a major part of the higher education system.

The Vicarious Learner project (http://www.hcrc.ed.ac.uk/gal/vicar/index.html) has argued that, in some conditions, learning by observation can have more benefits than actively participating in the dialogue (McKendree et al., 1998). McKendree argues that active participants in a dialogue have both an emotional and cognitive load to bear that the observer does not. Throughout the dialogue, the participants have a position to maintain or concept to defend in public, while the observer can concentrate on the content that is being discussed.

An experiment carried out by Cox et al. (1999) presents a convincing case for the pedagogic effectiveness of vicarious learning. The result of the experiment indicated that vicarious learning materials can be as pedagogically effective as traditional discourse material—in this case, verbalised instructional discourse. Cox's study compared, between four conditions, the performance of 48 students in the domain of grammatical parsing and syntax tree-diagram construction (topics covered by 'Human Communications' course at the University of Edinburgh). In the 'dialogue' condition (DL), subjects had access to a previously recorded tutorial on tree-diagram construction in the form of an animated recording of diagrams being constructed by a student with assistance from a tutor. This was accompanied by a transcript of the dialogue between the student and the tutor. In the 'discourse' condition (DI), subjects had access to an animated recording of diagrams being constructed by the tutor and the transcript of instructional discourse verbalised by the tutor. In the 'diagram only' condition (DO), students were only given access to the animations of the diagram being constructed, as used in the DL condition. The fourth intervention condition, 'linear text' (LT), allowed students access to paper-based tutorial notes only. These notes were also available for students in the dialogue and discourse conditions. The two best performing conditions were the dialogue and discourse conditions. An additional finding from this study was
Background to Vicarious Learning

that the DO condition was also effective in raising the post-test performance. All three conditions performed better than the LT condition and the control condition when there was no intervention.

Another experiment by Lee et al. (1999) conducted as part of the Vicarious Learner project reinforces the notion that vicarious learning is a pedagogically effective instructional tool. In this case, the experiment studies the effectiveness of vicarious learning within the context of an on-line Masters course in Computers in Teaching and Learning. In this experiment, 36 postgraduate students interacted with the Dissemination tutoring system (see Chapter 2.8: Implementations of CSVL), which gave the students access to primary instructional material, as well as vicarious learning material made from videotaped discussions between students, and also discussions between students and the topic experts. In terms of vicarious learning material, there were 108 video clips, 13 audio clips, 43 text transcriptions and 27 audio annotated graphics that were made from 30 hours of captured video footage. The students were split into two groups; one group had access to all the materials on the system, while the other group had access to the primary instructional material only. The result of the experiment showed that the group with access to vicarious learning material had larger “learning gains” than those with access to primary instructional material only. Learning gains in this experiment were described in terms of the difference in the pre and post-test scores in the knowledge domain. The group with access to vicarious learning material also performed better in online synchronous discussions, both in terms of quantity and relevance of statements given. Lee also found that in the discussions, students with access to vicarious learning material were “modelling the tasks and language used” in the material. This observation is consistent with Wenger’s model of a community of practice (Wenger, 1998). It seems that by interacting with vicarious learning material, students in this study have either moved closer to being a member of a community of students, or were already in the community, but are now sharing their practice and experience through vicarious learning material. Furthermore, another study by Beishuizen et al. (1997), investigating the effectiveness of using video clips of expert lecturers to teach novices about lecturing tasks, found that groups with access to the video clips outperformed groups that did not.
Background to Vicarious Learning

These studies present a strong case for the pedagogic effectiveness of vicarious learning. It is clear that the use of vicarious learning material facilitates clarification, deeper exploration and re-conceptualisation of concepts introduced to students by primary courseware. Its use can be seen as a step away from just pushing information at students – a practice that can be all too common in higher education. Additionally, computer support for vicarious learning can generate more opportunities for learning by incorporating current networking technology.

Other issues concerning vicarious learning include how the use of vicarious learning material can fit in with how the class or lecture is run. In other words, how can lecturers use vicarious learning material for maximum benefit? While this seems to be a pedagogic problem, it is also a design problem for CSVL systems. The functionalities or tasks that the system support should reflect the pedagogic needs of the lecturer and deal with possible socio-cultural problems of using CSVL. However, what is clear from reviewing these possible shortfalls of vicarious learning is that vicarious learning cannot work on its own and the shortfalls need to be compensated by using other teaching methods, i.e. it must be integrated into the overall teaching practice.

2.5 Vicarious learning and collaborative learning

Vicarious learning has already been used as an instructional medium in other CAL systems. One example of this is the use of vicarious learning in Computer Supported Collaborative Learning (CSCL). In the most common cases, CSCL is made up of a text-based conferencing system that allows students to have asynchronous and synchronous online discussions and exchange documents. In CSCL, students learn by participating in online discussions either by contributing to the discussion or just by observation. However, CSCL does not have the same pedagogical purpose as vicarious learning. With vicarious learning, the main aim is to clarify concepts or correct misconceptions of the student, while CSCL is directly presenting new concepts to students through discussions and explorations by the students.

Where CSCL and vicarious learning meet is the reuse of dialogues during online discussions. Moderators (lecturers or tutors in online discussions) notice that, while different groups of students raise different issues during their discussions, there are times when groups make the same mistakes or raise the same issue (McConnell, 1994).
Background to Vicarious Learning

In the former case, a group observing previous discussions may help to prevent that group from making the same mistakes as the previous groups. In the latter case, a group having access to previous group discussions on the same topic may be able to have even more in-depth discussions on that topic than previous groups, as the group would not need to spend time exploring threads of arguments or concepts that have already been discussed in sufficient depth. On the other hand, this is only beneficial if exploring those threads and concepts is not part of the learning process itself. An account of CSCL and vicarious learning in action is given by Gibbs (1999) who reports how philosophy undergraduates interacting within the coMentor virtual learning environment “learned from seeing each other's work, from having to 'write' down their ideas and share them with others”. The aim of the students using coMentor is for them to attain a deeper conceptual understanding of theoretical subjects. Gibbs also commented that students using the system “adopted learning styles that were beneficial to learning a theoretical subject matter”.

CSCL has the advantage of automatically logging all discussion that takes place. Consequently, generating raw vicarious learning material is an integral part of CSCL. However, one difficulty of vicarious learning within CSCL is the amount of material that is recorded. Because every thread of discussion is recorded, and not every interaction is worth recording for reuse (McConnell 1994), authoring vicarious learning material from CSCL interactions is often a tedious task. Even when an appropriate interaction has been identified, presenting the interaction to the student in unedited prose is insufficient. As with all learning material, the content needs to have, among other attributes, clear structure, scope and relevance (Sloane, 1989) before it can be of any significant pedagogical value to the student. On a higher level, information about the material such as instructional objectives – learning outcomes in terms of types of performance students are able to demonstrate at the end of instruction to show that they have learned what was expected of them (Gronlund, 2000) – can help both the student and the lecturer in learning and assessment, respectively. From the student’s point of view, instructional objectives provide guidelines for learning and, from the lecturer’s point of view, concrete targets that can be used for formative and summative assessment.
Vicarious learning in CSCL presents a strong case that recording material and presenting it unedited is pedagogically insufficient or, in other words, does not meet the requirement of an effective vicarious learning system.

### 2.6 Vicarious learning and computer science education

Diagram construction is a major part of the syllabus of computer science and information management students. Each year, students find it difficult to acquire the ability to construct system diagrams such as dataflow and entity relationship diagrams. To help the students, common mistakes made by students from previous years are shown to them in the form of completely constructed diagrams, yet students will acquire adequate skills only after several attempts with feedback from the course lecturer or tutor after each attempt.

#### 2.6.1 Observing collaborative learning activity

However, students can also acquire the necessary skills by observing one of their colleagues constructing a diagram or, more often, by collaboratively constructing the diagram as a group. Additionally, if the dialogue between the student(s) and the lecturer/tutor during an attempt at constructing a diagram can be captured, students who were not present will not only be able to see the resulting mistakes, but also how and why the mistake came about in the first place and, of course, the reasoning behind constructing the final correct diagram as well. In such cases, the collaborative learning activities will also benefit those students who were not present during such interaction.

### 2.7 What makes CSVL different from a video?

The main advantages of supporting the production and access of vicarious learning material via computers over conventional video are the ability to integrate such resources with other online learning materials (such as online coursework and lecture notes) and to create a certain degree of personalisation of the learning material. Digital video can contain URLs to online lecture notes or relevant online formative/summative assessment modules. Additionally, digital video can be divided into segments that can be much more easily navigated than conventional analogue video.

When real-life interaction of students is recorded, students will be able to relate directly to problems that they and their colleagues are having during that academic year. In the simplest form, CSVL will allow students to revisit their own collaborative attempts at
tackling a problem. Such revisits strengthen their understanding of the topic by promoting the use of episodic memory (Tulving, 1983). Episodic memory is a person’s personal memory encoded with respect to specific time and place, i.e. remembering the tutor explaining what episodic memory is on a hot summer afternoon in his/her office. Such memory is more persistent. While recalling a concept does not necessary indicate an understanding of that concept by the student, if the student has no memory of the concept in the first place, then comprehension is impossible. Consequently, a CSVL system that aims to exploit the student’s episodic memory should support the creation of material from the student’s own course and academic year (JIT) through a rapid material development process.

In addition to revisiting their own learning activities, a CSVL system can also enable students to view other groups’ attempts at tackling the same or similar problems by either accessing material archived from the current or previous academic years. This may minimise students making the same mistakes as students in other groups or previous years.

2.8 Implementations of CSVL

The pedagogical side of research on vicarious learning is important in optimising vicarious learning as an instructional method. This is reflected in the research efforts on vicarious learning so far. These range from controlled experiments, as discussed in Chapter 2.4: Pedagogic effectiveness of vicarious learning, that have been conducted to establish that vicarious learning has benefits for learning (Cox et al., 1999) to developments of how dialogues should be conducted or generated to maximise the benefits of vicarious learning. An example of this is using Task-Directed Discussions (TDD) to create dialogues more suited to vicarious learning in CMC (Lee et al., 1998) and real-world environment (Lee et al., 1999). The conceptualisation of TDDs originated from the difficulty of getting students to initiate or participate in non-trivial discussion of difficult concepts in a domain, which hindered the creation of effective vicarious learning material.

While the pedagogic investigation is essential, issues concerning how computers can be used to support vicarious learning must also be addressed. More specifically, there is a need to construct and justify a requirements specification for CSVL with respect to a
pedagogic framework, as little evidence of effort in this area is available. Reviews of four contrasting systems that can be used to support vicarious learning are presented here. The first two systems, the Dissemination tutoring system and the MANTCHI project tool set, explicitly aim to support vicarious learning and their implementation were derived from this pedagogic route. In contrast, eClass and VESOL approach the task of capturing learning activities from the technological perspective.

The Dissemination tutoring system (http://www.hcrc.ed.ac.uk/Vicar/TT/), as used at Heriot-Watt University and University of Edinburgh, is a video-based vicarious learning system consisting of video recordings of the interactions in one window, which is accompanied by notes on the topic under discussions and perhaps the page of the lecture note on the topic in another window. This system makes use of one static camera angle in each video clip and provides minimal support for navigating within the video clip and the props (lecture note) that are provided. Both universities used the system for teaching Human Computer Interaction courses. A more detailed description of materials captured by the Dissemination tutoring system was given in Chapter 2.4: Pedagogic effectiveness of vicarious learning.

The MANTCHI ('Metropolitan Area Network'-based Tutoring in Computer-Human Interaction) project investigates how tertiary courseware can be produced (Newman et al., 1999). However, the project also aims to create tools to manage material that are produced by an inter-university collaborative tutoring community. While this is not the same empirical setting as the research in this thesis, the project does provide indications as to what kind of issues a wide-scale CSVL implementation, whether distributed or centralised, may need to resolve in order to provide effective support for vicarious learning. For example, the project has found a need for a flexible access control model to support creation and usage of educational material within a metropolitan area network (MAN), arguing that common approaches to managing access and privacy of data “are not designed specifically to meet the needs of users in an educational environment and do not adequately support different types of learning – factual, discursive, experimental, cooperative, vicarious.” (Gong and Newman, 2002). A localised CSVL system may not need such flexible access control, however, it may still require adequate support for the management of consent and intellectual property rights.
(IPR) of the students and educational practitioners whose learning and teaching activities have been captured by the system.

On the other end of the spectrum, the eClass Project (formerly Classroom2000) at Georgia Institute of Technology (http://www.cc.gatech.edu/fce/eclass/index.html) shows what state-of-the-art lecture recording and dissemination technology consists of. The eClass system is the result of a study initiated in 1995 into automated capture of teaching and learning experience via an ubiquitous computing environment (Abowd, 1999). By combining video/audio recording with time-stamped slides and annotation, the system has managed to develop and utilise technologies to put lectures online. To date, eClass has been used in more than 100 classes by 24 'instructors'. Nearly 700 students in courses in science and engineering discipline have used the system. However, this emphasis of putting lectures online means that eClass does not focus on student actions and feedback, which is essential for vicarious learning. The materials that have been captured consist of recordings of lecturers giving a lecture and interacting with an electronic whiteboard. In these recordings there is very little or no dialogue with the students in the lecture. Additionally, eClass requires expensive equipment such as electronic whiteboards and backup equipment all of which contribute to the total price tag of $100,000 (according to eClass online promotional video), making it not cost-effective to implement in an individual lecturer’s office or small tutorial rooms.

In all the systems that have been reviewed so far, only one camera angle has been used to capture the video of the learning activity. In contrast, the VESOL (Video Editing System for Open Learning – http://www.sar.bolton.ac.uk/diverse/overview/vesol.htm) system, used at the University of Derby and University of Bolton, makes use of multiple video cameras to capture lectures for online presentations. The system allows the lecturer to choose as he/she is conducting the lecture which camera is used and when by pressing the appropriate buttons on a video-mixing device. The camera angles used are wide-angle shot, close-up shot of the lecturer (standing behind a lectern), projected PowerPoint slides, and lecture handouts (captured by a small lectern-mounted camera). The whole lecture is recorded onto VHS or SVHS videotape which are then converted to video-streaming format (RealMedia) for delivery on the internet.
Of the four systems presented, none seems to have the right balance between having the adequate technology to support production of effective vicarious learning material and using the technology already implemented in an appropriate way to support vicarious learning. For example, there were many video clips in the Dissemination tutoring system that showed a tutor and a student interacting around some props (either a whiteboard or a piece of paper on the table). Despite both participants frequently referring to these props, the system did not effectively capture what was being pointed to or written on these props. On the other hand, both eClass and VESOL use a sufficient number of camera angles (or virtual camera angles, in the case of capturing PowerPoint lecture slides) to capture lectures for online presentations. However, the overall setup of both systems does not support effective capture of dialogue between the lecturer and the students during lectures or tutorials.

2.9 CSVL and current trends in e-learning

While the trends in E-Learning in the 1990s were to provide real-world content on the internet, CSVL is more consistent with a new emerging trend where ‘content is no longer king’. E-Learning materials have evolved to provide Just-in-Time and, most recently, Just-in-Place learning, where materials are tailored or provided to the students based on their own localised experience in the classroom (be it virtual or real). This was brought about mainly through the notion that knowledge has a shorter half-life (Wenger, 1998), i.e. what may be best practice today can become redundant tomorrow. However, in many subjects, the state of knowledge may not be as vulnerable as Wenger has suggested. In most cases, it is the state of the knowledge being state-of-the-art that has a shorter half-life. The ‘old’ knowledge is often not negated by the presence of new knowledge – it merely becomes ‘not the best way’ to achieve a certain goal.

The review in this chapter concludes that vicarious learning does have benefits for the learner but, like any other pedagogic tool, it does have it shortfalls and so must be applied within appropriate contexts. In order to take the debate on the pedagogic effectiveness of vicarious learning further, a consideration of social and cultural factors will need to be taken. However, it seems that the weakest link in the chain of CSVL implementation is not vicarious learning itself, but the design and implementation of the computer systems that support such learning.
Chapter Summary

The literature review has revealed that while there is some research looking at the pedagogic effectiveness of vicarious learning, there is very little on the specifics of how technological requirements for supporting vicarious learning can be derived. This is a crucial gap in the knowledge that is required to implement CSVL. In particular, the requirements specification for implementing efficient support for individuals or small groups of lecturers who want to use vicarious learning as a pedagogic tool by creating effective educational materials have not been identified. There is a need to construct and justify the requirements specification for implementing CSVL that can efficiently and effectively support vicarious learning. The next chapter reviews the literature from the fields of multimedia production and television production to see what they have established as production variables that can affect the quality of video-based materials. Issues highlighted in the next chapter together with issues in this chapter will be used to derive research questions that form the foundation and defines the scope of the work carried out for this Ph.D.
3 Background to Video-based Material Production

Introduction
The previous chapter argued that there is a knowledge gap in creating pedagogically effective video-based vicarious learning material. This chapter investigates how principles in the fields of multimedia production and television production could provide useful pointers in creating high quality video-based material, especially from the viewpoint of the students. This chapter starts by reviewing what the literatures in the multimedia production and television production fields have already established to be variables that effects perceived quality of materials. This is then followed by a report of the result of an initial study into the importance of perceived quality of the material by the students. The chapter concludes by deriving some concrete variables that the ‘ideal’ production should contain, based on the literatures reviewed in this section.

As mentioned earlier, the main goal of this research is to investigate how best to implement computer support for vicarious learning. In order to focus the investigation, the following assumptions have been made:

- Perception of quality of material affects pedagogic effectiveness of the material.
- Interaction with vicarious learning materials influences learning outcome.

The main design problem that is being tackled is the construction of a requirements specification for a cost-effective CSVL system that can be easily implemented by individuals or small groups of lecturers as well as being adaptable to their individual needs. The system needs to be adaptable enough to meet requirements for installations in small rooms (individual tutorials) and medium-size rooms (group tutorials).

3.1 Pedagogic design
Within the context of pedagogic design, vicarious learning can form a part of various pedagogic designs. However, as the main aim of this research is to investigate the various aspects of technology used for implementing vicarious learning, Laurillard’s conversational framework (Laurillard, 2002) was adopted and maintained through out for consistency. In this case, vicarious learning requires the ability to observe the on-
going negotiation of meaning between the lecturer and the students. Another model of learning that has also been discussed in relation to CSVL is Wenger’s Community of Practice model (Wenger, 1998), where students are conceptualised as working towards being part of a community of practice, i.e. the community of systems analysts or, just as valid, computer science students. Interacting with vicarious learning material could represent a form of legitimate peripheral participation (Lave, 1991), depending on the content of the material and the learning tasks performed during the interaction.

As mentioned earlier, the need for vicarious learning resources was derived from real-world needs of students. Therefore, the pedagogic design of vicarious learning materials produced will be one that integrates vicarious learning into current instructional design, rather than create materials that will be used on their own.

3.2 How to make a difference?

So what can affect the observable behaviour of the students when they are exposed to vicarious learning material? In terms of the experience of the students with vicarious learning material, the following are some of the observable aspects of the students’ interaction with the material that can be affected by the content of the material and how it is implemented:

1. The perceived quality of the material by the students.
2. The manner in which the students interact with the material.
3. The effects of interacting with the material on the students’ learning output.
4. The acceptance of the CSVL system by the students into their learning environment.

(These issues are discussed in more details in Chapter 4: Research Questions and Chapter 5: Research Methodology.)

This research proposes that audio/visual production variables play a crucial role in determining the quality of the final material produced and that variables drawn from the following fields may have significant effects on the observable aspects (as outlined above) of the students’ interaction with the material:

1. Multimedia Production Design
2. Television Production Design
3. Post-production Design
3.3 Multimedia production design

The most established variables and perhaps those that will create the maximum improvement of the quality of materials are multimedia production variables. Reeves and Nass (1998) identified several factors that can influence viewers of multimedia material. The most relevant of these findings and their relevance in producing vicarious learning materials are summarised below.

3.3.1 Image size

Reeves and Nass found that larger images are evaluated more positively than smaller ones and better capture the viewer’s attention. Additionally, content on larger images are better remembered than those on smaller ones. Surprisingly, it was also found that lower fidelity images on the screen were evaluated no differently from higher fidelity images (see Chapter 3.3.2: Audio and video quality). These issues are important in producing vicarious learning materials because they indicate which area of the production to invest both time and money in for maximum results. This has implications for the way in which materials should be presented in terms of video size and resolution.

3.3.2 Audio and video quality

Variations in sound quality were found to have more impact on the viewer’s perception of the quality of the material being shown than variations in video quality. In Reeves and Nass’ experiment on the effects of poor audio quality, the “low-fidelity” audio material was produced by copying an analogue audio track from a video clip “several times”, adding three audio glitches, limiting frequency response and adding tape hiss. “High-fidelity” audio was made from the original CD-quality audio track of the video clip played through a surround sound stereo setup. They found that, while the video clip with high-fidelity audio was perceived as “likable and realistic”, resulting in the viewer being more immersed in the video, the viewer’s attention to the media and memory for information on the media was better when the low-fidelity audio track was used. Their rationale for this is that, in real-world face-to-face situations, poor audio fidelity is unfamiliar and therefore would result in the viewer consciously monitoring the content of the video.
Reeves and Nass also investigated the effects of variations in visual quality. "Poor visual fidelity" was produced by copying the original video clip through five generations on "bad" analogue tape and reducing the brightness of the video. "High visual fidelity" was produced using the original digitized and computer-enhanced video clip. Contrary to findings concerning audio fidelity, poor visual fidelity was found to have no effects on the viewer's attention to the media, memory for information on the media or perceived quality of the media. Their rationale for this is that, in real-world face-to-face situations, poor visual fidelity is common (e.g. in bad lighting conditions) and there are few tasks that rely on having perfect visual fidelity. Consequently, the viewer, faced with poor visual fidelity, would not have to reorient to an unnatural condition (as with poor audio fidelity) or consciously monitor the content of the video.

In terms of producing vicarious learning materials, these issues will need to be considered when deciding how sound and picture should be recorded during the discussions, i.e. should audio be recorded in stereo or mono and at which sampling rate and at what resolution should the video be captured? Reeves and Nass' research seems to suggest that if the aim is to enhance viewer's attention to and memory of learning material, then the visual quality of the material should not matter while the audio quality should be low, as this forces the viewer to pay more attention to the material.

### 3.3.3 Audio-video synchronisation

One of the most significant findings was how negative evaluations of the speaker are given when the video and audio are out of synchronisation. Viewers of videos containing audio-video asynchrony commented that people in the video were "less interesting, less pleasant, less influential, more agitated, and less successful in their delivery" than those in synchronised video. This is very significant, as educational materials should not have any of the attributes that have just been mentioned. Unfortunately, asynchrony often occurs when materials are inappropriately encoded (in terms of the choice of video and audio codec, bit rate, frame rate, video size and resolution) and/or streamed over the Internet through inadequate bandwidth or network congestion.
3.3.4 Scene changes

Reeves and Nass also report that scene changes can make a significant difference on how media is evaluated. Additionally, scene changes can be used to provide structural cues to direct the viewer's attention as well as serving as markers in the viewer's memory. It is possible to create structure within the production through the use of cuts as well as keeping the viewer's attention at the appropriate level. In order to create appropriate cuts and scene changes, it will be necessary to use more than one camera to capture the discussion. According to Reeves and Nass' findings, such addition should significantly improve the quality of the material.

All of these issues will need to be addressed during the production of vicarious learning materials that involve the use of audio and/or video. However, it is not known whether similar effects on the viewer will be present in the context of students accessing vicarious learning resources. This issue stems from the fact that Reeves and Nass' findings do not take pedagogic requirements into consideration. When vicarious learning takes place around a diagram, video fidelity could be more important than audio fidelity because it is more important to be able to read the diagram than to be more engaged with the material. Does this affect what or how things should be captured if it is aimed specifically for viewing on the computer screen? For example, Reeves and Nass suggest that when a video is shown in a small window of a computer desktop, the shot should be much closer than a conventional television shot as this will help to create better presence (of the speaker).

3.4 Television production design

Guidelines from the area of communication arts (or media studies) suggest that the number of camera angles also affect the viewer's perception of the quality of the production. The two main factors that have not already been mentioned are:

1. **Shot Selection**: Multimedia principles already point out that, if the production will be viewed in small windows, the camera should zoom in on the speakers to create the sensation of larger size. Television production principles add to this several points concerning the placement of cameras and how speakers should appear on screen (shot selection). These ranges from *wide-angle* shots used for orientation of the viewer to *over-shoulder* shots for suggesting relationship between speakers. Overall there are around seven main shots that can be used during an interview each
with specific purpose (Armer, 1990). Specifically in the context of this research, it is also important to make sure that the camera shots that are used allow a clear view of any props – such as models or drawings.

2. **Number of Cameras:** As well as shot selection, the number of cameras also influences the quality and style of the production (Watts, 1997). Single camera productions require a camera operator who can skilfully move around the set in order to film each speaker as he/she speaks without any obvious interruptions. In a two-camera production, camera movements are greatly reduced by *cross-shooting* (the field of vision of each camera appear to cross). Additionally, the camera operator can zoom in or out to get extra *over-shoulder* shots. However, if a third camera is introduced, the job of the camera operator becomes minimal or nonexistent. That is, it is possible to create all the necessary shots with three cameras for an interview situation. If no camera operators are required, materials can be created without the camera crew associated with traditional video productions.

### 3.5 Post-production design

In addition to multimedia and television production variables, there are some post-production design issues that may also affect the student’s perception of the quality of the material. Compared with text, video and audio are slow media for transmitting information – reading a book yourself is much quicker than having it read to you. It is therefore necessary to provide navigational support to allow students to efficiently access certain part of the material, without having to go through the entire content of the material. This navigational support can be implemented post-production in the following manner (see Chapter 7.4: *Study setup* for implementation of these features):

1. Basic navigational tools, such as play, pause, forward and rewind facilities.
2. Direct-manipulation interface for navigating around the video.
3. *QuickTime*™ *Chapter* feature to segment the video clip, provide placement indicator and support for navigating between each segment.
4. Links to relevant materials that are not contained in the video clip in the form of *QuickTime*™ *Web-link* feature.

Most video-based vicarious learning systems (see Chapter 2.8: *Implementations of CSVL*) consist of recordings of the interactions between lecturers and students,
Background to Video-based Material Production

accompanied by notes on the topic under discussions, and perhaps the page of the lecture notes on the topic. However, they do not incorporate all the navigational support features outlined above.

Two contrasting systems have previously been introduced in Chapter 2.8: *Implementations of CSVL*. However, both systems have not adopted the multimedia production and television production principles described above. The *Dissemination* tutoring system’s video clips are not as large as they can be (1-inch in diagonal) and neither system has used more than one camera angle in their attempt to capture the learning activities. It is possible to argue that neither system aim to make video materials of broadcast quality. Nevertheless, this does not mean that production principles are irrelevant.

3.5.1 Initial study: perceived quality is important

An initial study was conducted to see how the students would perceive the quality of a video production of a tutorial that does not adopt the multimedia or TV production principles, or implement navigational support as outlined above. A production was made from a single-camera recording of a 10-minute tutorial session. The camera angle was static throughout the production. 8 computer science students were shown the production and were asked to make general comments about the suitability of the video clip as a learning material. In the tutorial, a lecturer and a student have a staged dialogue on general systems analysis topics while seated around a table. At various points, either the lecturer or the student would refer to materials on pieces of paper or the whiteboard. The production was encoded into RealMedia streaming format, shown on a 1-inch in diagonal window with 22kHz, 8 bit, mono audio. Although the video clip was in a streaming format, the actual clip was stored locally on the hard disk to prevent the influence of network-performance irregularity.

Some of the most prominent comments from the students concerning such a production were:

1. *Poor sound quality made it very difficult to understand what each person was saying*. This seems to be the result of two variables in the study. Firstly, the audio was initially captured at low quality (12-bit stereo using the video camera’s in-built microphone). Secondly, the audio was replayed via a generic
computer soundcard through a pair of in-ear headphones. In terms of material creation, it is possible to control the quality at which the audio is captured, however, the equipment through which the audio is played is not usually within the control of the producer.

2. *The video was so small and blurry that there was “little point in it being there”*. This is the direct result of the production variables chosen when outputting the captured video from the authoring software (Adobe Premiere 6). At this size, it is difficult to see what the participants in the tutorial are doing. The size and resolution of the final video is an author-controllable variable.

3. *It was impossible to see what was written on the whiteboard or the pieces of paper on the tabletop*. Again, this is the direct result of the size and resolution of the video. With these production variables, it is impossible to see what is being written on pieces of paper on the desktop and/or on the whiteboard.

4. *The content was perceived as “deadly dull”*. Although it is not the primary aim of this production to be entertaining, what this comment points to is how difficult it is to perceive what the main message of the video was. There were no indications at all as to which part of the tutorial covers exactly which part of the curriculum or a particular topic. Once again, this is an author-controllable variable. More sophisticated navigational support, such as the Chapter facility, can be used to make the pedagogic structure and relevance of each section of the video clip more evident to the students.

5. *Students said they would be reluctant to use such material and would prefer to refer to lecture notes and books instead*. This comment seems to originate from the fact that the topic that the material attempted to cover is already effectively covered by traditional instructional discourse, such as lectures and handouts. Topics concerning general systems analysis and design issues are already abundantly discussed in standard textbooks, which the students are already familiar with.

Although there are very few research studies on how to implement effective computer support for video-based vicarious learning (as the majority of studies so far have been investigating the pedagogic effectiveness of vicarious learning itself), it is possible to draw from works in other fields that have encountered similar design problems. What the initial study revealed was that the perceived quality of the material not only affects
comprehension of the content being offered by the resource, but also its perceived practicality, i.e. whether such resource will be used or not. A previous study of real-time multimedia in a CSCL environment (Watson and Sasse, 2000) found that users’ perceived quality of materials were more affected by unsatisfactory audio quality resulting from the use of inappropriate end-system audio hardware and incorrect equipment setup, rather than by network effects such as packet loss and jitter.

Comments from students in this initial study indicate that perceived quality of recorded material can be similarly affected by insufficient end-system audio/video hardware and incorrect equipment setup when viewing vicarious learning material. As previously discussed (see Chapter 2.5: Vicarious learning and collaborative learning), CSCL environments can provide valuable raw unedited vicarious learning material. Consequently, if such environments are to be used to support vicarious learning, it is important to optimise the audio/video hardware setup used.

Additionally, the study raises the issue that not all content is suitable for distribution as vicarious learning material. Students commented that, for some topics, it would be quicker to obtain similar knowledge by reading lecture notes and books. This highlights the fact that information flow in video and audio is a very slow when compared with written materials. Therefore, the selection of the topic to discuss would also play a crucial role in determining the perceived quality of the resource. Diagram construction would suit this form of dissemination as the dynamics and the process of constructing the diagram is difficult to capture on paper and impractical to repeat during lectures.

3.6 The 'ideal production'

This section presents the conclusions derived from the initial study and the literature review in terms of what should be required when creating video-based vicarious learning material. These specifications are what the current literature on multimedia and television productions are suggesting to be 'ideal' with respect to the perceived quality of the material by the viewer:

1. The size of the video should be 720x576 pixels (full-screen DV).
2. The audio should be captured at 16-bits stereo audio, sampled at 48kHz.
However, these attributes are often dictated by the network bandwidth that is available while viewing the material online and therefore will be more of a design constraint rather than a design feature. Network bandwidth limitation forces the material producer to compromise on either the quality of the video (e.g. resolution, colour depth and frame rate), audio (e.g. number of channels, bit rate and sampling rate) or both. In contrast, the following features can be incorporated irrespective of bandwidth size:

1. Cuts or scene changes can be controlled and incorporated by design into productions.
2. Cuts or scene changes should be used to create structure within the production as well as keeping the viewer’s attention at the appropriate level – more than one camera will be required and each camera will need to be placed in the appropriate position to obtain the best possible angle.
3. The video must incorporate camera angles that give the viewer sufficient access to props.
4. Allow the viewer to navigate through the video with respect to a clear pedagogic framework.

These specifications are almost purely theoretical; consequently, empirical works carried out during this research will test their validity with respect to a CSVL implementation. In addition to their validity, the ability for educational practitioners to practically implement these specifications will also be investigated.

**Chapter Summary**

This chapter has reported results of an initial study that showed how perceived quality can affect the pedagogic effectiveness of video-based materials (in some cases, students would prefer not to use the material at all). Furthermore, this chapter has highlighted what the fields of multimedia production and television production have established to be the factors that most influence the perceived quality of video-based materials. By considering these factors, the specifications for what the ‘ideal production’ should contain have been derived. However, these specifications were derived purely from the literature review and their validity will be tested by the empirical studies of this research. In the next chapter, issues raised in this and the previous chapters are translated into the research questions that form the foundation and define the scope of the research carried out for this Ph.D.
4 Research Questions

Introduction

In the previous two chapters, the review of previous research on vicarious learning concluded that the specifics of implementing CSVL were unclear, i.e. most research concerning vicarious learning was either concerned with investigating or improving the pedagogic effectiveness of vicarious learning itself, or were focused on investigating certain technical aspects, such as frame rates in video when creating vicarious learning material. In order to investigate the specifics of implementing CSVL, this chapter proposes concrete research questions arising from the literature review in order to construct the requirements specification for computer support for video-based vicarious learning.

This research proposes that the specifics of implementing CSVL for individual or small groups of lecturers need to be investigated; in particular, previous research studies have not addressed the following issues:

1. Capturing Material: What are the usability issues when capturing material for producing video-based vicarious learning material? How can materials be captured as efficiently as possible? What materials need to be captured in order to create pedagogically effective video-based vicarious learning material?

2. Producing Material: What are the usability issues when producing video-based vicarious learning material? When producing video-based vicarious learning material, what should it contain in order for it to be pedagogically effective?

3. Accessing Material: What are the usability issues when students access the material produced? How will the students actually use the material?

As can be seen by the questions posed above, this research is concerned with both the usability issues of using computers to support video-based vicarious learning and the need to produce pedagogically effective material. This cross-disciplinary position of the research reflects the need to acknowledge that designing learning technology must not only consider the efficiency of the technology, but also whether the technology supports the creation of pedagogically effective material.
Research Questions

What follows in this chapter are specific questions, derived from those detailed above, that this research will answer. They are organised into four categories: Capturing Material, Producing Material, Accessing Material and General Design Issues. Additionally, a short section follows, detailing other possible lines of queries that is not pursued by this research.

4.1 Capturing material

4.1.1 What is important when observing dialogue for vicarious learning?

The main concern at this stage is what elements of an interaction should be captured by the system and in what form. Obviously, just recording a lecturer lecturing a class will not make the best use of the system, nor can such one-sided flow of information be called a “dialogue”. In short, it is important to identify what is the essence of a dialogue that needs to be captured for vicarious learning purpose. If what is being recorded is a one-to-one conversation between a student and the tutor, what should the material contain to make it an effective vicarious learning material? What attributes of the material affects the perceived quality of vicarious learning material? In terms of the Laurillard Conversational Framework (see Chapter 2.3.2: Laurillard’s Conversational Framework and dialogue), the exchanges between student and lecturer can have the following functions:

1. Lecturer introduces new concept
2. Student reflects on existing concept
3. Lecturer clarifies existing concept
4. Student corrects or modifies misconceptions
5. Lecturer creates goals within learning environment
6. Student acts within learning environment created by lecturer
7. Lecturer gives feedback on student’s action within learning environment
8. Student corrects or modifies action

If the exchange is being captured for use as vicarious learning material, which of these functions will need to be captured to create effective learning material? If these functions need to be captured, can the Laurillard framework be used to give structure and context to the material?
Research Questions

However, if this framework is adopted, there will be at least two sets of requirements for capturing instances of the negotiations as stages 1 to 4 of the framework are at the conceptual knowledge level while, stages 5 to 8 are at the experiential knowledge level. In the physical world, these two levels can take different physical forms and therefore will have different requirements for effective capture of their instances. For example, during a tutorial where the student has brought in a piece of work for comments and feedback, stages 1 to 4 are dialogues that go on during the tutorial, while stages 5 to 8 are the actions of the student (and tutor) making corrections or modifications to the work after receiving comments or feedback from the tutor. These two real world forms of the interaction will have different requirements for effective and efficient capture of their instances.

This issue relates directly to a previous implementation of CSVL where materials that were developed consist of exchanges between lecturer and student in the form of interaction and dialogue around a whiteboard or paper documents. The content of the whiteboard or the paper documents were not available for the viewer as it has either not been captured at all or captured at such a low quality that the content was not readable. Does this have an effect on the pedagogic effectiveness or the usability of the material?

4.1.2 What are the differences between staged and real-world dialogues?

The requirements for recording staged dialogues may be different to requirements for recording real-world dialogues. For example, in staged dialogue, the lecturer should not find it difficult to decide when to start recording – this is not the case with real-world dialogue. It is improbable that the lecturer would know when exactly to record ahead of time during a tutorial. It is also not appropriate to expect the lecturer to ask the student to repeat a dialogue again if in the end that dialogue turned out to be an interesting one, which may be of some value to other students as a vicarious learning resource.

4.1.3 What are the hardware requirements for effective and efficient capture of dialogue for vicarious learning?

The next design problem involves establishing how to capture the material once it has been identified as useful vicarious learning material. This is concerned with, in the case of video capture, camera and microphone positions, frame rates and resolution. As this involves the use of audio-visual equipment, established practice in the communication
Research Questions

arts discipline should be able to shed some light onto this matter and relevant published work in that field are sourced at the appropriate point in the investigation.

4.2 Producing material

4.2.1 How much editing facilities will the lecturer need?

Once the material has been captured, how much editing work is required before it is made available to the student? A previous chapter of this thesis (Chapter 2.5: Vicarious learning and collaborative learning) commented that the use of vicarious learning in CSCL environments could not be fully realised until the material is edited. Similarly, video clips in previous CSVL implementations lacked obvious structure and often had long pauses in the dialogue. Consequently, these video clips also require some form of editing before they can be used as effective vicarious learning material.

The question being asked is what editing supports are required by the lecturer in order to efficiently create effective vicarious learning material. The main issues are:

1. Does current video-editing software provide sufficient support for the need of lecturers?
2. Does current video-editing software suffer from any usability problems that are incompatible with how lecturers work?

4.3 Accessing material

4.3.1 How should the material be presented to the students?

The main concern with this issue is what material and information should be presented to the student. In common with other educational material, just presenting the video clip or audio recording without giving any structure or context to it will not be the optimum way of making use of the material. This will affect what information or metadata will need to be captured with the material. There are efforts at the moment to try to standardise metadata schema for educational materials. Investigations into this part of the system may go some way in finding out whether metadata concerning vicarious learning material can be generalised into the general metadata scheme for educational material or needs to have a more specialised scheme.
4.3.2 How do students interact with the materials?

The way material is presented to the student also depends on what the student or lecturer needs to do with the material. The student may be looking for material on a specific topic or browsing for material on a general topic or related topics. From the lecturer's point of view, it may be useful to be able to use the material for authoring other teaching material – for example, as part of an online coursework. Consequently, the system should not be designed so that proprietary software is the only way to access the material.

4.4 General design issues

4.4.1 How to design a system that meets all capture requirements but fits into the teaching/tutoring environment?

When capturing a dialogue, the system should not be so intrusive as to affect the dialogue that goes on. Ideally, the system should not have any affect on the dialogue at all. The student and lecturer should be able to take part in dialogue without having to compensate for the system. In terms of design, the goal is to make the system as transparent as possible. Taking an earlier example, it is often difficult for the lecturer to know when a useful dialogue might come up. How can the system be designed to assist the lecturer? A possible solution might be to have the system automatically capture material ten seconds in advance of the record button being pressed. Perhaps the whole session should be recorded and then edited later? Whatever the final solution, the implication for the requirements specification is that the system should be able to be setup and start capturing quickly and easily. The system should not require the attention of the lecturer or tutor when capturing the dialogues.

4.4.2 What are the usability issues of implementing CSVL from the points of view of those involved?

This question is concerned with the fact that there is very little documentation on the actual experience of implementing CSVL. Many studies are concerned with looking at certain aspects of vicarious learning, whether technical or pedagogical, but none of them address the practical issues of implementing CSVL. The primary aim of this question therefore is to find out what are the chief obstacles to implementing CSVL in higher education. It will look at the experience of the lecturer/tutor in capturing and
producing materials for vicarious learning, as well as the points of view of the students who access those materials as part of their course.

4.4.3 What impact does a CSVL system have on the teaching practice of the tutor/lecturer?

This issue concerns how the existence of a CSVL system may affect the tutor/lecturer’s teaching practice within the tutorial session. It is possible that the tutor/lecturer may alter the way he/she teaches as the tutorial is now going to be recorded and made available to others who are not actually present at the tutorial, e.g. other students or the head of the department. Also, would the tutor/lecturer teach in a different way if the aim of the tutorial is no longer just to get the student to understand a topic, but to also create effective vicarious learning material. Perhaps, the tutor/lecturer would ask more probing questions to get the student to explain how certain misconceptions originated, so that students viewing the session as vicarious learning material may be more able to understand why certain mistakes are made.

4.4.4 Are there any issues relating to the Data Protection Act?

Implications of the Data Protection Act (DPA) are more of a legal issue than a system design issue. However, CSVL needs to work within real world environments that need to work within legal requirements, such as those imposed by the DPA 1998 (http://www.legislation.hmso.gov.uk/acts/acts1998/19980029.htm). Concerns on this issue includes establishing whether anonymity is required for the students and making sure that necessary permissions have been obtained before using students in recordings. Additionally, this issue may affect the organisational structure or arrangements that may need to be put in place in order to fully implement CSVL. If CSVL is to be implemented on a wide scale, then it may become necessary to implement a system for managing consent of those whose teaching and learning activities are captured by the system.

However, there may be issues, beyond legal requirements, concerning the privacy of those whose activities have been captured by the system. In some ways, privacy issues could be more significant issues than legal requirements in determining whether the system will be accepted by those using it, i.e. students and lecturers. The users’ perception of whether a system is invading their privacy is a key factor in determining
the acceptability of that system (Adams and Sasse, 2001). Moreover, Adams and Sasse point out that, in the context of multimedia communication, there is a greater risk of an invasion of privacy with multimedia as it provides a richer set of data in the form of audio and video (than just plain text). For example, tone of voice and accent can be recorded via an audio stream and, likewise, dress sense and mannerism via a video stream. Adams (2001) argues the user (the one whose activities are captured by the system) may not be aware that these are data about him/her that will be captured by the system at the time of recording. Moreover, Adams (2001) also observed that user’s privacy could be invaded through misuse of the system. Some of the examples she gave include a student being identified as a “social loafer” when his lack of contribution to the discussion was noticed by other students across multiple sessions and an instance when a male student “stalked” a female student by enlarging the video window in which her image was being transmitted. While there are similar risks of such invasion of privacy off-line, students perhaps do not expect to have to deal with similar risks while being online in an educational context. Additionally, Bellotti and Sellen (1993) identified the need for users to be able to control and have feedback on how they present themselves during a multimedia interaction. If this is the case with CSVL implementations, then there are implications in terms of the computer support required during the editing process when authoring vicarious learning material. Consequently, an investigation into how CSVL can be successfully implemented in the real world will need to take into account such privacy issues outlined here, especially when videos are to be used to support vicarious learning.

On a related issue, an effective CSVL system should provide sufficient support for the management of Intellectual Property Rights (IPR). The access rights to vicarious learning material, that contain teaching activities of professional practitioners, would need to be controlled according to the terms of the IPR. However, this issue is more critical once CSVL is implemented on a wide scale. As this research is focused on investigating small-scale implementation of CSVL, the issue concerning the support for the management of IPR is not pursued in this study.
4.5 What this research is not investigating

4.5.1 Current technical restrictions
While this research is concerned with the practicality of implementing CSVL, it is not looking into how uncontrollable factors affect the quality of the materials produced. For example, this research does not investigate the effect of bandwidth restrictions, which can dictate the video frame rate and audio sampling rate of the material being produced, on the pedagogic effectiveness of the material.

4.5.2 Pedagogic effectiveness of vicarious learning
This research is not aiming to establish the effectiveness of vicarious learning. There has been previous research on this issue already as cited in the Chapter 2.4: Pedagogic effectiveness of vicarious learning. An assumption has been made that vicarious learning is a pedagogically effective mode of learning tasks that require representation construction (Cox et al., 1999) and social or behavioural modification (Lee et al., 1999). With this assumption, this research aims to identify similar domains in which the research questions that have been established in this chapter can be investigated.

Chapter Summary
This chapter has proposed concrete research questions from the literature review in order to construct the requirements specification for computer support for video-based vicarious learning. In particular, the questions are categorised into three areas for investigation:

1. How can appropriate educational dialogues be efficiently captured for use as effective vicarious learning material?
2. How can effective vicarious learning material be efficiently produced?
3. How do students make use of vicarious learning material?

These questions will be investigated with respect to issues concerning usability of computer support for tasks that need to be performed in those areas and the pedagogic effectiveness of materials captured, produced and accessed. The following chapter will outline the research methods that will be used to answer/investigate these questions.
5 Research Methodology

Introduction
In the previous chapter, concrete research questions were derived from the literature review. In this chapter, the way in which those research questions were investigated is outlined. The aim of this chapter is to give the reader an overview and justification of the research methodologies that were adopted by this work. More detailed descriptions of how the research was carried out can be found in the appropriate chapters that deal with each relevant research question. This chapter reveals that the majority of the data that were gathered for this work were both qualitative and quantitative in nature, with a bias towards qualitative data.

5.1 Major areas of enquiry
The research questions proposed in the previous chapter can be categorised into two major areas of enquiry:

1. How can pedagogically effective vicarious learning material be produced?
2. How can those materials be efficiently produced?

In deriving a requirements specification for CSVL, this research places equal importance on the pedagogic, technical and social aspect of designing such a system. Consequently, it would not make sense to create trials of materials that are not meaningfully contextualised in real-world pedagogy.

Throughout this thesis, the terms 'effectiveness' and 'efficiency' are used numerous times either for evaluative or formative purposes. For the scope of this research, the two terms are defined as follows:

- **Effectiveness**: In terms of pedagogy, effectiveness is defined as having an observable positive impact on the student’s “learning output” – in this case, written answers on paper in response to questionnaires given – concerning relevant concepts, i.e. those that are defined in the instructional objectives of the learning resource being used.
Research Methodology

In terms of usability, effectiveness is defined as the technology providing the necessary functionality for the user to complete a relevant task.

- **Efficiency**: In terms of pedagogy, efficiency is defined as minimising the time that is required from the student and the number of tasks that the student needs to perform to achieve the instructional objectives of the learning resource.

In terms of usability, efficiency is defined as relevant tasks or goals that can be performed or achieved without wasting time and resources.

5.2 **Selection of empirical settings**

In order to investigate the issues of efficient production of vicarious learning materials, this research looks at the usability issues of implementing CSVL in the real world. This approach enables the investigation to focus on the real needs and problems of educational practitioners who would like to implement CSVL. It is due to this focus on real-world issues that this research requires access to real-world courses and their students. However, not every course will be suitable for the purpose of this research.

In order for a course to be appropriate for this research, the course must have the following attributes:

1. The course has a real and present need for tertiary courseware, i.e. primary and secondary materials have failed to meet some pedagogic need of the students. Alternatively, materials can be tested on courses that have course modules that already make use of vicarious learning as a pedagogic tool.

2. The course requires a high degree of externalisation of concepts from the students as part of the course requirements.

3. The course has learning activities that can be clearly categorised in terms of each stage of the Laurillard Conversational Framework.

Several courses were considered for the test-bed for the investigations. However, the majority of these did not fulfil all of the criteria that have been set out. For example, the undergraduate course *The Romantics* in the English Department at UCL was initially short-listed as being suitable as the department employ an extensive tutorial-based teaching programme, where every student receives individual tutorials. This would provide ample opportunities to investigate and trial the capture and production of materials. However, after further consultation with the department and the students, it was apparent that there was comparatively little need for tertiary materials on that
Research Methodology

course. This was mainly due to the fact that the main goal of the course is to nurture each student's unique and original analytical skills when reading the set texts. The course goal is to promote as many different but valid viewpoints of the text as possible and not to steer the students down a particular analytical method or viewpoint. Additionally, although each student produces an essay for each discussion in the tutorial, it is not clear where exactly the relevant externalisations of concepts are with this form of student output. Not surprisingly, vicarious learning is not used as a pedagogic tool on this course.

Another course that was considered was a first year undergraduate course in the Department of Physics and Astronomy at UCL. On this course, students are frequently given problem sheets to complete and their works are marked by a tutor who provides feedback to each student either verbally or in written form. This course requires the students to externalise concepts as part of the course and proof of competence. This externalisation can be easily identified. However, this course does not already use vicarious learning as a pedagogic tool. Additionally, the student's interaction with the tutor is very limited (perhaps this is reflected by the department's use of the term 'demonstrators' instead of 'tutors') and would not provide enough opportunities to capture the appropriate materials. From the practical point of view, it would be difficult to gain enough access to the course and its students, as this department currently has no research ties with the Computer Science department.

The search for the appropriate course to conduct this research on resulted in two suitable courses being selected:

1. **B160 Information Systems Analysis and Design, UCL.** This is a first year undergraduate module taught in the department of computer science as part of Information Management B.Sc. degree in the School of Library, Archive and Information Studies (SLAIS) at UCL. This course requires the students to externalise concepts through diagrams (dataflow and object) as a major part of the course. The course has been using vicarious learning as a pedagogic tool for the past three years through group tutorial sessions. In terms of access, the author of this research is the tutor (and, for one academic year, course lecturer) of this course, allowing exceptional access and opportunity for conducting the investigation.
Research Methodology

2. TV Production, Saint John's University, Bangkok. This is a second-year undergraduate module taught in the faculty of Communication Arts, Saint John's University, Bangkok, Thailand. The module is part of the BA in Broadcasting degree. One of the major options of the degree is the Television Production module where the students learn how to produce a range of TV programmes. The course frequently requires the students to externalise concepts in the form of TV programmes through practical sessions in real studios and control rooms. The part of the module that already employs vicarious learning extensively is the real-time (live) editing sessions, where students observe other students working as a team with instructions from a tutor/lecturer to produce a programme in real-time. The goal of these sessions is to produce a programme of sufficient quality that will not require further editing. In a typical session, the students often make numerous trivial and non-trivial mistakes, which they learn to correct during the session with the help of the tutor/lecturer who acts as the 'director' of the production. In terms of access, the author of this research is a faculty member at Saint John’s University and therefore also has good access to this course and its students.

In the following sub-sections of this chapter, an overview of the methodology implemented in order to investigate research questions identified earlier is given. Additionally, the data collection methods are introduced here but are discussed and described in more detail in the relevant chapters that follow.

5.3 Factors affecting pedagogic effectiveness of material

As stated earlier, this research defines pedagogic effectiveness in terms of the instructional objectives of the materials and whether the materials will be used or not by the students. The research methodology deployed during these case studies is determined by the research questions detailed in the previous chapter and the context of this research. That is, the questions that are being asked are concerned with constructing a requirements specification for an effective CSVL system and investigate what is needed from the users' (lecturer and student) point of view. Therefore, many of the data collection methods used are borrowed from those used in HCI evaluations for systems analysis and design. Additionally, the context of the research also requires a more exploratory approach, as little has been established in terms of system
Research Methodology

requirements for supporting vicarious learning. As a result, the overall empirical works of this research are biased towards exploring a wide range of issues rather than a limited or more specific issue.

Classical controlled experiments are neither common in educational research nor are they the ideal mode of enquiry for the exploratory approach of this research, as they are more suitable for investigating the effect of a particular variable on a certain issue. While a well-designed controlled experiment is effective in proving or disproving a specific hypothesis, it is less effective as a vehicle for exploring and unearthing yet to be discovered issues. Many findings of this research do point to the use of controlled experiments to further explore the issues raised, however, these findings could only have been derived in the first place through the more exploratory approach adopted throughout this research. As the goal of this research is to discover as many new or undocumented issues concerning the requirements for a CSVL system as possible, within the limit of time and resource available, the decision was made to adopt case studies as the primary method of enquiry.

Two case studies form the basis of the empirical work of this research – St. John’s University (SJU) Case Study and UCL Case Study. Each case study is organised into phases – each phase addresses one or more research questions as detailed in Chapter 4: Research Questions. The details of each of these phases are discussed below.

5.3.1 SJU Case Study Phase 1 – Perceived Quality

When considering the perceived quality of the material, the literature review concluded that the number of camera angles might have an effect on the perceived quality of the material. However, this is in the TV broadcasting context. What needs to be determined is how this relates to the Laurillard Conversational Framework. The first phase of the SJU case study is used to explore the relationship between the Laurillard framework and the perceived quality of the material. This phase is conducted with the students at Saint John’s University. The main reason for choosing this group of students is the fact that communication arts students should be more critical in terms of production quality than information management students. A detailed description and result of this case study can be found in Chapter 6: SJU Case Study – Phase 1. The
main goal of this phase is to find out what vicarious learning materials need to contain in order to maximise the perceived quality of the material by the students.

5.3.1.1 Data collection method – focus group

In this phase of the case study, focus groups are used as opposed to individual interviews to elicit the perception of the students on materials viewed. This reflects the fact that, in Thailand, there are cultural and behavioural norms established between students and whoever is perceived to be in a position of authority, e.g. the interviewer. Students do not feel comfortable contradicting or criticising authority figures. It was felt that individual interviews would most probably result in a very quiet or passive student giving very little feedback or response. The focus group would be more likely to enable students, who would otherwise have not said anything, to feel more comfortable and give more comments.

In addition to focus groups, this phase of the study also involves observation of students while they were being filmed in order to create the test material for this study. This is the first opportunity during this research to see what issues may arise when creating vicarious learning material. The initial findings from this observation are used to decide what issues are to be investigated further in the UCL case study. More specifically, phase 3 of the study when data concerning CSVL implementation is gathered from a real-world setting (see Chapter 5.4.2: UCL Case Study Phase 3 – Real-world Issues and CSVL).

5.3.2 UCL Case Study Phase 1 and SJU Study Phase 2 – Pedagogic Effectiveness

While phase 1 of the SJU case study investigates how the number of cameras in a production affects the perceived quality of the material and how this relates to the Laurillard framework, the issue of the pedagogic effect of the material on students’ learning output and its relationship to the framework is investigated in this first phase of the UCL case study. This phase investigates the effect of the material on the students’ learning output in the context of students on the B160 course. Additionally, this study is also used to pilot data collection methods for UCL Case Study Phase 3: Interaction Pattern (see Chapter 7.1: Context of study for details). This phase is followed by the
second phase of the SJU case study, which aims to confirm the findings of this first phase.

5.3.2.1 Data collection method – structured and semi-structured questionnaire
The data that is required in these two phases are the effect of the material on the students’ learning output. The most effective way to obtain this is in the form of a questionnaire. The questionnaire allows a large number of students’ learning output to be collected in a short period of time compared with other data collection techniques such as interviews. A focus group would not be appropriate in this case as it is the individual student’s learning output that will be analysed in these two studies. More importantly, a questionnaire allows efficient collection of diagrams that are expected to form a significant part of the students’ learning output. Collecting this form of learning output would not be possible if interviews or focus groups are used as the data collection method.

Additionally, the questionnaire can be used to prompt the students to give answers on topics relevant to the instructional objectives of the materials they interact with. As topics are varied in both studies, the use of a completely structured questionnaire would not be the appropriate mean of obtaining a valid learning output of the student. Instead, the questionnaire consists of both structured questions (multiple choice questions) as well as loosely structured questions that require freeform answers from the students. Therefore, the basic setup of both phases is to allow students to complete a questionnaire while having access to material set 1 and then look at whether/how the students amend/append their answers on the questionnaire when access is given to material set 2. If the students make changes to their answers, then material set 2 has an effect on the students’ learning output – what the nature of the effect actually is will depend on what kind of changes have been made.

5.4 Socio-cultural and usability Issues
The second major aim of this research is to investigate how materials can be efficiently produced and what are the implications of implementing CSVL in the real-world setting of a higher education establishment. This issue is investigated in two phases. Firstly, the research looks at the issues of creating materials at a fine-grain level by analysing the usability issues of using vicarious learning material. The aim is to gain an insight
Research Methodology

into how students would use vicarious learning material and therefore allow material developers to implement appropriate functionalities to support the students. The research then investigates issues concerning the overall real-world implications of implementing CSVL by looking at the social-cultural factors that affect successful implementation of CSVL. The aim of this phase is to find out how factors outside the technical implementation of a CSVL system can influence the effectiveness of the system. These lines of enquiries are described in more detail below.

5.4.1 UCL Case Study Phase 2 – Usability of CSVL Material

This route of investigation looks at the usability problems that students might have when using or accessing vicarious learning material and what functionalities are required for them to effectively and efficiently use the material. The question of how material should be presented to the student is investigated. More specifically, it looks at how interaction at the experiential knowledge level (i.e. the props, student’s work on paper) should be made available to the students accessing the material. The investigation is contextualised by two systems that provide students with two very different modes of accessing the props. Firstly, the Dissemination tutoring system, where the video is disassociated from the props and the students have to manually navigate through the props themselves to find out where the changes are made. At the other end of the spectrum, there is the eClass system where the video clip and the changes on the whiteboard are fully synchronised with changes to the props. The main question that is being asked is, ‘what level of prop synchronisation is required to effectively support tasks performed by students when accessing vicarious learning material?’

The students in this phase of the case study are asked to interact with three sets of materials with varying levels of synchronisation between the video clip and the props (each student interacts with one set of materials only). Their interactions with the material is analysed for signs of common usability problems resulting from each set of materials. Additionally, their interactions are logged for later analysis in terms of navigational strategies and other aspects of their interactions that students have in common with each other.
Research Methodology

For this phase, UCL B160 course has been chosen as the empirical setting for two reasons:

1. Materials created from B160 can be authored to have different levels of synchronisation. Materials created at St. John’s University would not make sense at all if the prop view is not fully synchronised with other camera angles.
2. This study requires students to interact with the material individually and not as a group. This is much more time-consuming and would not be practical to do in the St. John’s setting.

5.4.1.1 Data collection methods – user logging and interview

There are two areas of investigation in this second phase of the UCL case study. Firstly, data concerning the interaction pattern of the students with the material need to be collected. The most effective way to do this is to log the on and off screen interaction of the student with the material. This will allow post-session analysis of the student’s interaction (what tasks were performed) as well as the context of those interactions (when those tasks were performed).

The second set of data that is required are the student’s perceptions of his/her experience of interacting with the material. The best way to obtain the student’s perception is through a loosely structured interview. This allows the interviewer to prompt the student for his/her thoughts on relevant areas and further explore appropriate issues that are raised. Through this method, a rich data set concerning the student’s experience with vicarious learning material can be obtained for later analysis.

5.4.2 UCL Case Study Phase 3 – Real-world Issues and CSVL

In order to investigate socio-cultural factors that affect the successful implementation of CSVL, this research attempts to implement CSVL for a real-world course, in this case for the B160 course. The aim is to find out what problems a lecturer or tutor might have if he/she tries to implement CSVL in a higher education setting. This attempt to implement CSVL in a real-world setting aims to reveal realistic and relevant issues concerning CSVL implementation. This is to balance investigations conducted in this research, which, up until this point has looked at various aspect of CSVL in isolation from practical issues of implementing CSVL. The course B160 was chosen as the empirical setting for this investigation for the following reasons:
Research Methodology

1. The decision was made to look at issues affecting higher education institution in the UK.

2. The course allows a high level of access, both in terms of access to appropriate students for studies and control over the pedagogic design of the course. This high level of access is crucial for this investigation as the investigation takes place over a long period of time (compared with other phases of both case studies).

Issues that are identified during this phase of the case study are explored further through interviews with individual students as part of the data collection method in phase 2 of this case study (see above). This highlights how this phase is conducted often in parallel with other phases of both this case study and the SJU case study.

5.4.2.1 Data collection method – user diary, observation and interview

As data for this part of the research is gathered over a long period of time, it is not practical or cost-effective to have fine-grained recording of activities to capture data on user experience. The most effective method in this case is the use of a ‘user diary’, where specific problems or experiences concerning attempts at implementing CSVL can be recorded. This way, problems can be highlighted and contextualised quickly and easily (for example, after a tutorial session), while minimising interruptions to pedagogic activities. The log concentrates mostly on problems that arise, but also details general experience that has not been documented in previous research.

Another data collection method that is used in this phase is user observation. ‘User’ in this case is both the lecturer/tutor and the students. This aims to record problems that have not been perceived by lecturers or students themselves.

Lastly, this phase uses informal interviews to collect data concerning the perceived usefulness and practicality of a CSVL from the lecturer’s point of view. While the data is actually about what lecturers speculate to be the pros and cons of CSVL, such speculation could influence whether the system will be adopted at all in the first place.
Chapter Summary

This chapter has outlined the empirical fields and settings of this research and given an overview and justification of the methodology that is deployed at each stage of the investigation. It has outlined how the research is organised into two case studies, each consisting of several phases. The overall organisation of the empirical study and the selected methodology reflects the exploratory approach of this research and its need to investigate a wide range of issues rather than a few specific ones. The chapters that follows elaborate on the methods and results of each phase of the two case studies as outlined in this chapter.
6 SJU Case Study – Phase 1
Perceived Quality of Material

Introduction
In the previous chapter, we saw that television production principles pointed to the need to use multiple cameras to capture learning activities. The use of multiple cameras not only raises production costs, but also the complexity of editing and producing the final material, therefore, increasing the amount of time and effort required from the author. This chapter investigates how the perceived quality of the material produced as vicarious learning resource is affected by the content of the material with respect to the number of stages of the Laurillard Conversational Framework (see Chapter 2.3.2: Laurillard’s Conversational Framework and dialogue) captured in the material. In particular, it looks at how many camera angles should be used to effectively capture a learning activity in terms of the number of stages of the framework. This issue is raised within the context of the need to create what is perceived as high quality learning resource while also minimising the time, effort and cost of producing such material.

6.1 Context of study
A system that efficiently supports production of vicarious learning material must enable the lecturer to create materials with the greatest degree of quality while minimising the amount of effort required to create those materials, i.e. it must be practical to use. From trial runs of capturing materials, the most time consuming task in the process of creating vicarious learning material was the video editing that needed to be done after each captured session.

Video editing for a single camera production involves identifying which part of the captured video may be pedagogically useful and editing out parts that are irrelevant. However, as mentioned in the previous section (see Chapter 3.4: Television production design), television production principles indicate that using more than one camera in a production increases the quality of that production (Watts, 1997). This poses some serious problems in terms of practicality as adding extra cameras means more editing time and effort. With two cameras, the lecturer not only has to choose which part of the captured session to use, but also which version or camera angle to use. While choosing when to use a certain camera angle may be as simple as switching to camera A while
person X speaks, this is very time consuming when conducted in post-production. In television studios, this task is often performed in real-time with the producer or director making the decision to switch cameras.

In order to solve this dilemma of quality vs. practicality, the main question that needs to be answered is:

- Although increasing the number of cameras will increase quality of production, is there a point of diminishing returns? Having ten camera angles would be great, but is this noticeably better than having three or even just one camera angle(s)?

6.2 Study goals
The purpose of this study is to investigate how increasing the number of camera angles in video productions affects the students' perception of the quality of the production. At this stage, computer support for the creation and usage of such materials is not being investigated. Once the optimum number of cameras required has been determined, the issue of providing computer support for the relevant features that are required for capturing, producing and accessing material can be addressed.

6.3 Empirical Setting
As this phase is investigating the effect the number of camera angles in a production on the students' perception of the quality of the production, this phase is conducted with the students taking part in the TV Production course in the faculty of Communication Arts at Saint John's University, Bangkok. The main reason for this, as stated earlier in Chapter 5.3.1: SJU Case Study Phase 1 – Perceived Quality, is that communication arts students should be more critical in terms of production quality compared with information management students (the participants of the UCL case study).

6.4 Study setup
In order to conduct this study, it was necessary to first create materials that will be delivered to the students. The TV Production course already extensively employs vicarious learning as an instructional method for teaching real-time editing process when producing a TV programme in real-time. Students on this course often observe other students working as a group with instructions from the tutor/lecturer to produce a variety of TV programmes. It is during these production sessions that learning
dialogues are exchanged between students and lecturer as the group works towards creating a programme of the required quality. Consequently, such a production session has been chosen as a suitable learning activity to capture as vicarious learning resource. The production session captured for this study is a group of students and a lecturer producing a *music video* (see Chapter 6.4.1: *Creating the test material* for details of this session).

The production session takes place in two adjacent rooms – the control room and the studio. The producer, director, soundman, switcher and computer graphics supervisor work in the control room while two actors, two cameramen and a stage manager work in the studio. It is the action in the control room that are of direct pedagogic relevance for this production, but the actions in the studio are also relevant in the wider pedagogic context.

### 6.4.1 Creating the test material

Three cameras were used to capture second-year undergraduate communication arts students producing their first television programme. Lecturers in this discipline usually introduce students to the theories of producing a “show” in the classroom, but it is difficult to teach students how things actually work or relate to each other in the studio. The instructional objectives of the video was to show:

1. Problems that other students encounter and how they solved them, e.g. what do the students do when the talents walk out of the frame of the cameras.
2. The dynamics and the dialogues that go on within the control room, e.g. how they make decisions within the group to accept certain takes.

The point of the video is to minimise the amount of time students spend inside the studio learning how to produce a show rather than actually producing one. As studio time is limited and expensive, this will allow students to make better use of their studio time.

As mentioned earlier, three cameras were setup to capture the students’ production session. The aim is to create for the study three productions that differ only in the number of camera angles that are used. Consequently, it was necessary to produce the
three productions from just a single take to ensure that the content of the productions are identical. Each camera was positioned as follows:

- **Camera 1**: Wide angle shot inside the control room with each person and the control equipment visible. Each person has his/her back towards the camera as they are working on the equipments within the room. Additionally, a small portion of the studio room was also visible.
- **Camera 2**: Wide angle shot inside the studio itself. This camera captures the actors, cameramen and stage manager.
- **Camera 3**: Close up shot of each person inside the control room. Each person’s face, in contrast to camera 1’s angle, is now visible.

![Figure 6.1: Screenshots showing the three camera angles used in the study (including PIP insert)](image)

In addition to these three camera angles, it was possible to add another angle, which was drawn from the actual production that the students were creating – i.e. the programme that they were making. This was presented as a picture-in-picture (PIP) insert. This is similar to being able to see what people are writing while they have a discussion around a whiteboard. From these three cameras and the PIP insert from the student’s production, the following productions were created:

<table>
<thead>
<tr>
<th>Production</th>
<th>Camera 1</th>
<th>Camera 2</th>
<th>Camera 3</th>
<th>PIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

**Table 6-1: Productions and their camera angles**

For Production 3 and 4, the cameras are switched at random interval with one constraint – when someone in the control room speaks, the active camera must be camera 1. The
productions in Table 6-1 are ordered according to the amount of effort it would take a lecturer to edit each production, where production 1 requires the least amount of effort.

6.4.2 Production with respect to the Laurillard conversational framework

The four productions have been produced by applying standard television production heuristics in filming behind-the-scene genre of programmes. Additionally, the four productions can also be categorised with respect to the Laurillard Conversational Framework (see Chapter 2.3.2: Laurillard’s Conversational Framework and dialogue).

- **Production 1**: captures the conceptual knowledge level (stage 1 to 4 of the framework) of interaction by capturing the dialogue and interaction between the students (control room crew) and the lecturer (producer). This production also partially captures stage 6 of the framework *Student's Action* (experiential knowledge level) by capturing the action of the students in the control room.

- **Production 2**: captures what production 1 has captured and also the result of the student action performed in the studio and the control room in the form of the raw version of the programme that the students are producing (picture-in-picture).

- **Production 3**: captures what production 2 has captured and also captures stage 6 of the framework by capturing the action of the students in the studio room.

- **Production 4**: captures what production 3 has captured, but does not capture any additional material with respect to the framework or the instructional objectives.

The content of the video has been categorised with respect to the instructional objectives of the video. For example, the hand action of the video switcher (the person who switches which camera is in use and relays orders to the cameramen from the producer) is an action, but it is not stage 6 of the framework *Student's Action* as the instructional objective of the video is not to show how to use the switching equipment. However, the switcher giving orders to the cameraman to pan his/her camera further to the left as an attempt to prevent the talent from walking off the frame is a *Student’s Action* as this shows how the students try to solve the problem of having an over-active talent walking off the frame. The full transcript of the audio track of the video clip can be found in Appendix B: SJU Case Study Phase 1 – Transcript of Video Clip.
6.5 Focus group findings

Once all the necessary productions have been created, twenty-one students (the whole class for that academic year) were grouped into three focus groups. Each group viewed the following productions:

<table>
<thead>
<tr>
<th>Focus Group</th>
<th>Production 1</th>
<th>Production 2</th>
<th>Production 3</th>
<th>Production 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Table 6-2: Focus groups and the productions viewed by each group

Students were not directly prompted to comment about the quality of the video but instead were first asked whether there were any differences between the two video productions. The complete translated transcript of the focus group (the focus group was conducted in Thai) can be found in Appendix A: SJU Case Study Phase 1 – Transcript of Focus Groups.

6.5.1 Focus group 1

This group viewed Production 1 and Production 2. In this focus group, “Video 1” is referring to Production 1 and “Video 2” is referring to Production 2. The main difference between the two productions is the insertion of the student’s production as a picture-in-picture (PIP) view. The group easily and quickly noticed this difference:

“In terms of using the video to see what’s going on, there is a lot of difference because in video 1 you can hear the instructions but you can’t see what happens, but with video 2 you can see how it’s done.”

Even though the group thought that the two videos were very different, for both productions, their attention was still focused on the quality of the production. Although the content of the productions were distinctly different, the main focus was still on how each production can be improved. This seems to suggest that at this stage, the quality of the production is still insufficient for it to be transparent to the student – the students cannot yet just concentrate on the pedagogic content of the video. Some of the more revealing comments were:

“… the picture is still not good enough, not detailed enough.”
SJU Case Study – Phase 1

“Camera angle not ‘beautiful’ ” (This is referring to how the camera has been setup and the angles that was chosen for the production.)

“There should be a monitor from each camera, should be able see what the switcher and producer is seeing. Can only see the back <of each person>.”

“Can hear the instructions but can’t see exactly what they are doing. Should cut to the face of the producer or switcher when they give instructions.”

“Sound is poor.”

The group was commenting that there were various mistakes and problems with the students’ production and how things can be improved, suggesting that they were learning from other’s mistakes.

“Students were dissolving when they should be cutting.”

There was also a suggestion that although more action is visible in Video 2, the action can be distracting:

“In Video 2, sometimes more attention is paid to the small video rather than to the instructions of the producer. But in Video 1 <we> can concentrate on instructions but can’t see what’s going on.”

One student’s comment summarised what the group’s overall impression:

“Video 2 is easier to understand. Both were still not very good. Not detailed enough but Video 2 is definitely better.”

The group thought that an archive of productions from different years would be very useful, so that they could see what problems there were, how people solved them and how to properly produce the programme (by watching final-year students in action). Students agreed that watching the videos was better than just listening to the lecturer. The videos would be very useful, but sound quality would need to be improved. The videos needed to show more actions that accompany the dialogues – see more of what is going on. This indicates that using just one wide-angle shot was not enough to capture everything. However, the main conclusion that can be made is that the quality of the both productions was not good enough for the students to be able to concentrate on just the instructional content of the video.
6.5.2 Focus group 2

This group viewed Production 2 and Production 3. The main difference between the two productions is the inclusion of an extra camera angle in Production 3. This extra camera angle enables the students to be able to see what is going on in the studio room in addition to the events in the control room. The following are the comments given by the students in this focus group. In these comments, “Video 1” is referring to Production 2 and “Video 2” is referring to Production 3.

Firstly, they noticed the extra camera angle and the fact that it captured more relevant material.

"The videos were different. Video 2 can see more things."
"A lot of difference"

Additionally, there were also comments to indicate that they thought that Video 2 was better than Video 1.

"Video 2 is better, you can see both the control room and stage. Good to also see the studio."
"Like video 2 more."
"Video 1 was much more boring than Video 2"
"If I have to choose <which one is better>, then definitely Video 2."
"Video 2 is like having a lecturer who uses transparencies but Video 1 seems like a lecturer without transparencies."

However, there was also an unexpected comment about the sound quality of the productions. The comment is unexpected as the quality of the audio tracks of both productions are identical or at least have not been altered on purpose.

"Video 1 sound quality wasn’t as good as Video 2."

There were also comments made about both productions, which indicates that the students thought that the quality of the material could still be improved on. Although these comments were concerned with areas that were outside the instructional objectives of the material, they indicated that the students would still like the material to be improved in these areas.

"Too far from the action."
"Should focus more on the action of the switcher."
When asked about whether they can understand the spoken dialogues, the students did not comment on whether they could hear the words that are being spoken or not. Instead, they were more concerned with the vocabulary used – there were a lot of jargons used, i.e. they did not have a problem with comprehending the audio track.

“I understand because I know the jargon, but not sure about juniors.”

“It would be useful to be able to see what problems other students have.”

“You can see what’s going on but there can still be more detail”.  

“Can see the control room and studio but can’t see in detail what each person is doing.”

“More <pedagogic> content needed.”

In addition to these comments, students in this group also commented that they could see that there may be benefits to archiving the work of students from each year, because they would be able to chart the progress made for each year as well as be able to see what mistakes had been made by other students, i.e. what can be improved upon.

6.5.3 Focus group 3

This group viewed Production 3 and Production 4. The main difference between the two productions is the inclusion of an extra camera angle in Production 4. This extra camera angle allows the students to see the faces of the people in the control room. The following are the comments given by the students in this focus group. In these comments, “Video 1” is referring to Production 3 and “Video 2” is referring to Production 4.

The main distinction between the comments of this focus group and previous focus groups is that this group did not think that Video 2 is better than Video 1.

“Not much difference. Yes, there’s another camera angle but not much difference.”

More surprisingly, students thought that Video 2 was more boring than Video 1. In the previous focus group, students thought that the video with less camera angles was more boring. However, this group still thought that neither video was good enough to be used as instructional material.

“Both Video 1 and Video 2 are not appropriate for learning and teaching <use as instructional material>.”

“Not enough detail pedagogically.”

“Need more detail into what is going on -- hand movements...”
Consistent with previous groups, this group made positive comments about archiving videos from each year and also added that this material would be more appropriate if used as part of a larger archive. Nevertheless, the students still preferred to have the video than to not have the video at all with the lecture. However, they insisted that the video needs to have more pedagogic content, i.e. this video alone does not cover enough topics concerning TV production and editing. It is worth noting that the comments that have been made were concerned with the pedagogic content of the video and not the quality of the production.

6.6 Summary of findings
There were significant differences in terms of perceived quality between Production 1 and Production 2 and likewise between Production 2 and 3. In both cases, the increasing the number of camera angles resulted in the students thinking that the quality of the production had been improved. However, there were no perceived improvements in quality when moving from Production 3 to Production 4. As a matter of fact, focus group 3 actually said that Production 4 was more boring than Production 3. This suggests that increasing the number of cameras does not always increase the perceived quality of the production. This study suggests that the optimum setup for this setting would be to use two cameras to capture the dialogue and one PIP insert to keep track of what the students are doing. At this stage, the technology used in the production became transparent to the group viewing the video and the group members were commenting on the appropriateness of the content of the video rather than the quality of the production.

The result of this case study is consistent with the view that the number of stages of the Laurillard framework that have been captured in the material affects the perceived quality of the material and that the perceived quality of material will improve when more stages of the Laurillard framework – more specifically, the experiential knowledge level – are captured in the material. Students did not think that Production 4 was better than Production 3. While Production 4 did have an extra camera angle, the production did not capture any additional stages of the Laurillard framework. However, does capturing more stages of the framework have an effect on observable student’s learning output? It is this question that will be investigated in the next two chapters.
This chapter has shown through a case study that vicarious learning materials containing more stages of the Laurillard Conversational Framework (in this case, the experiential knowledge level) are perceived more positively in terms of their quality compared with materials that only contain the conceptual knowledge level of the Laurillard framework. As this work has defined "effective" material in terms of perceived quality of that material by students using that material, then when capturing learning dialogue for use as vicarious learning resource, it would be necessary to capture at least the stages captured in this case study in order to create effective vicarious learning material.

In the next chapter, this requirement of capturing the appropriate stages of the framework is investigated in terms of its pedagogic effect. It looks at how making experiential knowledge level of the framework available in the material affects the student’s understanding of the issues contained in the material. In particular, the investigation is performed within the context of students in the computer science discipline.
Introduction
The case study in the previous chapter revealed that when camera angles capture more stages of the Laurillard Conversational Framework (the experiential knowledge level), the perceived quality of the materials produced is positively affected. However, if the addition of a camera angle does not capture a stage of the framework that has not already been captured, then the perceived quality of the material is negatively affected. In this chapter, the presence of experiential knowledge level activities in the material is investigated in terms of its observable effect on students' learning output. The chapter reveals that the presence of the experiential knowledge level activities of the framework in the material has a positive affect on students’ learning outputs and concludes that another study in a different empirical setting should be conducted to investigate whether the framework can provide a valid framework for developing effective vicarious learning resources.

7.1 Context of study
The study reported in this chapter follows on from phase 1 of the SJU case study. In that study, the perceived quality of the material is positively affected when a new camera angle captures additional stage(s) of the learning activity in terms of the Laurillard Conversational Framework. The main goals of this study are given below.

7.2 Study goals
In this study, the effect of capturing that additional stage of the framework – the experiential knowledge level – on the student’s learning output is investigated. Additionally, the secondary aim of this study is to act as a pilot study for the data collection method that is to be deployed in phase 2 of the UCL case study: Interaction Pattern. The aim of phase 2 of the UCL case study is to investigate how students interact with vicarious learning material and how the usability of materials is affected by different ways of providing access to the experiential knowledge level of interaction (access to props). In order to do this, students’ interaction with different sets of materials will need to be captured and analysed. The setup of this study will be used to
pilot how the interaction of the students with the material can be captured with sufficient details in order for their interaction to be analysed.

7.3 Empirical setting
As with phase 1 of the SJU case study, in order to conduct this study, it was necessary to first create materials that the students will interact with. Consequently, a course that fits the following criteria was required:

1. There are real teaching difficulties, where primary and secondary courseware have failed, i.e. there is a real need for tertiary material in an area of the curriculum where the students have consistently not learnt well either through exposition or individual work.
2. Part of the learning activities routinely involves externalisation of understanding, e.g. through diagrams.
3. A course whose learning activities can be clearly categorised in terms of each stage of the Laurillard Conversational Framework.

As mentioned earlier in Chapter 5.2: Selection of empirical settings, the Information Management computer science module – B160 Information Systems Analysis and Design – was chosen for having all of the above criteria as well as sufficient access to the students. It is from this course that materials were captured from real-world tutorials to be used for this study (materials were also captured from this course as part of UCL Case Study Phase 3: Implementing CSVL in the real world. The details of that phase of the case study and its findings are discussed in Chapter 10).

Tutorial sessions on this course were deemed to be appropriate for capturing as vicarious learning material as they can be easily categorised in terms of the stages of the Laurillard framework. The dialogue between the tutor and the student represents the conceptual knowledge level and the experiential knowledge level is represented by the interaction around the student’s coursework that is discussed and amended during the tutorial.

The students participating in the tutorial sessions were completing an individual piece of coursework, where they were required to express their designs of a computer-aided assessment system in diagrammatic forms: dataflow and entity-relationship diagrams.
The individual tutorial sessions were aimed at solving problems that an individual student had concerning his/her attempts at this coursework. Tutorial sessions were captured only when the student in that session consented to being recorded.

### 7.4 Study setup

Each tutorial session was captured using two DV cameras to capture the dialogue in the session and one flatbed scanner to capture the student's work and the changes made to it during the session. The scanner captured incremental changes made to the student’s work throughout the session. For this study, this was carried out by either scanning in each change to the student’s work as it was made or by scanning the final state of the student’s work and using an image-editing program to recreate the incremental changes made. It is also possible to capture these changes dynamically (with additional equipment and software such as a pen-based pointing device and a screen recording program), allowing the changes to be replayed to the students in real-time. However, the decision was made to capture the student’s work and the changes made to it in static form with incremental updates in order to allow investigation into the affect of synchronisation between video clip and prop in phase 2 of the UCL case study (see Chapter 9: *UCL Case Study – Phase 2 Interaction Patterns*).

One captured session was then selected for its suitability for the study. The session contains instances where the student had made a mistake in the diagrams, explained how the mistake came about in the first place and corrected the mistake with the aid of the tutor. There are seven sub-topics in the discussion:

1. DFD decomposition
2. Physical vs. logical dataflow diagrams (DFDs)
3. Linking different levels of DFDs
4. Dealing with error conditions in DFDs
5. Deriving the pseudocode for a process
6. Dealing with missing functionalities in the design
7. Differentiating between system state and system process

Five students from the B160 course volunteered for the study. Each student was given access to two sets of vicarious learning materials and a set of questions concerning dataflow diagrams, in the form of paper-based questionnaire, to answer (see Appendix
C: UCL Case Study Phase 1 – Example of Completed Questionnaire. The first set of material, Material Set 1, contains only the conceptual knowledge level of the Laurillard framework relative to the instructional objectives (given above) in the form of a QuickTime™ video clip, divided into chapters according to the sub-topics. The second set of material consists of Material Set 1 with the addition of the experiential knowledge level of the Laurillard framework in the form of a web-linked webpage showing the appropriate state of the student's coursework that is being referred to at that time in the video clip. The webpage is updated in synchronisation with the video clip.

Figure 7.1 shows the chapter facility in the video clip and the webpage updated by web-links embedded within the video clip.

![Screenshot showing chapter facility and embedded web-link](image)

Figure 7.1: Screenshots showing implementations of chapter facility (left) and embedded web-links (right)

The study was conducted as follows:

1. Student interacts with Material Set 1 (MS1). This set has enough camera angles for conveying only the conceptual knowledge level of the model.
2. Student completes questionnaire for the first time in black ink.
3. Student interacts with Material Set 2 (MS2). MS2 has an extra 'camera angle' to convey the experiential knowledge level of the model in the form of web-links to the appropriate material referred to at that time in the video clip.
4. Student completes questionnaire using the same answer sheet in step [2] but this time in green ink to accentuate any changes made after interacting with MS2.
UCL Case Study – Phase 1

At all times, the students are able to navigate through the video clips through either standard QuickTime™ controls or the video chapter facility. There are no limits on how long each student is allowed to interact with the material. The students can complete the questionnaire at any time during the session. The students would indicate when he/she thinks that all questions have been completed to the best of their abilities. With this setup, if the students do not make any changes to their answers to the questionnaire after interacting with MS2, then this would indicate that the extra camera angle (the experiential knowledge level of the Laurillard framework) does not have an affect on the students’ learning output.

7.4.1 Physical setup

Each student sits in front of a 20-inch computer monitor and has access to the mouse for controlling the material. The monitor is connected to a laptop computer, which mirrors the screen on the laptop LCD display onto the monitor. The keyboard is not available to the students as no keyboard input is required. Desk space in front of the monitor is available for the student to place the questionnaire, which is to be completed.

For the pilot study, the student’s on-screen actions are logged as screen recordings (dynamic real-time recordings of the screen activities) in the form of digital video (DV) files encoded via Pinnacle DV500 video editing system at full screen DV resolution. The student’s off-screen actions are logged using a DV camera using an over-shoulder shot to record hand movements when he/she interacts with the material and/or answers the questions on the questionnaire. To ease legibility of this chapter, the result of this pilot study is reported within its context in Chapter 9: UCL Case Study Phase 2 – Interaction Pattern.

The student’s answers to the questions are recorded on paper as they are completed. As detailed earlier, the student first completes the questionnaire in black ink while interacting with MS1 and then amends/append their answers in green ink while interacting with MS2.

7.5 Results

All participants corrected or amended their answers to the questionnaire after watching the second video clip. The changes following interaction with MS2 are given below.
Where there was more than one instance of students’ answers of the same category, the most legible example has been chosen for illustration.

7.5.1 Answers of graphical nature

Perhaps these are the least surprising changes made to the students’ answers, as MS2 contains the graphical representation of the material that is being discussed in the video clip. Student 2 and 4 did not give any answer at all to Question 6a (which requires the answer in the form of a DFD diagram) until they had interacted with MS2. However, not all students had to interact with MS2 in order to give an answer to this question. Student 3 and 5 gave their answers before interacting with MS2. Moreover, they did not amend their answers after interacting with MS2. The actual answer given by Student 3 (post-MS1) and 4 (post-MS2) are illustrated below:

Figure 7.2: Answer given by Student 3 to question 6a
7.5.2 Elaboration of previous answers

Every student with the exception of Student 2 elaborated previous answers following their interaction with MS2. However, these were not graphical by nature. All of the elaborations were text-based, usually clarifying a point made after interacting with MS1. For example, Student 1 and 3 elaborated on a short answer for question 6 “What was wrong with student’s pseudo-code for process 1.2?”

Figure 7.3: Answer given by Student 4 to question 6a

Figure 7.4: Answer given by Student 1 to question 6

Figure 7.5: Answer given by Student 3 to question 6
There were also instances when post-MS2 elaborations were trivial. These were usually, in the form of two or three-words annotation of previous answers (e.g. Student 5).

7.5.3 Correction of previous answers

There was only one instance when a student (Student 4) corrected an answer (i.e. crossing out a previous answer and writing a new one) that was given after interacting with MS1. However, this correction did not seem to originate from a previous misconception after interacting with MS1 but a clarification of concept after interacting with MS2. As can be seen below, Student 4 did correctly understand that there was a problem with the process “Student Authentication”, in that there was a process that should be a system state. However, he/she was unsure about exactly what the problem was before interacting with MS2. The student’s post-MS2 answer gave a more detailed answer.

![Image of handwritten answer](Image)

Figure 7.6: Answer given by Student 4 to question 7

7.5.4 Addition of new answers

Student 1 and 4 gave new answers to Question 5 and 5a after interacting with MS2. These were the only instances, with the exception of graphical answers as detailed above, when students gave a new answer after interacting with MS2.
7.6 Analysis of results

The result of the study reveals that, despite MS2 having more graphical components of the student’s coursework, a large amount of corrections and amendments made by students in this study were text-based. Students seemed to give better answers when they had access to graphical representations of what was being discussed in the video clip. Some students did not give any answers at all to certain questions until they had interacted with MS2. However, there were students who gave answers to these questions after interacting with MS1 and did not correct or amend them after interacting with MS2. It is not clear in this study why some students could not answer those questions without interacting with MS2, while others can.

However, it is clear that students’ answers to the questionnaire were affected by their interaction with MS2. Every student corrected or amended their questionnaire answers after interacting with MS2. This is consistent with the thought that materials containing an extra stage of the Laurillard framework (as MS2 does) do have an effect on the students’ learning output. Additionally, when students gave corrections or amendments, the correctness of the answers increased or at least did not decrease. However, the magnitude of the improvement is not clear due to the freeform style of the answers given.

7.7 Conclusions

This study indicates that materials containing conceptual knowledge level and the experiential knowledge level of the learning activity have an effect on the students’ learning output, compared with materials that contain only the conceptual knowledge level of the learning activity. It also indicates that the effect is a positive one (students gave more correct answers). However, there were only five students in this study and the nature of the effect (whether it was positive or not) was still unclear due to the freeform style of answers given. Consequently, another study is required where there are more participants and the improvement in the correctness of the students’ answer can be assessed more clearly.
Chapter Summary
This chapter concludes that materials containing more stages of the Laurillard framework (in this case, the experiential knowledge level) have a greater effect on the student’s learning output. This conclusion is derived from the amendments that every student in this study made after interacting with Material Set 2 where they were given access to the experiential knowledge level of the interaction in the tutorial session (unavailable in Material Set 1). However, there were only five students in this study and the result, at the moment, can only be applied to this particular setting of this study. Consequently, another study is required where there are more participants and the improvement in the correctness of the students’ answer can be assessed more clearly. In the next chapter, the effect on the student’s learning output is reinvestigated in a different empirical setting to confirm and clarify observations made in this chapter.
8 SJU Case Study – Phase 2
Effect on Students' Learning Output (Confirmation)

Introduction
The previous chapter concluded that materials containing the addition of the experiential knowledge level of the learning activity have an effect on the students’ learning output. However, there were only five students in that study, whose setup did not allow the nature of the effect on students’ learning output to be clearly assessed. This chapter reports on phase 2 of the SJU Case Study. The study confirms the observation made in the previous case study and concludes that vicarious learning materials containing both the conceptual knowledge level and the experiential knowledge level of interaction have more positive effects on the student’s learning output, than materials that only have the conceptual knowledge level.

8.1 Context of study
This study follows from phase 1 of UCL Case Study where impact of capturing an additional stage of the Laurillard framework on the pedagogic effectiveness of the resulting material is investigated. As stated earlier, pedagogic effectiveness is defined within the parameters of observable learning output of the students, in this case, their performance on a multiple-choice questionnaire with one freeform question.

8.2 Study goals
In a different domain and setting, this study aims to confirm the result of phase 1 of the UCL case study, where the capture of the additional stage of the Laurillard framework has a pedagogic effect on the students’ learning output. Therefore, the study is only concerned with the pedagogic effect of capturing this extra stage of the framework and the students’ interaction with the material will not be investigated at this stage. With this exception, this study looks at the same issues as phase 1 of the UCL case study, but in a domain outside computer science.

8.3 Empirical setting
This is phase 2 of the SJU case study and therefore has the same setting as the first phase of this study. As the focus of the investigation is now on the pedagogic effect of the material as opposed to the perceived quality of the material, the instructional
objectives of the materials produced in phase 1 are highlighted below. These instructional objectives will be used to assess the students' learning output, especially when the output style is freeform.

Students should be
1. familiar with good and bad practices in programming a music video,
2. familiar with problems and solutions concerning camera angle selection, during the programme,
3. able to identify organisational problems in the control room and studio and solve those problems, and
4. able to identify the appropriate camera setup for producing a music video.

The video clips used in this study are two out of the four video clips that were produced for phase 1 of this case study. More specifically, they are Production 1 and Production 3 of the set of videos that were created. In that study, Production 1 was perceived to have the lowest quality while Production 3 was perceived to have the highest. In this study, Production 1 and Production 3 are referred to as MS1 and MS2 respectively. As a reminder, the screenshots of the two productions are given below:

![Figure 8.1: Screenshot of Production 1 (MS1)](image)

![Figure 8.2: Screenshots of Production 3 (MS2)](image)

The aim of the video is very much tertiary in nature. That is, the students should already know what constitute a good programme, in terms of the edit decisions and organisation of the control and studio room personnel. However, in this subject, how such knowledge is applied is even more important than knowing that knowledge in the first place. It is here that vicarious learning materials can play an important role. An effective vicarious learning material in this setting should be able to get the students to apply their understanding and externalise that in the forms of comments that they could
make on a production. More specifically, they should be able to see where the problems are and whether those problems have been solved in an effective way.

8.4 Study setup

Ten second-year undergraduate communication arts students (the whole class for that academic year) watched the two sets of QuickTime™ video clips and answered a questionnaire. Note that, although the students for this study were second-year undergraduates (as with phase 1 of this case study, see Chapter 6: *SJU Case Study – Phase 1*), they were not the same students as those in first phase of the study, as this study was conducted one academic year after the first phase.

The study was conducted as follows:

1. Student is given a questionnaire that they can complete at any time during the session (see constraints in steps 3 and 5).

2. Student views Material Set 1 (MS1). This set has enough camera angles for conveying only the conceptual knowledge level activities of the Laurillard framework.

3. Student completes questionnaire for the first time in black ink. At this stage, the student can request to view the video clip again. There is no restriction on the number of times the student can view the video clip.

4. Student views Material Set 2 (MS2). MS2 has an extra ‘camera angle’ to convey the experiential knowledge level activities of the framework, in the form of a picture-in-picture (PIP) insert of the programme that the students in the video clip were making.

5. Student completes questionnaire using the same answer sheet as in step 3, but this time in red ink (or a different colour from the one used in step 3) to accentuate any changes made after interacting with MS2. The student can request to view the video clip again with no restrictions on the number of times the student can view the clip.

8.5 Questionnaire design

The questionnaire aims to test how well the students have understood concepts specified in the instructional objectives, as previously stated in Chapter 8.3: *Empirical setting*. Additionally, as well as being used for this study, the questionnaire was also used on the *TV Production* course for formative assessment purpose. There are four parts to the
SJU Case Study – Phase 2

questionnaire with the questions arranged as follows (the complete questionnaire can be seen in Appendix D: SJU Case Study Phase 2 – Example of Completed Questionnaire):

The first part is ‘General’ and is not significant to the study, but it provides a rough standardisation of the students. The questions in this section concerns general issues on the topic that are answerable without applying knowledge learnt during lectures.

(1) The student production was filmed in one take.
   True   False   Don’t know

(2) It is essential to count down from five before starting a take.
   True   False   Don’t know

(3) Conversation inside the control room is kept to a minimum.
   True   False   Don’t know

‘Production’ and ‘Production Team’ contain questions that assess how well students have understood concepts of the instructional objectives. The following questions are directly related to the instructional objectives of the video clips.

From the ‘Production’ section

(5) When the music is slow, how should the cameraman pan the camera?
   Pan it slowly   As normal   Don’t know

(6) The student production used too many fade-in effects.
   True   False   Don’t know

(7) The camera(s) is/are ...
   Tripod-mounted   Shoulder-mounted   Don’t know

(8) How is/are the camera(s) positioned relative to the stage in the studio?
   All on Left   Centre All on right   Left & Right   Don’t know
From the ‘Production Team’ section

(12) The talents caused problems for the cameraman by moving too much.
   True   False   Don’t know

(13) The producer indicated during the studio session that the students’ production had which of the following faults?
   a. The camera’s vertical position is incorrect (too low/high)
   b. The camera’s horizontal position is incorrect (too far to left/right)
   c. The cameraman is too slow in capturing the talent
   d. There are not enough cameras to capture the production
   e. The students have not planned this session well enough

(15) What was wrong with cameramen’s coverage of the programme?
   a. One of the cameramen was capturing only one talent all the time
   b. The focus isn’t very good
   c. Zoomed out too much
   d. The camera shot was too high
   e. Too much headroom above talents’ heads

The last section, “Overall Production”, by allowing free-form answer, will be used to see how deeply the students have understood the concepts and issues raised in the video clips.

(17) What improvements on the production would you implement if you are to make a similar programme?

8.5.1 Empirical variables

The questionnaire design allows the derivation of the following observable empirical variables.

1. Level of correctness: whether the student has answered the question correctly or not. This is looked at in two dimensions, with respect to each student and each question, e.g. “Does the student’s performance improve after viewing MS2” or “Does question x have more correct answers after students have watched MS2?”
2. **Comments given by the student**: this is the direct result of the freeform question prompting the students to suggest how they might improve the programme should they have to produce a similar programme. The quantity and quality of the comments is analysed. In terms of quantity, this is merely the number of words the students gave as their comments. However, the quality of the comment is more useful as an indicator of their level of understanding, i.e. do they indicate that the instructional objectives have been achieved? Issues relevant to the instructional objectives will be indicators of those objectives being achieved while off-topic issues will indicate otherwise.

8.5.2 Note on study

During the study, it was necessary to verbally translate the questionnaire from English to Thai, as some of the students were not sufficiently confident enough to reply in English. The translation was conducted before the students viewed any video clips to make sure that they fully understood the questionnaire. Therefore, when inspecting the raw data for this study, it should be noted that some writing on the questionnaire is actually the translations that the students noted down before the study began, rather than comments made by the students.

8.6 Results

Detailed results can be seen in Appendix E: *SJU Case Study Phase 2 – Student’s Tabulated Answers* and Appendix F: *Saint John’s Case Study Phase 2 – Students’ Raw Comments*. Students did not request to watch either clip more than once. Due to the small sample size, it is not possible to draw statistically significant conclusions. However, the results do represent an indicator of the characteristics of the students’ learning output during the study.

8.6.1 Correctness (relative to student)

In all cases, students answered more questions correctly after watching MS2. The following graph summarises the students’ performance before and after watching MS2.
The total number of corrections was 36. There were on average (mean) 3.6 ‘corrections’ per student. The highest number of corrections for a single student was 6 and the lowest was 1. Of these corrections, 31 (86%) resulted in increasing the student’s overall correctness (i.e. they gave the right answer).

In addition to corrections, there were also amendments – some students did not give any answer to certain questions as well as not giving enough answers to questions where they can choose more than one answer. In total there were 44 amendments, giving a mean average of 4.4 amendments per student. The highest number of amendments for a single student was 7 and the lowest was 1. Of these amendments, 34 (77)% resulted in increasing the student’s overall correctness of the student’s performance.

There were no instances in which students’ overall performance decreased after watching MS2. The average increase in overall performance was 29% (STDEVP = 10.83).

8.6.2 Correctness (relative to question)

The following graph shows the percentage of students giving correct answers for each question after watching MS1 (1st pass) and after watching MS2 (2nd pass).
More students were able to answer correctly questions that were directly relevant to the instructional objectives after watching MS2. In particular, for questions 6, 10, 12, 13 and 15, the percentage of students giving correct answers improved by at least 100%. These questions, with the exception of question 10, come from either the ‘Production’ or ‘Production Team’ sections as detailed earlier. These questions not only required the student to watch MS2, but also to apply theories learnt during lectures. Question 10’s percentage of students giving correct answers improved the most after students watched MS2. However, this question only required students to observe how many talents were involved in the production – this was just a matter of counting how many different people they could see in the PIP-insert. What this does indicate is that every student was paying attention to the material or at least the PIP-insert.

There was no increase in the number of students giving correct answers for questions that were not directly relevant to the instructional objectives (questions 1, 2, 3 and 16). Questions 1, 2 and 16 showed a ceiling effect as every student gave the correct answer after watching MS1. On reviewing the result for question 3 (for which not every student gave the right answer, but the performance did not improve after watching MS2), it was found that the question construction was problematic. A reminder of question 3 is given below:
(3) Conversation inside the control room is kept to a minimum.

True          False          Don’t know

From the result, it seems that students had different interpretations as to what constitute ‘minimal’ in terms of conversations inside the control room. MS1 did effectively capture the level of conversations in the control room – after all, these were the dialogues. Therefore, it seems that students, including those who gave the “wrong” answer, were satisfied with their answers after watching MS1. As a result, no corrections or amendments were made to answers for this question.

There were no instances in which students’ performance with respect to each question decreased after watching MS2. The mean average overall increase in performance with respect to each question is 28%. However, there is a wide spread in the performance of the students in the study (STDEVP = 24.61).

8.6.3 Quantity of students’ comments

Students made more comments after watching MS2 than after watching MS1. This may be due to the fact that guessing the answer is harder for the students when giving freeform answers. As a matter of fact, only one student wrote a comment after watching MS1. This indicates that students required access to the experiential knowledge level activities in the material in order to be able to complete the question.

In terms of absolute quantity, the students’ comments are analysed in terms of the number of words in their translated comments. While this does not reflect exactly the number of words that the students actually wrote, it can demonstrate the magnitude in which the quantity between each student differed. Additionally, there are (unsurprisingly) some linguistic differences between Thai (the language used by the students) and English (the language that their comments have been translated into). A Thai sentence saying something can have more or less words than an English sentence saying exactly the same thing. However, while the number of words may be different, the number of sentences remains the same. Therefore, the exact number of words used is not compared here.
After watching MSI, only one student made a comment (Student 3). The comment was 23 words long. After watching MS2, every student made a comment. There were on average (mean) 73.1 words of comments given by the students. The longest comment contained 178 words and the shortest contained 20 words. While the sample size of this study is too small to allow statistically meaningful statements to be made about the quantity of comments given by the students, it indicates that the quantity of comments (as mentioned earlier) differed greatly between each student (STDEVP = 50.94). What is clear from this result is that watching MS2 did have an effect on the quantity of comments given by the students.

8.6.4 Quality of students' comments

What is implied by “quality of students’ comments” in this study is whether those comments are correct and are relevant to the instructional objectives as stated in Chapter 8.3: Empirical setting. For example, a comment, that gives a critique of a camera angle that has been used inappropriately in the production and what can be done to improve that aspect of the production, would be categorised as being correct in terms of the assessment of the production and relevant to the instructional objectives, i.e. instructional objective [2] “Students should be familiar with problems and solutions concerning camera angle selection, during the programme” (see Chapter 8.3: Empirical setting).

Not surprisingly, considering the lack of comments after watching MS1, the quality of the student comments was also significantly higher after watching MS2. Although not every student managed to raise relevant issues in their comments, those that did displayed a good understanding of the theory and demonstrated that they could apply that theory in the form of planned improvements for the programme should they have to do it themselves.

The following comments from Student 1 show how the student raised issues relevant to the instructional objectives.

“Will use Dissolve effect less, i.e. will let the camera rest on the picture more before dissolving. This program dissolves too quickly”
SJU Case Study – Phase 2

"Will use cameramen or rehearse with the cameramen so that framed shots are more fluent as, from the video clip, the cameramen used are not yet sufficiently competent"

"Additionally, I will use [instead of how it is setup] a still camera angle on a tripod and another shoulder-mounted or maybe even two shoulder-mounted cameras because in a music video, the camera has to move a lot more so that they'll be able to capture the talent more quickly than this. [because] the cameramen are responsible for most of the faults with this program."

In contrast, Student 2 revealed that there were some students who had very little grasp of the topic and consequently were less specific about the proposal for improving the production. The following was the whole of the comments given by Student 2:

"I will study the script better than this, so that if I was making this program, I'll consider how the picture will come out so that the editing process won't be complicated."

Other on topic discussions from other students include:

"... Especially cameramen, must use more competent cameramen – must be able to follow the talents and focus the camera more sharply. The switcher must be someone who is more knowledgeable about framing pictures. The switcher must know when to use which camera and when cameras should exit, so that the cameramen could follow his orders." Student 4

"And concerning the production, the job of the cameramen, I want the cameramen to study more about how to frame the picture, the size of the picture, because the way the pictures are captured are not good at all. And in terms of effect, they used Dissolve too often, making the viewer bored. What I want to add to is the stage. In the video, it looks that there is nothing. I want to add more props on stage." Student 5

Students were also prompted to discuss organisational issues associated with programme production:

"I will write a script before the production because it looks like there was no script. I will plan the camera angles and the size of the picture [the zoom] beforehand. There should be [before the production] a dialogue between the cameramen and the switcher so that good camera shots are obtained." Student 6
Comments from students after watching MS2 were constructive, giving more information on how they would actually go about improving the show: the camera angle, the set, the show script, the talents’ actions. This is in contrast to comments made after watching MS1, which were very scarce and very general when given. The most extensive comments were made by Student 8. The comments made discussed improvements that need to be made concerning the organisation of the control room and the division of responsibility for each person.

“Must reorganize how people work, i.e. must have a script ready both for the talents and for the production team. Must have clear division of tasks and each person must know exactly what he/she is responsible for. There should be a rehearsal before shooting the production and check all equipment and props, including the readiness of the talents and the production team. The producer should have the most important role, he must give clear and definite orders, must be able to control the situation, maintain concentration and attention so that he can deal with problems that arise as quickly and as well as possible. Most importantly, there must be a clear script and understanding of that script by having a meeting to discuss the script before shooting the production, because if the producer, production team and talents don’t understand the script then there will be problems with the production. Understanding the script is an important part of programme production, because everyone will understand what they are responsible for and what they’ll have to do.”

8.6.5 Repeated exposure to MS1

It is not possible to speculate how the results would have been different if MS1 had been shown twice. Although none of the students requested to view MS1 for a second time, it is uncertain whether students may or may not have benefited from repeated exposure of the material. Perhaps the students really have got everything they can out of MS1, which is also possible, as MS1 does not effectively capture any experiential knowledge level activities with respect to the instructional objectives of the material. Nevertheless, what the results do show is that watching MS2 did have some effects on the students’ learning output. This is most easily observed in the difference in the quantity of comments made by the students while/after watching MS2. The increase in the level of correctness of the answers given in the MCQ section, while not statistically significant, is also consistent with the notion that watching MS2 did have positive effects on the students’ learning output. This provides further support for the view that vicarious learning material containing experiential knowledge level activities are more pedagogically effective than those that do not.
8.7 Analysis of results

8.7.1 Pedagogic effect of capturing additional stage of the Laurillard framework

The results are consistent with the view that, when an additional stage of the Laurillard framework (as derived from the instructional objectives) is captured, there are positive pedagogic effects on the student's ability to achieve those objectives. In this case, the additional stage that was captured is the experiential knowledge level of the learning activity. Students gave more correct answers and corrected/amended their incorrect answers after viewing MS2, which contain the additional stage of the framework in the form of a picture-in-picture insert of the programme that the students in the video were producing.

Additionally, the analysis of comments made by students after watching MS2 shows that the clip managed to prompt some students to discuss topics that are directly relevant to the instructional objectives. Many comments showed that the student had applied theories that have been learnt in class to give meaningful critique of the programme being made in the video, as well as creating plans for improving the production they were watching.

However, not all students improved their performance to the same extent. There were two students (Student 9 and 10) whose performance increased very little, while other students' performance obviously benefited from the additional captured stage. This applies equally to the comments made by the students. Some students made very little comment at all, indicating that either the material had not been effective in prompting students to discuss the relevant issues or that the student did not have sufficient basic grasp of the theories in order to apply them in this instance.

8.7.2 Lack of comments on social issues

The students' comments contained very little discussion about what they would do to improve or implement the social structure inside the control room. This is an important issue, i.e. students should know how to behave when they take on certain roles.

However, from the video transcript of both MS1 and MS2, it is apparent why this may be the case. In both of the materials that the students watched for this study, there were no situations where there were social conflicts in the control room that were then
rectified on screen. If this was the primary aim of the courseware, then this would be a serious shortcoming in the material produced. What the video clips managed to show are the students' editing decisions and how they organised themselves while producing the programme and the resulting programme. As editing decisions (and how they came about) and how they affect the final production are part of the instructional objectives, the material produced (MS2) is able to satisfy the instructional objectives in this case.

However, if the aim of the courseware were to show these social conflicts and their resolutions, then it would not be possible to effectively show those situations with the camera angles used in this study. What would have been needed are dynamic camera positions where the conflicts can be shown more clearly (in the style of fly-on-the-wall documentaries). This would require greater man power as well as the ability to be present at the moment when students and lecturers have their social conflicts – perhaps even less likely to happen when there are cameras around to record it.

8.7.3 Effectiveness of tertiary courseware

The result of this study, particularly from analysing the comments made by the students, indicate that tertiary courseware is effective in prompting students to apply the knowledge that they have learnt in lectures to a real-world problem-solving situation. Often it is easier to understand the theory than to apply it (although it is possible to argue that students have not properly understood the theory until they can apply it). In other situations, all that is required from the students is ability to communicate conceptual knowledge (stages 2 and 4 of Laurillard's framework), but in this case, it is very important to also be able to apply it (stages 6 and 8). When applying their knowledge in this instance, there are a lot of issues that they need to consider in parallel and how other things fits each other overall. The fact that the material has prompted the students to discuss these topics with reference to a real-world problem demonstrates how tertiary courseware has been effective in this case to get the students to apply their knowledge and thus satisfy the instructional objectives of the material.

8.8 Conclusions

There were observable pedagogic effects on the students' learning output in the form of their answers to the questionnaire, in both this study and phase 1 of the UCL case study. Without exception, capturing another stage – in this case, the experiential knowledge
level – of the Laurillard framework improved the students’ learning output relative to
the instructional objectives of the video clips used in each of the study. This indicates
that for vicarious learning materials to be pedagogically effective, it is essential to
capture both the conceptual knowledge level and the experiential knowledge level of the
learning activity.

In phase 1 of the UCL case study, the instructional objectives are to show the kind of
mistakes previous students have made in their data-flow diagrams (DFDs) and to
illustrate how those problems were resolved with the help of a tutor. In this case, the
experiential knowledge level of the activity is the student making changes or corrections
to his/her coursework and the result of those changes or corrections. Each change was
captured and presented to the student in synchronisation with activities in the video clip.

However, should the instructional objective be to teach the student how, or how not, to
behave in a tutorial, then the same material will be less effective as tertiary courseware.
To satisfy such an objective, the video clip will need to contain moments of conflict
where the student does not know how to behave and then capture the moment when the
student finds out how to behave and then adjusts her behaviour. There are no such
‘critical moments’ in any of the tutorials captured for this study.

In phase 2 of the SJU case study, it is essential to identify the instructional objectives
before capturing the studio session. For example, the video clips produced from these
sessions identify the experiential knowledge level activities as the production and
editing decisions taken by the students and the resulting production. The video clips
capture these stages by including the camera shot of the control room and the students’
resulting production as a PIP insert. The result of this study shows that capturing this
extra level of activities has an observable effect on the student’s ability to be able to
produce meaningful comments about the process of creating the production.

However, should the instructional objectives be to teach the students how to operate the
numerous equipment that they need to use in the studio and the control room, then the
video clips would not have captured the essential experiential knowledge level activities
in the control room, as the actions of the students will need to be captured more
effectively. In the video clips, there are no instances in which the camera has managed
to capture any critical incidents concerning the usage of such equipment. To satisfy this instructional objective, the camera angles needed would have to capture moments when things go wrong with how the equipment is operated, and the cameras should capture the action of the equipment operators at those moments.

To summarise, the findings from these studies indicate that, in order to create effective vicarious learning material, the producer of the material should first identify the conceptual knowledge level and the experiential knowledge level activities with respect to the instructional objectives and then capture those activities. These findings are consistent with Cox’s findings (Cox et al., 1999) in the study on the effectiveness of using vicarious learning material to support learning within the domain of sentence parsing and discourse representation structure (see Chapter 2.4: Pedagogic effectiveness of vicarious learning). In that study, Cox found that students with access to the animated recording of tree diagrams being constructed by a student with assistance from a tutor (experiential knowledge level activities) and a transcript of the dialogue that was exchanged between the student and the tutor (the conceptual knowledge level activities) performed better than students who had access to only the animated diagrams.

In terms of specifying a CSVL system, this implies that it is not necessary to have a system that can capture everything that is going on during a learning activity. What is required is a system that can capture activities that are part of the conceptual knowledge level and the experiential knowledge level according to the instructional objective(s). A practical implication of this conclusion is that resources can be channelled towards effectively capturing activities that will have pedagogic values. For example, when video footage was being captured for phase 1 of the SJU case study, many people who worked in the studio commented that the static camera angles would not be sufficient for a “behind-the-scene” programme. Suggestions were made for having a mobile cameraman who can zoom in on hand-actions and facial expressions. It is true that such camera angles may allow a more interesting “behind-the-scene” programme to be made. However, it would require more manpower and more complex post-production editing. More importantly, those extra camera angles would not have captured anything that is of pedagogic value with respect to the instructional objectives that have been defined.
Chapter Summary

The last three chapters have investigated the effect of capturing the experiential knowledge level of interaction on the perceived quality and the pedagogic effectiveness of the material. In all three cases, capturing this additional stage of the learning activity resulted in the material improving in pedagogic effectiveness, i.e. the perceived quality is increased and the students' learning output is improved. Consequently, this chapter concludes that a major requirement for an effective CSVL system would be the ability to effectively capture both the conceptual knowledge and the experiential knowledge level of the learning activity. In the next chapter, the way in which the experiential knowledge level of the activity should be made available to the students using the material is investigated.
9 UCL Case Study – Phase 2
Interaction Patterns

Introduction
The SJU case study and the first phase of the UCL case study, investigating what needs to be captured in order to create effective vicarious learning material, concluded that it is crucial to effectively capture and give access to activities at the experiential knowledge level of interaction. With this in mind, it is important now to establish how this level of interaction should be presented to the student, as this affects how the material should be captured in the first place.

One of the main research questions that were asked in Chapter 4: Research Questions was, “how would students interact with the material?” This question was asked because there is little or no documentation on how students have interacted with various forms of video-based vicarious learning material. There are a number of studies that refer to students benefiting from interacting with vicarious learning materials, but none are very specific about the nature of those interactions. This chapter reports on investigative studies that were carried out to document how students use vicarious learning material and what their perceptions are of vicarious learning resources.

9.1 Context of study
This chapter investigates how materials should be presented to the students. More specifically, it looks at the usability issues concerning the nature of the association of prop access with the relevant video clips. This study is conducted within the context of the two systems that were introduced in Chapter 2.8: Implementations of CSVL as previously implemented video-based vicarious learning system or system whose technology can be used for vicarious learning.

9.1.1 Manual vs. synchronised prop access
The first one of these is the Dissemination tutoring system, where the video clips are disassociated from related materials, in this case either the whiteboard or pieces of paper on the table. That is, video clips of the tutorials are shown in one window while the materials under the discussion in those tutorials are shown in a separate browser.
window. Consequently, students using this system have to manually navigate through the materials (or props) to search for the relevant sections that are under discussion.

The second system, eClass (formerly Classroom2000), implements a fully synchronised association between video clips and their related materials, in this case the content of an electronic whiteboard. Students using this system can see the amendments made to the electronic whiteboard as it happens in the video clips, i.e. they do not have to manually search through different images of the whiteboard and work out which one is relevant for certain sections of the video clips.

9.2 Study goals

The purpose of this phase of the study is to investigate whether full synchronisation of material and video clip is necessary for students to effectively and efficiently use vicarious learning material. It looks at whether manual navigation of props causes any usability problems for the students and then progressively adds degrees of synchronisation and navigation features to the material while analysing how the usability of the materials are affected.

9.2.1 What data will be collected?

Data concerning two areas of investigation will be collected. This reflects the need for a thorough documentation of how students interact with vicarious learning material and also what the students themselves perceive to be the problems when interacting with the material. Such data will help to inform developers of video-based vicarious learning material of what make effective courseware and what functions are required to efficiently access it.

Firstly, quantitative data about how the student’s interaction with vicarious learning materials are affected by the following production variables are collected:

1. Manual access to props
2. Video-synchronised access to props
3. Both modes of accessing props

This data will allow differences in interaction pattern from each mode to be analysed.
In addition to quantitative data of the student’s interactions, the study will also be used to elicit qualitative data concerning the following issues:

1. **Did the student experience or perceive to have experienced technical or pedagogic problems when using the material?** This question is used to highlight what problems students have with materials of different production variables. Additionally, it is also used to indicate whether certain types of materials have more pedagogic problems than others.

2. **What is the student’s assessment of the usefulness of the material?** Until this study, materials that have been systematically developed have not been assessed in this way. This question is designed to probe how students feel about using or being part of the CSVL environment, if it is implemented widely.

3. **What improvements does the student feel should be implemented?** While all the additional functionalities that were implemented in the test material used in this study were derived from a theoretical framework, this question allows students themselves to suggest how the material can be improved (and therefore be more efficient and effective). As students were not shown other sets of material, this will also be a good opportunity to see whether the additional functionalities that have been implemented coincides with those suggested by the students, i.e. positively affects the perceived quality of the material.

### 9.3 Study setup

Three sets of materials, which the students interacts with for this study, are created from the following components:

- A QuickTime™ video clip containing the conceptual knowledge level of interaction of a tutorial. The following topics are covered in the video clip:
  - DFD decomposition
  - Physical vs. Logical dataflow diagrams (DFDs)
  - Linking different levels of DFDs
  - Dealing with error conditions in DFDs
  - Deriving a pseudocode for a process
  - Dealing with missing functionality in the design
  - Differentiating system state and system process
These topics are explicitly shown in the video clip by the implementation of QuickTime™ chapters. Additionally, the video clip also implements the following form of navigation features: play, pause, rewind, forward, move to beginning of clip and move to end of clip through 'button' interface; and rewind and forward through a direct-manipulation interface. A screenshot of the video clip showing these features is given below:

Figure 9.1: Screenshot showing chapters implemented in a QuickTime™ video clip

- Manual prop access (Figure 9.2 on the next page) giving access to the student’s work that is discussed in the video clip in the form of hyperlinks that the student can click on to navigate different stages of the changes in the prop during the tutorial (experiential knowledge level of the tutorial).
- Time-Synchronised prop access (Figure 9.3 on the next page) giving the same access, in terms of content, for the student as the manual prop access method, with the addition that activities at the experiential knowledge level are now time-synchronised to the video clip, i.e. when the tutor/student makes a change to the prop, that change is automatically reflected in the prop access frame of the browser.
Figure 9.2: Screenshot showing material with manual prop access via hyperlinks

Figure 9.3: Screenshot showing material with time-synchronised prop access
From these components, the three sets were created as follows:

<table>
<thead>
<tr>
<th>Set</th>
<th>Video Clip</th>
<th>Manual Prop Access</th>
<th>Time-Synchronised Prop Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Table 9-1: Table showing what each set of material consists of

Set 3 has both Manual and Time-Synchronised prop access implemented – allowing the student to disassociate the prop from the video for manual navigation of props while still maintaining the ability for students to use the video clip for synchronised access to prop. The screenshot below shows what material set 3 looks like:

![Screenshot showing material with both time-synchronised and manual prop access](image)

Figure 9.4: Screenshot showing material with both time-synchronised and manual prop access

9.4 Data collection methods

Student volunteers (12 in total) from the course B160 were asked to complete a questionnaire (the same one as in phase 1 of this study) by using the material contained in the material set that is provided to them in the session. It is worth noting for this study that questions in the questionnaire are ordered in chronological order with respect
to the topics covered in the video clip. For example, the question concerning the content of the data dictionary comes after the question about the DFD.

9.4.1 Result from pilot study

The pilot study conducted during phase 1 of this case study revealed some problems with the method of capturing the student’s interaction session with the setup used in that study (see Chapter 7.4: Study setup). Significant problems were found in the following areas:

1. **Subject’s on-screen interactions were captured by another computer in full DV resolution.** While this did provide a convenient way of capturing the on-screen interaction, the setup required a large hard disk in order to be able to capture every interaction in this study – one hour of DV takes up approximately 13GB of disk space. In the pilot study, the hard disk on the capture computer ran out, resulting in complete loss of the ability to capture on-screen interaction.

2. **Subjects listened to the audio using headphones.** In the pilot study only the student could hear the soundtrack of the material being used. While this does not affect the ability for the interaction session to be analysed graphically, it makes contextualising the student’s activities very difficult. For example, why is the student rewinding the video clip to a specific location and then repeats the process several times? Additionally, synchronising the on-screen and off-screen activities will be much easier if there is an audio track to do it with.

The pilot study has revealed that the way on-screen and off-screen interactions are captured need to be redesigned to deal with the problems detailed above. The study setup given below reflects this need.

9.4.2 Capturing interaction patterns

During the study, the students’ interactions with the material are captured using the following two camera angles:

1. **On-screen interaction:** This camera angle captures exactly what is happening on the screen. This enables basic interaction activities such as play, stop, rewind and other navigational activities to be captured for analysis.
2. **Off-screen interaction:** This camera angle captures the student's activities off-screen. The reason for also using this camera angle is to capture the 'critical moments' (see below) in the student's interaction.

As the pilot study revealed that there are practical problems with the size of hard disk that is required to capture all the interaction sessions, this study will capture all interaction to DV-tape first and then transfer each session individually onto hard disk for processing and analysis. This is achieved by using two digital video cameras – one for each camera angle that is required. The first camera captures the off-screen interaction, using the same setup as in the pilot study in phase 1 of UCL Case Study. The second camera captures the on-screen interaction by filming the LCD screen of the laptop that is used – the student interacts with the large CRT computer monitor that 'mirrors' the LCD screen. As the LCD screen does not flicker, the video captured is stable and is sufficiently detailed to enable analysis of the on-screen interaction to be performed. A software-based screen recorder was not used in this instance as, during initial testing, such programs used too much system resource, causing jumps and pauses in the video clip.

Using the two camera angles detailed above, the interactions of the students with the three sets of materials created were captured.

9.4.3 **Post-interaction interview**

As detailed earlier, this study is also aimed at obtaining the student's assessment of the material and their experience of using vicarious learning itself as a learning material. To recap, the following questions were proposed earlier:

1. Did the student experience or perceive having technical or pedagogic problems when using the material?
2. What is the student’s assessment of the usefulness of the material?
3. What improvements does the student feel should be implemented?

In order to investigate these issues, each student, after completing the questionnaire was given an interview when only their voice was recorded. The issues discussed during the interview were loosely structured around the issues given above. The student at this point still had access to the material so that he/she can illustrate any problems experienced during the interaction session. Any on-screen illustrations given by the
student at this point were recorded as a video-stream and synchronised with the interview audio-stream.

9.5 **Data analysis methods**

Captured materials were analysed at two levels. Firstly, the students' interactions were analysed quantitatively in terms of the number of times navigational features were used and when. In this case, the following features were analysed:

1. Play/Stop button
2. Forward/Rewind button
3. Forward/Rewind through direct manipulation interface ("scrub" control)
4. Access to sections of the video via *chapter* control

In addition to the number of times these features were used, the amount of time that each student spent interacting with the material was also recorded and analysed.

While the screenshot camera angle provided quantitative data in this study, the off-screen camera angle provided qualitative data. The angle was designed to capture the 'critical moments' of the interaction session. These critical moments provided the context for the activities captured by the screenshot camera angle, i.e. when the student rewound the video clip to a certain point and viewed it again, was he/she searching for something or just checking an answer that had been given earlier? More specifically, when and how long the following activities took place were captured:

1. Observing the material — obtaining relevant information from the material.
2. Navigating through the material — searching for relevant information.
3. Writing answers to the questionnaire — answering the questionnaire once the relevant information has been found.
4. Reviewing the material — checking that the answer given is correct by looking at the material again.

These categories of activities were used for analysing the student's interaction. In addition to these activities, moments when the student had a problem using the material were also captured. Together with the on-screen activities, this enabled analysis of how the student managed or not managed to cope with the problem.
9.5.1 Overlaying video streams
As mentioned earlier, the students' on-screen and off-screen activities were captured using two digital video cameras. The two video streams were then overlaid on top of one another with the on-screen activities video-stream transparency setting set to 60% to allow both video-stream to be seen simultaneously. To allow both video-streams to be as large as possible, the decision was taken to overlay them (as opposed to setting them side by side). This enabled the student’s answers on the questionnaire to be legible and any mouse action on the screen to be clearly visible. With this setup, the student’s on-screen activities (e.g. searching for something) before and after his/her off-screen activities (e.g. answering a question on the questionnaire) could be analysed (see Figure 9.5).

![Figure 9.5: Overlaid video-streams of student's session](image)

9.5.2 Coding interaction sessions
Each student’s session was then coded in terms of what navigational features he/she used and what off-screen activities preceded or followed the use of those features. Each of these activities was time-stamped allowing all activities to be tabulated chronologically. The coding scheme was simple and objective. The following activities were coded together with the time-code when the activities occur:

1. Pause button pressed
2. Rewind button pressed
3. Forward button pressed
4. Rewind via direct-manipulation interface
5. Forward via direct-manipulation interface
6. Access of chapter facility

The resulting logs contains what features were used and when. While it was possible to automate the coding of such data, the coding in this study was done manually so that the context of the activity can also be observed. These subjective observations were noted separately, but within the context of the objective coding of the activities. These were categorised into observations relating to on-screen ("Note") or off-screen ("Task") activities.

The timing of the coding is accurate to within ±1 second. This level of accuracy is sufficient for the purpose of the analysis in this case study, as it is the overall interaction pattern of the students that is of concern. To enhance legibility, each activity was then colour-coded using the following colour scheme to aid identification of different interaction patterns of the student:

<table>
<thead>
<tr>
<th>Colour</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Navigating backwards in the video clip using any interface</td>
</tr>
<tr>
<td>Orange</td>
<td>Moving backwards in the prop view using hyperlinks</td>
</tr>
<tr>
<td>Green</td>
<td>Navigating forward in the video clip using any interface</td>
</tr>
<tr>
<td>Light Green</td>
<td>Moving forward in the prop view using hyperlinks</td>
</tr>
<tr>
<td>Purple</td>
<td>Reaching the end of the video clip</td>
</tr>
<tr>
<td>Blue</td>
<td>Writing on the questionnaire</td>
</tr>
</tbody>
</table>

Table 9-2: Colour scheme used to code students' activities

Figure 9.6 (on the next page) shows the colour-coded activity log for Student 1, representing an orderly progression through the video clip with three instances (in red) when the student moved back in the video clip (twice via the Chapter interface and once through the Direct-manipulation interface). It also shows the subjective observation notes that contextualises the activities. The full interaction profile of each
9.6 Students' interaction patterns

This section details the result of the analysis of the students' interaction session as captured by the two DV cameras. Overall, over 15 hours of video data and 5 hours of interview data were gathered. Out of the 12 sessions captured, 10 are valid. One session was invalid because the student did not realise that she could stop at any time. As a result, she repeated tasks several times and artificially extended the duration of her session. Consequently, her interaction log was discarded. However, her interview data has been retained, as the aim of the interview was to elicit the student’s general attitude towards vicarious learning material (see Chapter 9.8 Students' perception of vicarious learning resource). Another session had to be abandoned halfway through when the student had to leave for another engagement before completing the whole questionnaire.
9.6.1 Navigational features used

None of the students in this study treated the video clip as a linear resource. That is, every student reviewed parts of the video multiple times in order to answer the questionnaire. However, not all students used all modes of navigation provided in the material. There were two main preferences for moving through the video clip.

1. The majority of students (8 out of 10) preferred to use the direct-manipulation interface to navigate around the video clip. These students would use the chapter headings as a substitute for a tape counter as indication of where they were in the video clip.

2. Student 1 and 3 preferred to use the *chapter* interface as the primary interface for moving around the video clip. These students would then use the direct-manipulation interface to fine tune where they were in the clip.

Additionally, some students preferred to pause the video clip, while others preferred to let the video clip run and then rewound the clip when they needed to review a section. All students used the Rewind feature more often than the Forward feature, with some students never using the Forward feature at all.

9.6.1.1 Usability problems with rewind/forward interface provided by browser

The rewind and forward facilities provided by the Internet browser (Internet Explorer 5.2 Macintosh), in the form of buttons, were problematic for students who tried to use them (Student 5 and 6). This was because, although the buttons did actually work (i.e. they moved the video clip backward or forward frame-by-frame when the buttons were pressed), the students did not seem to expect this behaviour (frame-by-frame navigation) from the buttons. Instead, it seems that they were expecting the video clip to be moved backward or forward much more quickly – much like the rewind and forward buttons on VCRs when pressed while the video is playing. When the student pressed and depressed the button, the video clip moved back/forward only one frame. After pressing the rewind/forward button a few times, the students gave up and went on to use the video scrub control (direct-manipulation interface) instead for their navigational tasks.
9.6.1.2 Video chapters

When chapters were implemented in the video clip, two students did use them extensively to navigate through the video clip, while others (eight students) used the chapter display as an indicator of where they are in the clip. However, when chapters were used to navigate through the material, students also expected the prop view to be updated as well. This indicates that just synchronising the prop with the video clip at the moment of change was not adequate. If the material was treated as a linear learning resource (i.e. like a video or movie, where they can sit through the material in one go), they would not need to review the material and therefore this synchronisation problem would not be an issue. The problem with prop synchronisation is discussed further below.

9.6.2 Prop-based vs. video-based navigation

Students navigated through the materials either by the video clip or by the changes made to the prop. That is, one group of students would look for certain stage of prop change while another group would looked for certain moments in the video clip. Those who adopted prop-based navigation strategy experienced most problems using Material Set 2 where there was no support for the manual form of navigation. The screenshot below (Figure 9.7 on the next page) is the interaction profile of Student 5 who adopted a prop-base navigation strategy. The screenshot shows that the student had to navigate back and forth several times before being able to answer a question on the questionnaire.
On the other hand, when manual prop navigation functionality was provided (such as in Material Set 1 and 3), this group of students used the feature extensively. The screenshot below (Figure 9.8 on the next page) shows Student 11 (interacted with Material Set 3) using the manual prop navigation feature to flick between different prop views before answering a question. It also shows that, despite the material having the highest degree of synchronisation in this study, this student still wanted to manually navigate through the prop, as this mode of navigation supports the task of flicking between different prop views effectively.

A similar interaction profile can be seen with Student 2 who interacted with Material Set 1. However, as manual prop navigation was the only way this student can navigate through different prop view, this profile is biased towards this form of navigation. Nevertheless, it is interesting to see how Student 11, who had access to both means of navigation, had a very similar interaction profile to Student 2 (see Figure 9.9 on the next page).
Figure 9.8: Interaction profile of Student 11

Figure 9.9: Interaction profile of Student 2
This prop-based navigation strategy is in contrast to students who only relied on places in the video clip as navigation points. These students would have a much less complex interaction patterns. They are also the ones who perceived themselves to have very little problems when using the material. This indicates that support for video-based navigation had been implemented in each material set more effectively than support for prop-based navigation. A good example of this is the interaction profile of Student 8 (interacted with material set 3) who used the rewind feature only four times. When the manual prop view was used (twice), it was only to view the prop for an extended period of time and not as a navigational task. The interaction profile of Student 8 can be seen below:

![Interaction profile of Student 8](image)

9.7 High-level interaction patterns

So far, only the student’s navigational strategies have been analysed. This section will now examine those strategies in terms of their high level tasks that they were performing while navigating through the material. Particularly of interest are moments when the students are:
• Observing the material
• Navigating through the material
• Writing answers to the questionnaire
• Reviewing the material

9.7.1 Serialist vs. holist approach

When inspecting students' interaction patterns, the way students used the material appears to be independent of the set of material they interacted with. That is, there were no sets of material that had students who only used either prop-based or video-based navigation (as discussed above). The interaction log suggests that the approaches adopted were linked to each student and not to the material set, as there are no material set in which only one approach was adopted by every student who used that set. The way in which a student moved around the material also corresponds to how he/she tackled the questionnaire given. However, students' interaction patterns can also be categorised with respect to Pask's learning strategies (Pask, 1988). A student who has a serialist learning strategy would tackle an unfamiliar concept step by step and build up his/her knowledge sequentially. On the other hand, a student who adopts a holist learning strategy would prefer to first obtain a general overview of an unfamiliar concept and then make connections between different aspects of the concept with respect to this general overview by looking at some aspects in more detail. Consequently, the students' interaction patterns recorded in this study have been categorised into the serialist and holist profiles below.

Serialist Profile

Students with the serialist approach began by watching the video clip and, as soon as they have identified a relevant part of the clip, they either paused the clip and answered the related question(s) on the questionnaire or immediately rewound the clip to review that section. Students in this group moved through the video clip in a more orderly fashion and answered each question on the questionnaire in chronological order. The interaction patterns of Student 4, 7, 10 and 11 fitted the serialist profile. In many of these cases, the student did not get to the end of the video clip until the end of the session (if at all). This is in contrast to students adopting the holist approach, who often reached the end of the video clip much earlier on in the session (see below).
Holist Profile

Students who adopted the holist approach first watched the whole video clip and then reviewed smaller sections of the clip. These students answered the questionnaire by first answering any questions that they can while they were watching the clip, often missing out questions that required deeper reflection on the topic. These questions were answered when they reviewed the material. Consequently, students adopting the holist approach reached the end (or within 1 minute of the end) of the video clip earlier on in the session than students who adopted the serialist approach. The interaction patterns of Student 1, 2, 3, 5, 6, and 8 fitted the holist profile.

Overall there were four students whose interaction patterns matched the serialist profile and six that matched the holist profile. Table 9-3 summarises the approaches adopted by the students in this study.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Material Set</th>
<th>Approach Adopted</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MS2</td>
<td>Holist</td>
</tr>
<tr>
<td>2</td>
<td>MS1</td>
<td>Holist</td>
</tr>
<tr>
<td>3</td>
<td>MS2</td>
<td>Holist</td>
</tr>
<tr>
<td>4</td>
<td>MS1</td>
<td>Serialist</td>
</tr>
<tr>
<td>5</td>
<td>MS2</td>
<td>Holist</td>
</tr>
<tr>
<td>6</td>
<td>MS1</td>
<td>Holist</td>
</tr>
<tr>
<td>7</td>
<td>MS3</td>
<td>Serialist</td>
</tr>
<tr>
<td>8</td>
<td>MS3</td>
<td>Holist</td>
</tr>
<tr>
<td>9</td>
<td>Invalid Session</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>MS3</td>
<td>Serialist</td>
</tr>
<tr>
<td>11</td>
<td>MS3</td>
<td>Serialist</td>
</tr>
<tr>
<td>12</td>
<td>Invalid Session</td>
<td></td>
</tr>
</tbody>
</table>

Table 9-3: Summary of approaches adopted by students

9.8 Students' perception of vicarious learning resource

This section reports the results of content analysis of post-interaction interview sessions with the students on their perception of vicarious learning resource. The transcript of each interview can be found in Appendix H: *UCL Case Study Phase 2 – Transcript of Interviews.*
In general, students in the study perceived the vicarious learning resource that they had interacted with as positive, with many saying that the material would have been very useful if it had been made available to them before they had submitted in their coursework on DFDs. However, there were also some students who expressed concerns about capturing a student's work and making it available to other students. A detailed analysis of the students' perceptions of the material is given below.

9.8.1 Perceived usefulness of observing another student's tutorial

Every student who was asked what they thought about being able to see another student's tutorial commented that the ability to see another student's tutorial is very useful. This is irrespective of the set of material they interacted with. The following sub-sections discuss different categories of students' comments in detail.

9.8.1.1 Learning from another student's mistakes

A common perception among students was that the material allowed them to learn from other student's mistakes and this was perceived to be useful for the students.

"I think the ideal [version] will be good as well, but with this, I think you learn from the mistakes, what not to do. The good thing about this is it tells you what not to do and then tells us how to do it. Whereas if you just tell us how to do it, then we'll just copy that and not learning issues in other things." Student 10: Material Set 3

"Because you can look at what mistakes they've made and maybe it's something that I didn't really think about. So, it's another chance for me to learn about other people's mistakes so that I don't really make the same mistakes again." Student 9: Material Set 3

"Say if you have this common problem with that <student> you may not actually realise it or something but then realise just then that oh I've actually done the same thing as her or him." Student 11: Material Set 3

9.8.1.2 Directly relevant to coursework

Some students commented, more specifically, that the particular material they interacted with would have been very useful for them had they had access to it before they had submitted their most recent System Design coursework. This is despite the fact that the material only raised a limited number of relevant issues for the coursework.
“... it’s not so much about seeing another person’s tutorial, it’s being able to see the mistakes that other people make from their work ... and how it gets corrected and what the corrections are... Cause, having handed in my coursework, I know I’ve made some of those mistakes ...” **Student 7: Material Set 3**

“Yeah, I think I would have [used it if it was made available during the coursework week] because it would have helped us with like our DFDs and stuff... Because you know we have to do the coursework. Yeah, it might have come in handy for that to see where they make their mistakes so that we don’t make the same ones.” **Student 8: Material Set 3**

“Because like when I was just looking at that now, because I’m doing a coursework with DFDs I think that is like that’s helped me see what could might be wrong with mine, you know, because I have never done DFDs before so it’s like. I know it now that you have to think of everything from, not like I didn’t know this before the tutorial, but it’s sort of given me an example to see how like you can’t have sort of “input details” you have to have ... you don’t even need that because it’s not a system process, so you know, things like that. So I think even though I’m not doing exactly the same thing as that, it’s still helpful to see the sort of comments that you can make on her project. You know you can sort of apply them to your own, which is quite helpful I think.” **Student 5: Material Set 2**

### 9.8.1.3 Social issues of material

Some students also commented on the social value of the material. More specifically, they commented on how the material helped to boost their confidence by allowing them to see what goes on in another student’s tutorial. These comments indicate how interaction with vicarious learning material developed for this study can be considered as Legitimate Peripheral Participation in the community of students (see Chapter 2.3.5: *Wenger’s Community of Practice model*). In this case, the material can affect the self-identity and the practice of the student interacting with it.

“It gives you ideas of what like how you want to prepare yourself when going into a tutorial session because in the beginning she was flipping around and didn’t know where to start. So it makes you realize you should be prepared for it and know what you’re talking about ... because you’re going into these assignments not knowing, or expecting, like how much effort and how your work is going to turn out. So, it’ll boost your confidence and kind of help you out while going through the process I would say.” **Student 6: Material Set 1**
UCL Case Study – Phase 2

"I think it’s helpful in a way because then you can just sort of see the sort of things that will be said in a tutorial. But in a sense it might not be very nice for the student if they don’t want their tutorial shown to everyone else." Student 5: Material Set 2

This observation is consistent with those made by Lee et al. (1999) that one of the benefits of vicarious learning is social which results from "exposure to peer discussion [that] creates positive feelings of being part of a learning community" (see also Chapter 2.4: Pedagogic effectiveness of vicarious learning).

9.8.2 Willingness to share the experience

The student above (Student 5) raised an issue that is not uncommon among students in this study. While every student thought that the material was useful, not all of them were enthusiastic about having their own tutorial sessions recorded. Ironically, the feature of the material that the students find most useful – the ability to learn from another student’s mistakes – was the main area of concern when considering whether they would allow their tutorial session to be shown to other students.

“It would probably be quite embarrassing because I’ll say dumb things and people would laugh or whatever. But I mean, for example, say if it was ... I don’t know. It’ll probably be a bit embarrassing but I mean if it was like come in and look at that where you just don’t know who it is then I think it’ll probably be fine. Well, you don’t actually have to see the girl’s face in this and it would still be the same thing... It probably would but I mean to you it would but to them they would just see, o they make like ... Say if you make a really silly mistake like if you completely miss you miss a process out, an obvious process out, I mean sure you correct it at the end, but it’s just silly for missing the obvious process out in the first place. Which would be...I don’t know.” Student 11: Material Set 3

Another concern when considering whether to give consent to being recorded or not is the fear of plagiarism. Students were concerned that people viewing the material would have an unfair advantage over the person being filmed. However, this was only the case if the student being filmed had the same assignment as those viewing the material.

“I mean if they’re doing, if the coursework topic’s different to the topic that I’m doing, I wouldn’t mind [being recorded] at all because I mean if they can learn something out of the tutorial that we have that will be quite good, because I would like to like see their tutorials as well. But if they’re doing the same topic and if they had the chance to look at my tutorial, I don’t think I would ... no... But I mean if it’s
a different topic, a different coursework title I wouldn’t mind at all.” **Student 9:**

**Material Set 3**

One student (Student 8) did not want to be recorded at all, citing a combination of not wanting other people to see her mistakes and the general dislike of being recorded on film. However, the same student said that she would consent if the material can be anonymised so that people would not be able to recognise her.

### 9.8.3 Perceived problems with material

In this section, the problems that the students have explicitly stated as having encountered are detailed. These were derived from comments in which students have stated that they experienced a specific problem or suggested areas where the material can be improved. By analysing comments that explicitly and implicitly point to problems with the material, a complete picture of what aspects of the material the students perceived to be problematic is derived.

#### 9.8.3.1 Need better access to props

There were various comments concerning how access to props (i.e. the work of the student in the video clip) had been provided. There were some distinctions between the types of comments between students who interacted with different sets of material. Firstly, those students who interacted with Material Set 1 (manual navigation) complained that it was difficult for them to find the appropriate diagram for certain moments of the video clip.

"It says in the discussion, that means between the student and the... but they don’t really talk about the top level and that. They start talking directly from ... the first process. So I was looking for that but they start talking about the ... errors the physical and logical errors." **Student 2: Material Set 1**

"... Except for when you ask one two 2 process one and two. It was difficult to find in the beginning." **Student 4: Material Set 1**

However, when the props are time-synchronised with the video clip, students reported a different problem when accessing the prop. Namely, they had difficulty finding which part of the prop was relevant to the discussion. This was particularly the case, when the top-level DFD was concerned, as there could be many processes under discussion at any one point.
“Some parts, the last bits were unclear... as to what the corrections being made are. They're talking about process going from there to there, but you don't know which one is going from where to where.” **Student 4: Material Set 3**

“Sometimes it’s a little hard to understand what is going <on>. When I see the pages that she’s brought up the DFD. What actually is it that you’re discussing?” **Student 1: Material Set 2**

The problem of finding out which part of a diagram is relevant at certain moments are corroborated by the suggestions that students gave for improving the material. These concern the way in which the changes in the diagram can be made more obvious, thus highlighting the relevant area of the diagram. The suggestions ranged from using different colours for corrections made to the prop (Student 4 and 7) to being able to see the hand movements while the corrections were being made (Student 1 and 4).

### 9.8.3.2 Synchronisation of prop and video clip

As this study used three sets of material with increasing degrees of synchronisation between the prop and the video clip, it was perhaps reasonable to expect complaints concerning problems of synchrony between prop and video clip to lessen as the degree of synchronisation is increased. However, the interview data indicates that increasing the degree of synchronisation does not lessen the perceived problems of synchrony, but instead changes the nature of those problems.

**Manual vs. Synchronised Prop Access**

Firstly, some students who were given the manual mode of navigating through changes in the prop (Material Set 1) wanted to have the time-synchronised mode of navigation. This relates to problems that this group of students reported earlier, concerning the difficulty in locating the relevant diagram for the discussion in the video clip.

“Because if it is on the topic then I can compare it and listen at the same time and see what's wrong... Like he is explaining what's going on here and you can like see what you're saying according to what is <on the table>.” **Student 2: Material Set 1**

Showing the students exactly which diagram is relevant at which point seemed to the students to be the ideal way of solving this particular problem. Note that this was what the students thought would solve the problems – students did not interact with other sets of material other than their own.
However, conversely, some students who interacted with Material Set 2 (time-synchronised mode of navigation) wanted to be able to manually navigate through the changes in the props. This is well illustrated by the following comments from a student (Student 1) who was shown Material Set 1 having just interacted with material set 2.

“That’s what I was supposed to say because sometimes it was hard. I wanted to see. When I was hearing about the dialogue and I wanted to see go to different places and see the top level and then so that I could change and go to the top level and then see and go to the pseudocode and look at the different things in her work, so that I wasn’t controlled by the camera that <shows> you know what is already there. So that I could sort of ... go ... yes, yes, this is much better.” Student 1: Material Set 2

Timing
The video clip synchronises with the props by updating the webpage to display the appropriate prop when the video clip reaches a pre-designated section implemented via QuickTime™ web-link feature. The author of the material – in this case, the course tutor/lecturer – determines exactly when this synchronisation takes place. Students reported problems originating from this method of synchronisation. One of the problems was that the prop view changed when the students did not want it to.

“... when I was trying to answer the question about decomposition to authenticate student, like the screen kept on changing to data dictionary while I was actually listening to this bit, authenticate student, and I didn’t really know what was wrong with it and I kept clicking the authenticate student button to get this diagram and then it kept on changing to data dictionary.” Student 9: Material Set 3

“When I was trying actually, it just kept on changing when I was actually listening to something and look at a picture, it maybe didn’t want me to look at it or something... Say if I wanted to look at the “Forms” database and they were actually talking about data dictionary, well, or that just starts to display data dictionary, it won’t allow me to look at the thing I wanted to because it keeps on changing... So, it was kind of irritating. I have to pause the tape and then look at it. Whereas, somehow if you... In a way it’s good because it follows it through but it does that by taking control of what I’m looking at.” Student 11: Material Set 3

Another problem with this method of synchronisation was that searching for certain prop changes via the video clip was difficult for the students. This was because if the
student navigates to a point in the video clip that is after the appropriate web-link placement, the prop view will not update until it gets to the next web-link.

"...when I was moving, like just moving along using that bar <chapter facility>, I found that the pictures didn’t always match with what was being said immediately. Like it would eventually come up."  **Student 5: Material Set 2**

"It’s only when I was searching for it [prop changes] I found difficulty finding it...Yeah, No. Well, yeah, I was trying to search through this [chapter navigation] to find this [prop changes].”  **Student 3: Material Set 2**

### 9.3.3 Specific implementation problems

Some of the problems mentioned above can be attributed directly to the way the material has been implemented, i.e. web interface using QuickTime™ plug-in.

#### Web-link Locations

QuickTime™ web-link implements a one-way synchronisation of the video clip and an HTML page. Within the context of this case study, this means that when students move through the video, the prop view (in HTML) is updated. However, if the students move through the HTML pages, the video clip does not move to the appropriate point. This one-way synchronisation causes navigational problems for some students. Additionally, students who extensively used the Chapter facility experienced synchronisation problems when the web-link was placed before the Chapter tag — the appropriate HTML page was not loaded, as the video clip did not pass the web-link tag.

#### Navigation Buttons

The behaviour of QuickTime™ buttons for forwarding and rewinding the video clip was inconsistent with the expectation of the students. They expected the video to be forwarded/rewound much quicker than QuickTime™'s frame-by-frame progress through the video. In many cases, the student simply gave up using these buttons and used the direct manipulation interface instead.

The interview data showed that the problems with prop synchronisation stemmed from four different requirements of the students when navigating through the material.

Materials need to support the ability for students to:

1. navigate through the material via the different chapters of the video clip
2. navigate through the material via different stages of changes of the prop
3. determine which prop changes are relevant for certain parts of the video clip
4. determine which part of the video clip is relevant for certain prop changes

In summary, students need to be able to navigate through the material through a meaningful pedagogic framework in the video clip and the prop. Also, synchronisation of prop and video clip needs to be implemented in both directions.

9.9 Pedagogic differences between student's answers

Although it is not the goal of this phase of case study to study the pedagogic effect of the materials on the students' learning output, an inspection of the answers given by the students in this case study has revealed two categories of students who participated in this study. Firstly, there were students who understood the key concepts of dataflow diagrams by using primary and secondary courseware and were using tertiary courseware provide in this study to augment their understanding. The students gave explanations and justifications of their correct and incorrect answers. The second group of students had not understood the key concepts prior to their sessions. The answers given by these students were just copied from the graphics on the screen or even the actual words that were spoken in the tutorial.

9.10 Limitations of this study

While this study did gather some revealing data concerning how students would use vicarious learning material, it had a number of limitations. These are discussed below.

9.10.1 Questionnaire-driven interaction

Ideally, the study would find out how every student would interact with every kind of vicarious learning material. For example, a student using the material for revision of a particular area may use the material differently from another student who is using the same material to answer a particular question in a piece of coursework. Interactions with the material in every scenario would have to be observed in order to obtain a comprehensive account of the students' interaction patterns. However, this is not practically possible. Consequently, it was necessary to look at the students' interaction pattern while performing a particular task. Not only does this define the scope of the study, but also provide consistency in the goals of each student. To summarise, the use of the questionnaire in this study does affect the student's interaction with the material, but it also provides a consistent goal for each student during the interaction session as
well as defining a scope for the study so that it can be conducted within the time and resource available for this research.

9.10.2 User logging method

This case study has not been setup to effectively log exactly where the students navigate to within the material. However, it has managed to log approximate points where the students navigate to within the framework of the *chapters* within the video clip. This is sufficient for the purpose of this case study. However, a log showing where the students are in the video clip at one-second intervals would allow a deeper analysis of the students' interaction.

9.10.3 Granularity of investigation

This study investigates how students interact with vicarious learning material on an ‘intra-material’ scale. That is, how they use the material once it is in front of them and ready to use. What this study has not investigated is how the students will access materials if, as would be the case if CSVL is fully implemented, there is more than one set of material that they can or need to access. In order to investigate the student’s inter-material interaction patterns, it would be necessary to create a large array of materials and to index those materials in some meaningful ways that are consistent with the student’s pedagogic need. While this is relevant in terms of what is needed to provide comprehensive computer support for vicarious learning, it is outside the scope of this work. Additionally, an investigation into this issue was not possible due to the time constraint of a 3-year study. The issue of what needs further investigation in order to fully implement CSVL is discussed further in the final chapter of this thesis (Chapter 12.7: *Future work*).

9.11 Conclusions

Extensive analysis of students’ interactions with vicarious learning material and post-interaction interview data has revealed some key aspects of how students use vicarious learning material. Additionally, it has also revealed students’ perception of vicarious learning material in terms of its pedagogic usefulness. The findings of this study are summarised below.

Every student in this study extensively used navigational facilities to complete their task. Not only does this have implications for what kind of features will be required to
effectively support their navigational activities, but also, the fact that there were frequent navigational activities suggests that using tertiary courseware or, more specifically, vicarious learning material is more than just a vicarious experience of a tutorial. It seems that students who took part in this study had a more extensive learning experience than if they were just present at the tutorial and did not contribute to the discussion. While being present at the tutorial would present students with the opportunity to ask questions themselves, they would not be able to revisit parts of the tutorial (as they extensively did during this study) that they may find useful while completing a piece of coursework or revising for an exam.

In the literature review, the issue of the speed at which information is disseminated through audio and video was discussed in terms of how much slower these media convey information to students compared to written text. However, it was argued that this would not be an issue with vicarious learning materials as these materials fill the pedagogic gap that other materials cannot fill. The interview data from this study confirms this conjecture as students perceived vicarious learning material in this study to be pedagogically useful for them. Students’ comments were very positive with some (students) being able to see exactly how such materials can be of immediate use on the course. The only negative comments concerning the material were centred around some students’ concern about privacy of students whose tutorial sessions were captured. This mainly stems from the fact that the material captured moments when the students make mistakes and some said that they might be embarrassed if others can see their mistakes on the course.

In terms of the how the students use the material itself, this study observed interaction patterns that can be categorised into the following schema.

- **Chapter vs. Direct-Manipulation interface preference**: Students can be divided into two distinct groups with one preferring to use the *chapter* interface and the other preferring to use the direct-manipulation interface for their navigation activities.

- **Serialist vs. Holist approach to using the material**: The study has observed that each student’s interaction pattern can be categorised as fitting either a serialist or holist profile. The observation is consistent with Pask’s (1988) learning strategies.
**Prop-based vs. Video-based Navigation Strategy**: The final schema for categorising students in this study is more subtle than the previous two schemas. It concerns how the students determine where they want to move to in the material. This activity is often triggered by a need to see a certain part of the tutorial or a certain stage of the prop (the coursework). One group of students completed this task by thinking of where they wanted to go to in terms of the appropriate location within the video clip. However, another group of students did not think of where they wanted to go to in terms of the positions within the video clip, but in terms of the stages of the changes in the prop. The distinction being made here is that there was one group of students (prop-based navigators) who required additional navigational support, so that they could navigate through the materials via the changes in the prop, rather than solely via the video clip navigation feature.

The distinctions made above lead on to a consideration of how the props – in this case the student's coursework – should be presented to the student. The study is conducted within the context of two systems that implement prop presentation at two extremes of synchronisation. This study finds that manual synchronisation (no synchronisation) supports students who adopt prop-based navigation strategy while full synchronisation better support the activities of students adopting video-based navigation strategy. Despite the two extremes of requirements, it is possible to implement materials that will support both strategies of navigation. The requirements can be satisfied by fully synchronising props to the video clip as well as providing a navigational structure based on stages of prop changes through which the students can navigate. A possible way to implement this, using the system in this case study, is to use the *chapter* facility to flag where and what the changes in the props are, so that when the students view the prop via this interface, the video also moves to the appropriate location in the clip.
Chapter Summary

This chapter has revealed, through extensive analysis of students' interaction with vicarious learning material and post-interaction interview data, some key aspects of how students use vicarious learning material. It has derived three schemas through which students' interaction can be categorised. These are

1. *Chapter* vs. Direct-Manipulation interface preference
2. Serialist vs. Holist approach to using the material
3. Prop-based vs. Video-based navigation strategy

Such findings have implications in the way materials should be presented to the students, especially in terms of how prop views should be implemented. Additionally, the study has also revealed that students perceived vicarious learning material to be pedagogically useful for them. However, some students were concerned about issues of privacy and plagiarism arising from the production and use of such materials.
Implementing CSVL in the Real World

Introduction

This chapter investigates the real-world issues when implementing CSVL. That is, it aims to fill in the knowledge gap of what issues are raised when an implementation of CSVL is attempted in higher education. The main contribution of this chapter is the identification of real-world problems facing a CSVL implementation in higher education. In particular, it aims to highlight factors that can affect a successful implementation of CSVL. The main areas of concerned are:

- Practicality of capturing learning activities for creating effective vicarious learning resource
- Practicality of producing effective vicarious learning resource
- Socio-cultural issues when capturing materials
- Privacy and legal issues when implementing CSVL

This chapter concludes that successful implementation of CSVL is not only dependent on technical efficiencies, but also an effective overall technical and organisational design that considers the relevant HCI usability factors and socio-cultural issues that have been encountered in this study.

10.1 Context of study

All the case studies for this research have so far only looked at technical production variables that can affect the effectiveness of the material produced. However, effectiveness and efficiency of a system do not only depend on its technical integrity. System effectiveness and efficiency are often affected by human behaviour and problems often arise when the system requires those using it to breach certain established norms such as behavioural, cultural and evaluative norms within the organisation.

10.2 Study goals

The aim of this case study, therefore, is to investigate what human factors can influence a successful implementation of a CSVL system in a higher education setting. It aims to identify what obstacles an educational practitioner may face when attempting to capture and produce vicarious learning material from real-world situation and environment.
10.3 Capturing real-world dialogues

Diagram construction is a major part in the syllabus of computer science and information technology students. Each year, students find it difficult to learn how to construct system models such as Entity-Relationship (ER) or Unified Modelling Language (UML) diagrams. To help the students, many lecturers show common mistakes in diagrams constructed by students in previous years. But since the process of constructing such a diagram involves more than the finished product can communicate, most students acquire the ability to construct such diagrams only after several attempts of their own, with feedback from the lecturer. This type of feedback – delivered 1-to-1 or in small groups – is very demanding on lecturers’ time. To get more learning revenue from this time-consuming process, the tutorial sessions were captured as digital videos, and integrated into course notes and online computer-aided assessment (CAA) system. In effect, students who are not present in the tutorial can vicariously learn the same material and more through this setup. Students can also acquire necessary skills by observing one of their colleagues constructing a diagram or, more often, by collaboratively constructing the diagram as a group. Additionally, if dialogues between the student(s) and the tutor/lecturer can be captured during an attempt at constructing a diagram, students who were not present will not only see the resulting mistakes, but also how and why those mistakes came about in the first place and, of course, the reasoning behind constructing the final correct diagram as well. Hence, this particular case study looks at how best to produce digital video-based (DV-based) vicarious learning materials for teaching diagram construction in the field of computer science and what kind of problems lecturers face when producing video-based vicarious learning material for such a course.

10.4 Empirical setting

The setting for this case study is the tutorial environment for the course B160 Information Systems Analysis and Design run by the Computer Science department at UCL. Students on this course often have group or individual tutorials with the lecturer and tutor so that problems concerning their coursework can be addressed. The students can pre-arrange a time for the meeting or just turn up and see whether the lecturer/tutor is available to see them. Consultations take place either in an open-plan shared office of the tutor, or in the lecturer’s individual office. For practical reasons, this study investigates at how materials can be captured when tutorials take place inside the
lecturer's office, as conducting this study in a shared office would disrupt the work of other research students also working there. As noted earlier in this chapter, this course already makes use of teaching methods consistent with tertiary courseware usage where students learn from the experience of other students. However, materials used in these instances have never been captured for use as tertiary material. Therefore, this setting provides the ideal environment in which to study issues affecting successful implementation of a CSVL system.

10.5 Study setup

Based on the list of production variables that have been derived in the literature review chapters (see Chapter 2.8: Implementations of CSVL and Chapter 3: Background to Video-based Material Production), a lecturer's room was setup with three digital video (DV) cameras, one electronic whiteboard and three microphones. Two Intel-based PCs were also used for post-production video editing. At this point, the total cost of the system was under US$10,000. While it had significantly less functionality, this setup was only one tenth of the cost of eClass. Below is a list of key components of the system:

- 3 digital video cameras
- 1 MIMIO™ electronic whiteboard
- 1 Intel-based PC configured for DV-editing
- 1 Intel-based PC configured for whiteboard content capture
- 1 high quality omni-directional microphone
- 2 lavaliere microphones

It is worth noting that this case study was conducted in parallel with other case studies in this research. The study is actually the first study of this research but, as data collection took place over a period of two and a half years, it was also the last study to finish. Consequently, the initial setup (given above) for capturing materials did not benefit from hindsight following findings from other studies in this research.

10.5.1 Video configuration

The following video configuration was derived from the literature review pointing to the fact that tutorial sessions are very similar to TV interviews from the television production point of view. TV production principles indicate that in order to effectively
capture the situation a three-camera production is required. Consequently, three DV cameras were setup inside a lecturer’s office, where most tutorials took place. This enabled productions with the following camera angles without the need of any cameramen:

- **Camera 1**: Wide Angle shot
- **Camera 2**: Over shoulder shot of lecturer (student’s view)
- **Camera 3**: Medium close-up shot of student (lecturer’s view)

From this setup, it was possible to produce not only a three-camera production, but also two and one camera productions by omitting camera 3 and 2, respectively. Figure 10.1 shows how the cameras have been positioned in order to achieve the above camera angles.

![Initial camera setup](image)

**Figure 10.1: Initial camera setup**

10.5.2 Access to props

One of the main complaints that students had with the one-camera production in the initial study (see Chapter 3.5.1: *Initial study: perceived quality is important*) was that it was difficult, if not impossible, to see what was being written on the whiteboard. To solve this problem, an electronic whiteboard was installed in the lecturer’s room. The model that was chosen, MIMIO™ (http://www.mimio.com/), captures what is written on a conventional whiteboard by tracking the movement of pens that emits ultrasonic signals when something is written on the board. This was chosen over ‘standard’
electronic whiteboard because it is very portable (can be used on any conventional whiteboards) and has a much lower overhead cost of the equipment ($400 per unit). Additionally, a flatbed scanner and a digital camera were used to capture any relevant materials written on paper. The images captured by this method would sometimes require enhancement to improve readability – this was done through ‘Whiteboard Photo’ software from PolyVision (http://www.websterboards.com/products/wbp.html).

10.5.3 Audio configuration

Although this study does not investigate how varying audio quality affects the effectiveness of the materials as vicarious learning resource, the decision was made to try to capture audio at the highest quality level possible, so that problems concerning audio quality in the materials can be minimised. Furthermore, if the material is to be used in a real-world situation, it will have to be streamed over a network, which will result in significant deterioration of sound quality from the original. Consequently, audio needs to be captured at high quality to minimise the deteriorating effects of streaming over a network.

When choosing microphones to capture audio, there are three main types of microphones available; boom, lavaliere and the camera's built-in. A decision was made to use lavaliere microphones for three main reasons:

1. Lavaliere microphones do not require an operator
2. Lavaliere microphones do not pick up as much natural ambience sound as boom or the cameras’ built-in microphones. This is important as there are a lot of room noise (relative to a studio) coming from the window and the computers in the room.
3. Lavaliere microphones are easier to place correctly than boom microphones, which need to be accurately aimed at the speaker(s). For this reason, omni-directional microphones have also been chosen as unidirectional microphone will not pick up sound properly if placed the wrong way round. Directional microphones also have the various problems including off-axis response, proximity effect and lack of low-frequency pick-up.
Condenser microphones were used as these are more sensitive than dynamic microphones – dynamics microphones are useful for recording loud noises in ‘hostile’ environment, i.e. dynamic microphones are much more rugged.

As well as correctly setting up the microphones, the following issues will need to be addressed in order to ensure high quality sound recording for the production: room acoustic and cable interconnects. However, these are trivial when compared with setting up microphones where mistakes can be costly in terms of quality and time needed to sort out the problems.

10.6 Data collection methods

Methodology and data collection methods used in this case study are derived from HCI evaluation methods. Such approach is effective when focusing on the human factors influencing successful implementation of a system in an organisation. This is of particularly concern with CSVL, as such a system can significantly influence or be influenced by the teaching and learning practices of an educational institution, both from the point of view of the lecturers/tutors and the students. Three data collection methods are used in this case study to collect data on the user experience of using and being part of a CSVL system

1. **User observation**: This is the primary method used to document the experience of all parties involved. The observation aims to record instances where the norms of those involved are violated by the system and the consequence of the violation to those involved. Additionally, observation would allow these violations to be observed within their context, enabling supplementary data to be collected (if necessary, through another more appropriate data collection method). Through this method, as opposed to more rigid methods such as data logging, the study can be more flexible about documenting issues that arise through norms violations. This is consistent with the overall exploratory approach of this research.

2. **User diary**: This is used to document the experience of lecturers/tutors creating vicarious learning materials. The log aims to record problems faced by the producer of vicarious learning material and how those problems are solved (if they are actually solved).
3. **Stakeholder interviews:** This is used to complete the interview data from phase 2 of the UCL case study on the user's experience of a CSVL system. In this case study, the interviews are focused on the possible use of CSVL from the lecturer's/tutor's point of view.

Phase 2 of the UCL case study concentrated on the technical or 'hard' side of analysing how students will interact with vicarious learning material. However, this case study focuses on finding the human factors that can affect a successful implementation of a CSVL system. For this study, the following types of tutorial were captured:

- **Individual tutorial:** student receives a 1-to-1 tutorial with the lecturer/tutor. This study has captured tutorial sessions held by both lecturers and tutors.

- **Group tutorial:** usually 4 or 5 students meet with a lecturer/tutor to discuss a group assignment. This study has captured such sessions with two tutors.

What follows in this chapter are the findings of this case study. To aid readability, the findings are grouped in terms of the issues they relate to (as opposed to being grouped by the method by which each finding is derived).
10.7 Pedagogic issues

10.7.1 Capturing experiential knowledge level activities

For a small group discussion (1 lecturer and 2 students), written materials were often discussed on paper and not around a whiteboard as in the materials in the Dissemination tutoring system. Students presented works that they have done previously on paper (and not on the whiteboard as was the case in the initial study) and discussions and amendments centred around the pieces of paper on the desktop. Desktop and surrounding cameras were not able to get a good angle on what was written on the paper—even at close range both physically and through zooming. It was very difficult or impossible to make out what was being written on the pieces of paper.

Why was the whiteboard not used in this instance? While the video clips in the Dissemination tutoring system showed a tutor and student discussing a concept around a whiteboard, in tutorial sessions during this study, students brought along half-completed coursework which they have done on paper. Consequently, the majority of discussions took place around the pieces of paper that the students brought along with them. This also meant that any amendments made to the students’ work were on those pieces of paper. As a result, there were no discussions around the whiteboard, as was the case in the tutorial sessions captured by the Dissemination tutoring system.

A consequence of having this tutorial environment is an additional requirement for CSVL systems to be able to effectively capture the experiential knowledge level activities when those activities are not conducted around a whiteboard. The technical problems and solutions of capturing the experiential knowledge level activities when they are conducted around the students’ paper-based coursework are discussed later on in this chapter (see Chapter 10.8.5: Capturing handwritten material).

10.7.2 Unscripted dialogue

Unscripted dialogues often took time to get going. There were often periods of silence when discussion materials, such as problem sheets or student’s work, were being read or inspected by the lecturer or other students. Trivial or off-topic discussions also took place. This was not a problem in itself as the aim of this study is to capture real-world dialogues as opposed to scripted ones. However, when off-topic discussions do occur,
those moments in the session will require time to edit them out of the final production, as they do not have obvious pedagogic value.

10.8 Technical issues

10.8.1 Production setup

There were many problems in setting up the room for capturing the tutorial sessions. Many of which derived from the initial aim of this research to produce good quality production with respect to standards set in the broadcasting industry. However, the following problems were most significant when capturing real-world interactions:

- **Lighting**: the room has not been specifically lit for video production. The camera cannot be pointing towards a strong light source, e.g. window. However, this problem can be turned around by using the light from the window and the room to light up the participants of the tutorial sessions. Such setup has been effective in lighting the participants in this study.

- **Background Noise**: as predicted, there were some background noises from the computers in the room, but dialogue was still clear, even when students were murmuring. Nevertheless, this study found that background noise was greatly reduced if computers with loud cooling fans were turned off during the tutorial.

- **Sound quality**: When the built-in microphone was used, the camera needed to be very close (within two metres) to the students for the best audio pick-up performance. However, this meant that cameras needed to be placed in locations where they would get in the way of the lecturer in the room if the equipment was not packed up after use (this was not the case when framing the picture to get the right kind of shot, as the cameras could zoom in from a distance). To setup the equipment every time it needed to be used was impractical, but leaving the equipment out was also inconvenient for the lecturer. Additionally, each time the equipment needed to be setup, there were many areas in which the equipment can be setup incorrectly. Consequently, when equipment cannot be setup permanently, it is vitally important that equipment used is easy to setup correctly and effectively.

- **Interruptions**: Telephone calls and people entering or leaving the room sometimes interrupted the session. These could be edited out of the final production, but required more time and attention from the lecturer.
• **Multiple Microphones:** If the tutorial sessions were to be captured in the form of an interview programme using a TV production setup, then multiple microphones would certainly be used. However, this study finds that there were many problems associated with using multiple microphones. Multiple microphones could cause the following problems which would be difficult for a lecturer with no technical support to solve:

- Cancellations and hollowness when both microphones are picking up the same dialogue, but at very slightly different time.
- Phase errors when microphones are wired in the opposite polarity.

For these reasons, it was decided not to use multiple microphones, whose audio streams also require post-production mixing. While the use of multiple microphones would have resulted in better audio quality in the final production, the effort required from the lecturer was significantly greater than when only one microphone was used. Consequently, a single high-quality omni-directional microphone would be more appropriate as this requires very little attention during setup and usage.

10.8.2 Video editing

Materials needed to be edited to create vicarious learning materials that are pedagogically effective and efficient. However, there were some significant problems in carrying this out in real life. Firstly, off-line editing of dialogue was extremely time-consuming. TV studios perform real-time (live) editing, but to do this at UCL would mean having technical support every time material is authored. This is costly as well as impractical. While off-line editing does allow very precise (frame-by-frame) control of the editing task (such as switching between video-streams and transition-timing), when creating material for this research, the task that was performed most often was switching between one video-stream to another. Current video-editing packages require the user to precisely define and place these ‘transitions’ on the timeline. While this ‘stop-go’ method is efficient for precisely placing and defining these transitions, it is also very time-consuming compared with what is normally performed when switching cameras in live productions. On these occasions, the camera angles are changed with a press of a button, defining which camera is ‘live’ at a particular moment. It is this fast
and simple ‘live’ mode of editing that is required when producing in-house vicarious learning material.

Additionally, it was not possible to capture to hard disk from multiple cameras at the same time. This was a significant problem when more than one camera was used in the production, as any additional camera required more time in post-production to transfer to computer (see Chapter 10.10.1: Transferring material to hard disk for editing). This poses a design dilemma, because in some situations more than one camera is required to effectively capture the situation (see Chapter 8: SJU Case Study – Phase 2). Consequently, the decision to add another camera should only be taken when it is necessary to ensure the pedagogic effectiveness of the material.

10.8.3 Stability of video editing software
The current range of DV-editing software does not interface reliably with DV cameras, especially with cameras in the home and semi-professional price band (under US$1,500). This did not seem to be limited to just one particular software or hardware on the PC platform. Adobe Premiere 6 crashed very often (well documented trait on the Adobe’s own website) and some DV cameras interfaced with software more effectively than others. Consequently, such a setup is not at all suitable for use in educational environment as a lot of time could potentially be wasted with dealing with the unpredictability of the setup. The exception to this was Apple’s iMovie, which was the only program that showed true plug-and-play characteristics. However, iMovie did not support editing of multiple video streams. This feature was required in many of the settings in this research where more than one camera angle was necessary.

Additionally, there may also be issues concerning the reliability of DV hardware. During the course of this research, two out of four DV cameras failed – no tapes can be viewed or recorded using those cameras. Admittedly, the cameras have been used much more extensively than they would otherwise have been for domestic purposes.

10.8.4 Viewing whiteboard contents
Using the MIMIO™ whiteboard
The MIMIO™ whiteboard managed to capture written contents on the whiteboard (when the whiteboard was used – see discussion above) with sufficient detail. Images captured by the whiteboard could be easily saved as JPEG or GIF files for incorporation
into the material during the editing process. However, contents captured by the MIMIO™ whiteboard are not captured with real-time timing information. Instead, the sessions are divided into moments when changes are made to the whiteboard, exactly when (in minutes and seconds) those changes are made are not recorded. Consequently, MIMIO™ whiteboard sessions cannot be synchronised with video streams making real-time viewing of changes and activities around the whiteboard impossible.

Using a DV camera
When whiteboard contents were captured using a DV camera, the quality of the original DV video was good enough to just make out what was written on the whiteboard when viewed on a 20” TV monitor. However, there is significant degradation in video quality when encoding into RealMedia format and viewing on a computer monitor (even at full-screen). Although videos encoded in Windows Media showed less degradation, it was still difficult to make out words and structures written on the whiteboard.

In terms of camera setup, capturing written materials and interactions around them present the need for an additional camera angle not usually seen on TV productions of interviews or discussions. In television productions, another camera or camera angle are used to capture the handwritten materials by zooming in on either the whiteboard or the piece of paper. This is sufficient and effective as the combination of size and resolution of the resulting video when shown on a television screen is high enough for the content of the whiteboard (or paper) to be visible and legible to the viewer. However, this is not the case if the same video is converted into streaming media that need to be streamed over a 256kbps or even a T1 LAN connection and displayed on a computer monitor. The streamed video has lower resolution than the original DV file and often contains pixel corruptions that make the content illegible. Additionally, the size of the video is greatly decreased due to limitations imposed by bit rate and video compression codec, making the content illegible even when the resolution of the video is maintained from the original. This study finds that the practice of using a camera to capture written materials by TV productions is not appropriate in this case and other methods should be used to capture these activities. Earlier, this study reports that students did not want to use the whiteboard to show their work and preferred to present their work on paper instead. Ironically, this proves to be easier to capture in this study, as the next section will detail.
10.8.5 Capturing handwritten material

When students' work is presented on paper, the problem of capturing the material is non-trivial, but is more easily solved within the context of this study. In order to capture the work and make the content legible, two approaches can be taken.

Using a DV Camera

A DV camera can be used to capture the content at high resolution so that the decrease in resolution after conversion to streaming media can be compensated for. The result of this was mixed. While it was possible to statically capture hand-written diagrams with sufficient clarity to ensure on screen legibility (with the aid of 'Whiteboard Photo' software), it was difficult to capture small texts and changes that were applied to the material as they happened during the session. Often, the tutor suggested changes or made changes himself/herself to the initial material. When the changes were being made, because of hand movements across the paper or the whiteboard, the pixels that represented the words or diagrams were blurred as the compression algorithm tried to capture as much of the changes as possible, while using as little memory as possible. Figure 10.4 (on the next page) shows the blurring of printed text when using a DV camera to capture the content. Moreover, there was the difficulty in placing the camera so that it could capture the material without being obtrusive.
Using a Scanner and Screen-capture Software

In order to overcome problems concerning material legibility caused by insufficient DV camera resolution, another approach to capturing handwritten content involving the use of a scanner and screen-capturing software was adopted. In this setup, the original material was scanned into a computer as graphics files (or the original electronic version emailed to the tutor), which can then be edited by using a pen-based pointing device during the tutorial session. The initial stage of the material and the subsequent edits can then be captured using a screen-to-AVI program, such as TechSmith’s Camtasia. This method allowed the changes made to the student’s work to be outputted as either graphics files or as a high-resolution AVI video file, enabling materials to be legible throughout the captured session and, when outputting a video file, results in a much smaller video file of the captured material (when compared with AVI files created via a DV camera). The student and tutor could make changes to student’s work using a pen-
based pointing device, while all of their on-screen and off-screen activities could be captured by the software and DV cameras respectively. The resulting graphics files were synchronised with the video clip of the tutorial as implemented in phase 1 and 2 of this case study. On the other hand, when changes to the student’s work and the dialogue in the tutorial were captured and presented as two video files, the synchronisation of the two video streams were implemented as a similar web interface (to those in this study) using Synchronized Multimedia Integration Language (SMIL).

10.9 Social-cultural issues

10.9.1 Students’ perspective

While capturing dialogues for creating test materials for phase 1 and this case study, some significant social-cultural issues were encountered. The most serious problems originated from the students whose tutorials were to be recorded. Often, students were reluctant to consent to having their tutorials recorded (see Chapter 10.9.3: CSVL and the Data Protection Act for further discussion on consent). The main reasons given were:

1. Students said that they did not want their colleagues and especially, students from more junior years, to see them making mistakes. Some students did not think that they had completed enough work to present it to other students. In either case, it was the students’ perceived low quality of their work that hindered them from giving consent to having their tutorial sessions captured. Some students who had this concern were persuaded to give their consent by explaining that, although they might be seen as making mistakes, by the end of the video clip, they would be seen as competent and as possessing the required skills to obtain a good grade. Some students, however, would still not give their consent even after receiving this explanation.

2. Some students had a religious belief or faith that did not allow an image of them to be represented in pictorial form. No attempt was made to persuade students who gave this reason to give their consent, but they were asked to elaborate their reason.

Although these issues did not cause problems in terms of technological implementation of CSVL, they did present a very significant obstacle in creating vicarious learning materials. In some cases, in order to create pedagogically effective vicarious learning
material, mistakes by students need to be captured in the material (see Chapter 10.11: CSVL: A tutor’s perspective). The observation of the transition from mistakes or incompetence to model answers or competence forms the central part of vicarious learning materials. It is not possible under the Data Protection Act to create vicarious learning materials without first obtaining the consent of the participants or anonymising the material. However, interview data from phase 2 of the UCL case study indicates that students are more willing to give consent when tutorial sessions of other students are also captured. Consequently, if a CSVL is to be implemented in the real world, it is important to ensure that organisational structure has been put in place to obtain consent from the students at the beginning of the course or academic year. This could be as simple as the departmental office providing a form for the students to sign in order to give their consent for their tutorials to be captured and used as tertiary courseware. However, consideration should also be given to those students who do not consent. That is, while it is possible to argue that such students are contributing less to the course as a whole, their refusal to give consent should not put them at a disadvantage to those who did consent (see Chapter 10.9.3: CSVL and the Data Protection Act for a further discussion on consent and privacy).

10.9.2 Lecturers’ and tutors’ perspective

In addition to issues raised by the students, there were also similar issues raised from the lecturer/tutor’s point of view.

During some tutorial sessions, concerns were raised about the fallibility of lecturers or tutors. In one captured tutorial session, the lecturer was concerned about how effectively she has resolved a misconception by a student – although the misconception was successfully corrected, she felt that the misconception could have been dealt with more effectively. She made a comment during the session, "Is all this going to be shown to everyone?"

After the session, while the lecturer had not actually made a mistake, there were concerns about how recording tutorial sessions can make mistakes permanent as well as available for scrutiny beyond those who were immediately present in the tutorial. A course tutor, whose group tutorials were captured, echoed this concern. In these tutorials, the students came to him with problems with their coursework, but the nature
of these problems were not known to the tutor before the tutorial. The tutor said that he felt that he had to be at his best all the time when a session is captured. Consequently, this puts him under pressure that he may otherwise not have been under if the tutorial sessions were not recorded.

During this research, this issue was not critical to the success or failure of capturing materials, as all lecturers and tutors involved knew that material captured will only be used exclusively for this research. Additionally, although they did not edit the final material themselves, they had full control of the content of any material that was kept for research purposes. However, it is possible that if CSVL is implemented in the real world, such issues may prevent some lecturers, who are less keen on adopting new forms of courseware authoring, to implement CSVL in the long term (if at all). It may indicate the need for those who are part of the CSVL system to feel that they have control over the content of the material being produced. This stresses the need for the capture, editing and production process to be as efficient as possible so that it is practical for lecturers/tutors to produce the material themselves rather than relinquish control of the material’s pedagogic content to a multimedia technician as a result of the process of courseware production being too complex and/or time-consuming.

10.9.3 CSVL and the Data Protection Act

Some students gave their consent on the condition that the material is anonymised. The students’ concern with their privacy is consistent with observations of users of multimedia communication technology (in Adams, 2001). Often, text-based material can be anonymised either by deleting personal references within the text or omitting the names of the participants in the dialogue. This kind of anonymisation usually has little effect on the pedagogic content or the usability of the material itself. However, in video-based vicarious learning materials, anonymisation is much more disruptive, also requiring more skills and effort. The easiest way to anonymise students in the video is to blur out the students. However, they may still be identifiable by their vocal characteristics such as voice pitch or accent. Adams (2001) identified that such audio stream can contain data about the users that they might not want to be recorded or transmitted. Additionally, there may be implications concerning the pedagogic effectiveness of the material as blurring out half of the interaction activity may result in incomplete capture of the experiential knowledge activities of the Laurillard framework.
Students who took part in this research appeared not to be as sensitive about what data was being captured about them. However, this could be largely due to the fact that the vicarious learning material produced was only made available to participants of research studies and not to a wider audience. Students in this study may perceive a greater risk for the invasion of their privacy if the material is made available to a wider audience, putting such material at greater risk of being misinterpreted or misused (Adams and Sasse, 2001).

Consequently, before any materials can be captured, it is preferable to obtain the consent of the students (both student and tutor) for their tutorial session to be captured and used as vicarious learning materials without the need to anonymise the participants (as opposed to students giving consent, but also demanding that they are anonymised). This requires each student to understand exactly what the captured session will be used for. If the student consents, then the post-production editing process is greatly simplified. It was at this stage of creating vicarious learning material that problems concerning socio-cultural issues were discovered. Although not directly related to technological aspects of creating vicarious learning materials, these issues are critical to the success or failure of a CSVL system, should one be implemented in the real world.

10.10 Logistical issues

10.10.1 Transferring material to hard disk for editing

Even when materials have been captured successfully, there are logistical issues that need to be resolved. As all materials were captured on DV cameras, after each captured tutorial session, a significant amount of time was required to transfer those materials onto hard disk for editing. For a 1-hour tutorial, using one video camera, a further one hour is required for the transfer. The situation worsens when there is more than one camera. For example, a 1-hour tutorial using three cameras would require a further three hours for transferring all video clips to hard disk. A possible solution to this problem is to record video directly to hard disk. However, such a setup will require a large amount of disk storage space if several tutorials are recorded before being editing into their final forms. This problem is discussed in the next section.
10.10.2 Required amount of disk storage space

Digital video takes up a large amount of disk space. A one-minute video clip in full-DV resolution requires about 220 MB of storage space. Taken in isolation, each video clip does not cause many problems in terms of storage requirements. Additionally, the final edited video clips that are presented to the students can be encoded as DV, but via mpeg4, DivX or other more lossy codecs that requires significantly less storage space. However, video clips encoded using these codecs cannot be easily edited, as any change in the clip requires the clip to be rendered (a time-consuming process) before those changes can be seen or inspected. Storage space problems arise during the editing process, where DV encoded files are used as source videos for editing. Editing a 1-hour tutorial session captured with 3 cameras will require around 45 GB of free disk space to store three hours of DV. So if the lecturer wants to store more than one tutorial (for example, six 1-hour sessions) on the editing machine at any one time, a video-editing workstation with a 270GB hard disk for storing those footages would be required. This is currently significantly more storage than the average high-end workstation on sale today (2nd quarter, 2003).

10.11 CSVL: A tutor's perspective

While studying the capture and production of vicarious learning materials, whether as an experiment or a case study, there was one process that consistently took place when materials were created, which may not have taken place if the tutorial sessions were not being captured to create vicarious learning materials. This process was the tutor’s discovery of the cause of the misconceptions in the students’ misunderstandings. It is important to highlight the fact that this process actually took place, as it was a fundamental process in creating effective vicarious learning material during this research. When conducting tutorials for students on the B160 course, in order for students to effectively learn vicariously to avoid the mistake made by the student in the material, they needed not only to be able to see the other student’s actions (corrections and amendments), but also to understand why those misconceptions happened in the first place. This was achieved by probing deeper into and identifying the source of the student’s misunderstanding, when conducting tutorials for creating vicarious learning material. Many students on this course (more than a quarter), through their misconceptions, arrived at conclusions (in this case, DFDs) that they knew to be wrong, or at least not totally correct. However, since they did not know how else they could
externalise their design, they did not revise their flawed conclusions. However, when students were shown how such misconceptions came about in the first place, they were able to identify misconceptions in their own designs, enabling them to amend their conclusions accordingly.

For this reason, while capturing material for this case study, it was necessary for the tutor to probe deeper than usual into why the student made the mistakes that he/she did. If the misconceptions are not explained from the student’s point of view, the resulting courseware is just an extension of primary courseware, i.e. the material will contain “how not to do it” and will then be followed by “how to do it”.

10.11.1 Vicarious learning and phenomenography

The concept of exploring a student’s misconception may not only serve the purpose of creating tertiary courseware. The processes of exploring and categorising how students experience learning are fundamental to the phenomenographic research methodology (Marton, 1981), whose focus is on the variations in ways students experience a certain phenomenon in a certain context. It is possible for the tutor, after conducting individual tutorials with a number of students from the course, to recognise a pattern in the different ways in which students have understood or misunderstood key concepts. Additionally, as a phenomenographic study categorises events in terms of the students’ variations on how they experience a phenomenon (Marton and Booth, 1997), it may be feasible to suggest that such categories can also be used to categorise vicarious learning materials (as opposed to categorising them using the curriculum structure which may or may not reflect how the students have experienced the course). The issue of tagging vicarious learning with appropriate metadata is discussed further in Chapter 12.7.2: CSVL and educational metadata. A short account of an instance in a tutorial session where a student’s misconception is explored further is given below.

10.11.2 Personal note

As a result of exploring the misconceptions of various students on the same topic, I was able to discover many reasons for students’ misconceptions and erroneous actions in their coursework – often the reason behind the misconceptions was completely unpredictable.
For example, during a tutorial session, one student gave a very logical description of her steps in constructing data-flow diagrams based on her understanding of the lecture notes. Unfortunately, this resulted in her producing a diagram that repeated exactly the same mistake – mixing logical and physical level of system description – that was made in a sample diagram of common mistakes given to the students before the coursework was set. Knowing this was a mistake, she still stuck to her original diagram, as it was the only way she could conclude the diagram should be. In this case, the student understood all the notations she required for DFD construction: more specifically, the concept of having to differentiate between logical and physical processes and that these two different types of process descriptions cannot be mixed in one DFD. The main problem was her conception of what is logical and physical was different to my own (the tutor’s). For her, “Input UserID & password” was a logical process, as it did not specify how the “UserID” and “password” were inputted (e.g. type “bob”). However, for me “Input UserID & password” was a physical process of the user – her system did not “Input UserID & password”, it transformed the dataflows “UserID” and “password”, e.g. “Authenticate UserID & password”.

The reason for the student’s misconception would have remained unknown to me, and other students who would access the tutorial session, had I not probed further to find the reasons behind her misconceptions. If that had been the case, then the resulting material would show the student’s work, the error in the student’s work and how to do it correctly. This is nothing more than once again returning to the classroom and showing the students “how not to do it”, “how to do it” and then the vicious cycle continues.

10.11.3 Laurillard Conversational Framework revisited

This concept of exploring the student’s misunderstanding is already present in the Laurillard Conversational Framework. At the conceptual knowledge level, the student describes his/her understanding of the concept back to the lecturer (stage 2) and then the lecturer re-describes the concept to the student after reviewing the student’s description of the concept (stage 3). It is possible to argue that the process of exploring the reason for the student’s misconception is implicitly taking place in stage 3 of the framework. However, this process is so essential in creating effective vicarious learning material, that it may be worth highlighting its presence by making such activities explicit rather than implicit in the framework. Similarly, the process of giving feedback on the
student’s action (stage 7) at the experiential knowledge level happens after exploring the student’s reason for his/her erroneous actions. Consequently, a version of the Laurillard Conversational Framework is given below (Figure 10.5) with the activities mentioned above shown in grey:

Figure 10.5: Laurillard Conversational Framework showing explicit exploration of misconceptions

Additionally, this structure also provides a framework for what should be observable by the student when capturing materials for use as vicarious learning material. However,
stages 1 and 5 can be less explicit as student of the same cohort should have already shared the experiences of these stages. In the case where the student accessing the material does not belong to the same cohort, stages 1 and 5 will need to be provided in some form to contextualise the material being accessed.

10.12 Conclusions
This study has found that there are some significant factors that can affect a successful implementation of a CSVL system in a higher education setting. However, many of these factors can be overcome with prior planning and correct setup of the equipment used during the process of creating the final courseware. The study has found and resolved issues in the following areas:

1. Pedagogic issues of identifying and capturing activities in the tutorial sessions that can be used as vicarious learning material.
2. Technical issues in setting up equipment that can capture learning activities
3. Socio-cultural issues in capturing tutorial sessions
4. Logistical issues when editing materials for the final production

These issues indicate that the successful implementation of a CSVL system is not solely dependent on the technical efficiency of the system used in creating the final courseware. In particular, systems that are capable of producing materials of superior production quality (in terms of TV production principles) may not be appropriate for use as a CSVL system due to the demand on the effort and time of the lecturer when using such a system.

Additionally, this study finds that the process of creating vicarious learning material is not only beneficial for the students who will use those materials, but also for the lecturer producing those materials. By actively exploring the cause of misconceptions during the tutorial and making the resolution of those misconceptions available to other students, the lecturer/tutor is no longer treating a multitude of symptoms caused by a handful of misconceptions. Furthermore, such active exploration of misconceptions has allowed the discovery of causes of those misconceptions, which would have otherwise remained unknown to the lecturer/tutor year after year.
Chapter Summary

This chapter concludes the empirical work conducted for this research. It balances the focus of the investigation, which has so far focused on specific production variables and designs, by looking at the ‘softer’ areas of CSVL system design. It has reported on some real-world issues that may affect the successful implementation of a CSVL system in a higher education setting. It concludes that while these are mainly non-technical in nature, they can influence whether a CSVL system is successfully implemented or not. Additionally, the chapter highlights an unexpected bi-product of creating vicarious learning material and discusses its findings within the context of phenomenography.

The following chapter summarises all the requirements specification constructed by this research for an effective and efficient CSVL system, bringing together the findings of each phase of the two case studies that form the empirical foundation of this work.
11 Derived Requirements Specification

Introduction

This chapter takes the empirical findings from the two case studies that form the empirical studies of this research and constructs from their findings the requirements specification and recommendations for an effective and efficient computer support for vicarious learning. The requirements specification cover issues that have been investigated throughout this research. These include requirements and guidelines to ensure that:

1. learning activities are efficiently captured so that effective vicarious learning resource can be produced
2. material producers are provided with necessary and efficient support for producing vicarious learning resource
3. resource authors are informed of what the final production should contain for it to be pedagogically effective
4. materials produced can be used effectively and efficiently by the students

A system that efficiently supports production of video-based educational multimedia must enable the author to create materials with the greatest degree of quality, while minimizing the amount of time and effort required to create those materials, i.e. it must be practical to use. The requirements detailed in this chapter are not intended to be a comprehensive list requirements for a CSVL system, but are the requirements that have been derived from the empirical studies of this research. The aim is to contribute to the growing knowledge of what would be required to successfully implement an effective and efficient CSVL system. A summary of all the requirements and recommendations given is given at the end of this chapter.

11.1 Pedagogic framework for capturing material

Requirement 1: CSVL system should be able to effectively and efficiently capture learning activities at the experiential knowledge level of interaction, as set out in the Laurillard Conversational Framework. This has direct and significant implication on what equipment will be required.

Requirements derived from: Empirical findings from phase 1 and 2 of the SJU case study and phase 1 of the UCL case study.
Derived System Requirements

This requirement is derived from findings in the above phases of the two case studies that vicarious learning materials containing activities at the experiential knowledge level are perceived more positively as well as having an observable positive effect on the students' learning output, compared with materials that have failed to capture activities at this level. Consequently, when deriving a specification for a CSVL system, it is necessary to make sure that the specified system can effectively and efficiently capture activities at the experiential knowledge level. This requirement is derived together with the proposal that the Laurillard Conversational Framework can be used as a development framework for creating effective vicarious learning material. This is discussed further in the next and concluding chapter.

11.2 Capturing experiential knowledge level activities

Requirement 2: The output of these activities (changes made to a diagram or document) or 'prop' should be captured together with timing-data so that the captured material can be efficiently edited with the accompanying video footage.

Requirements derived from: Empirical findings from phase 2 of the UCL case study

This requirement is derived from the need to synchronise the state of the prop to the video clip of the student's learning activity. The prop should be captured together with some form of timing-data. Without this data, it is very difficult, if not impossible, to synchronise the prop with the video clip. How the experiential knowledge level activities are captured is also dependent on how those activities will be presented in the final production.

Requirement 3: Material should be captured at sufficient resolution so that the content is legible when displayed on the screen.

Requirements derived from: Empirical findings from phase 3 of the UCL case study

When creating materials for this research, the initial methods used followed those in TV productions where the prop (be it whiteboard or paper-based) are captured using another camera angle, requiring a cameraman to zoom in on sections that requires the student’s attention. However, when this method is used when creating vicarious learning materials that are to be viewed on a computer screen, the content of the props were not
Derived System Requirements

legible on screen as the resolution was too low causing excessive blurring. Digital
video is not of sufficiently high resolution for written or typed content (Times New
Roman, font size 12) to be legible when viewed on a computer screen using 1024x768
resolution. Digital video codecs create too many digital artefacts, especially when
capturing movements. Consequently, props should be captured at higher resolution.
For example, student coursework can be scanned in or emailed to the tutor prior to the
session and a screen-recording software used to record the changes that are made to the
coursework on the screen while a DV camera captures the off-screen interactions
around the coursework. This setup would allow high-resolution capture of props as
well as provide time-code data for synchronisation of props and video clip(s).

11.3 Video capture facilities

Requirement 4: Simultaneously capture DV footage from more than one camera
directly onto a hard disk (array).

Requirements derived from: Empirical findings from phase 3 of the UCL Case Study:
Implementing CSVL in the Real World.

This requirement was derived from the problem of having to transfer the videos
captured on DV tapes to hard disk after a tutorial session has been captured. This takes
a significant amount of time, especially when more than one camera is used. For
example, a 1-hour tutorial captured on 3 cameras would take 3 hours to transfer to hard
disk. Although the process of transferring the video footage to hard disk is a simple
one, it is the time this task takes that is problematic. By capturing video directly onto
hard disk at the time of the tutorial, the pre-edit time will be cut substantially.
Consequently, the practicality of the resulting CSVL setup will be improved, i.e. less
time and effort required from the lecturer.

11.4 Video-editing facilities

Requirement 5: Video-editing facilities should allow the video clips to be edited post-
production using a 'live' editing interaction model.

Requirements derived from: Empirical findings from phase 3 of the UCL Case Study:
Implementing CSVL in the Real World.

This requirement is derived from the need to edit a production that uses more than one
camera and the problem material producers face when using the current range of video-
Derived System Requirements

editing packages. These packages are geared towards professional video productions that require precise timing and placement of transitions between one video-stream (camera angle) to the other. Such precision and fine-tuning are not only unnecessary to produce effective vicarious learning materials, but also very demanding on the producer in terms of time and effort. What is required is a ‘live’ mode of editing off-line video material (see Chapter 10.8.2: Video editing). The interface would adopt the real-time editing metaphor (see below). This allows switching from one video-stream to the other in real-time, without having to stop the video that is being edited and specify the transition. This ‘live’ editing process was used to create the test vicarious learning material for phase 1 and 2 of the SJU case study (using real-time editing equipments available at St. John’s University’s studio). When using the ‘live’ editing process, each SJU case study material was created in under ten minutes, while each UCL case study material of the similar length each took just under one hour to produce (excluding rendering time, which varies according to the video codec chosen).

A survey of the current range of video-editing suites reveals that there are no software video-editing packages that support this mode of interaction. Apple’s iMovie is very easy to use, but does not support the ability to have more than one synchronised camera angle to choose from at any one moment.

While Adobe Premiere and Apple’s Final Cut Pro support multiple camera angles, they do not allow the author to choose camera angles via a ‘live’ interface. Both packages force the user to use the ‘stop-go’ approach to video editing. A system is required that enables real-time camera switching by supporting the following tasks:

1. play each captured camera angle (video file) at the same time (once they’ve all been downloaded and synchronized) so that the author can see exactly what each camera has captured at any one moment.

2. allow the author to choose which camera to use in real-time without having to stop the videos being played (as if the production is being made live in a studio). This task should be as simple as clicking on the camera angle that is wanted at that time to switch to that camera in the final production.

This will critically improve the usability of video-editing systems in two major ways:

1. The editing time will be cut substantially compared with the ‘stop-go’ approach.
Derived System Requirements

2. The editing task and user-interface will be simplified to just picking which camera is “live” or active at certain time.

11.5 Material design and presentation

Requirement 6: Video clip and prop view (when captured in the form of static graphics files) should be synchronised, but facilities should also be provided to allow navigation through the prop view that is independent from the video clip.

Requirement derived from: Student observations made during phase 2 of the UCL case study

Activities at the conceptual knowledge level should be presented fully synchronised with activities at the experiential knowledge level. Students who interacted with fully synchronised material experienced, and perceived themselves to have experienced less, navigational problems than those who interacted with materials in which the activities at the two levels were not synchronised.

However, students interacting with the material should also be able to navigate through each stage of the activities in the experiential knowledge level, independently from the activities in the conceptual knowledge level. Many students spent time looking for certain stages of the activities at the experiential knowledge level, i.e. looking for moments when a diagram was corrected as well as what the diagram was like before it was corrected. This task was often performed without the students accessing the materials in terms of the conceptual knowledge level activities (i.e. they performed the search using the prop view navigation facilities without accessing the video clip view).

Additionally, if the prop view is captured as a dynamic video file, it should also be fully synchronised with the video clip of the tutorial. For example, the student should be able to move through the prop view video file while the video clip of the tutorial stay in synchronisation with the prop view video file.

Requirement 7: Use video chapter facility to segment the video and provide navigational signposts for students who use the facility to move around the material.

Requirement derived from: Student observations made during phase 2 of the UCL case study
Derived System Requirements

Student observation shows that students make extensive use of the *chapter* facility, as an indication of where they are in the material and/or as the navigation interface for moving around the material. The *chapter* feature should reflect the changes in prop, so that the student can navigate to specific prop changes through the *chapter*. As students often use the *chapter* navigation feature as opposed to navigating through the material via direct-manipulation or button interface, the web-link points should also be repeated after the *chapter* section point. This will make sure that the prop view is refreshed to the appropriate point every time the student uses the *chapter* navigation feature.

**Requirement 8:** The size and resolution of the video clip that accompanies the media that is used to present the activities at the experiential knowledge level, should allow for the content of that media to be legible.

**Requirement derived from:** User diary from Phase 3 of the UCL case study, but also in evidence when implementing test materials for all phases of the UCL case study

Contrary to Reeves and Nass’ (1998) finding that ideally the size of the video clip should be as large as possible, this research finds that the size of video clips does not always need to be as large as possible, e.g. full screen DV. When creating material for the UCL case study (see Chapter 7.4: *Study setup*), half-screen or even quarter-screen DV allowed room for higher definition view of the props in the browser window when using web-link. This was the result of the DV codec not being sharp enough to allow written material captured via the camera to be legible even when shown in full screen on a 20-inch computer monitor. While it is possible to use cameras to capture written material, this requires a dynamic camera angle (and therefore a real or virtual cameraman) that can pan to or zoom into a relevant section of the material.

To deal with this problem, the props (written material) were captured in higher resolution (via a scanner) and shown in a separate area of the screen from the video clip. Consequently, it was no longer possible to display the video clip in full screen and the size of the clip was changed accordingly to accommodate the prop view portion of the screen. This also highlights another contradiction with Reeves and Nass as far as picture resolution is concerned. Reeves expressed the view that picture resolution is secondary to picture size in terms of maximising viewer engagement. However, when
Derived System Requirements

dealing with props that need to be legible on the screen, the resolution in which the props are shown is crucial in determining whether the content of the prop is legible or not. This does not imply that picture size is now an unimportant aspect of material creation. The prop still needs to be shown at a size that allows the content of the prop to be legible.

This research adopted Reeves and Nass’ research as a guide to producing effective multimedia material. Although Reeves and Nass have discussed briefly that their findings may not be applicable to materials created for learning (Reeves and Nass point out that user arousal from large picture size may be counter-productive to learning), what is clear is that their research does not define effectiveness in terms of pedagogy or the tasks performed by the students in this research. Instead, ‘effectiveness’ in their studies is defined, among others, in terms of viewer’s engagement with and perceived realism of the material. The findings of this research do not indicate that Reeves and Nass’ conclusion about video size and resolution is incorrect. However, there is empirical evidence to suggest that their conclusion may not be applicable for implementing a CSVL system where prop legibility is critical.

11.6 General design requirements

Requirement 9: The equipment used to capture learning activities should be as simple as possible to setup and use, without compromising on its ability to capture key stages of the activities with respect to the Laurillard framework.

Requirement derived from: User diary from phase 3 of the UCL case study.

Throughout this research, there were many instances when materials of sufficient pedagogic quality could not be produced because equipment used to capture the learning activities were not correctly setup or operated. For example, in one tutorial session, the setup required the tutor to manually capture images of the student’s work using a DV camera still-picture capture facility. While there was nothing wrong with the camera, the tutor did not correctly operate the camera. Consequently, the setup did not capture the student’s output from the learning activity. As detailed in this research, this is an important stage of the Laurillard framework that needs to be captured in order to produce effective vicarious learning material. While the setup was initially
Derived System Requirements

considered to be effective (i.e. it was capable of capturing all stages of the framework that it intended to capture), in reality the setup was prone to this critical failure.

Similarly, the setup of the equipment should also be kept as simple as possible. An example is the setup of microphones to record the audio track of the learning activities. Initially, the use of multiple microphones was considered to be the optimum setup for capturing dialogues during a tutorial. This is still the case if the system can be setup by an experienced sound crew. However, multiple microphones are difficult and time-consuming to setup correctly and, consequently, such setup is prone to misconfiguration. The setup use in this research opted for the use of a single high quality omni-directional microphone. The use of such a microphone requires that the background noise in the room is kept to a minimum. However, it is much easier to ensure such an environment than having to deal with problems such as phase errors when setting up multiple microphones.

11.7 Others

Requirement 10: Video streams are automatically edited as they are captured so that the lecturer does not have to spend time editing the material after the tutorial session(s).

Requirement derived from: User diary from phase 3 of the UCL case study and also from the experience of creating test material for all phases of the two case studies.

In all cases, when creating test materials for this research, a significant amount of time was spent editing materials that have been captured into appropriate materials for the case studies. One obvious solution to making a CSVL system more practical to use is to eliminate this editing process by automating selection of camera angles in a multiple camera setup. Such a system will automatically detect when someone is speaking and choose the appropriate camera angle, resulting in a single video stream. This automation would allow the tutor to edit a multiple camera production in the same way as he/she would edit a single camera production, i.e. he/she only needs to choose which part of a captured section to use.

There are already systems that can perform this task, however, all are very expensive and therefore outside the resources of most educational establishments. Additionally, such a system will take away from the tutor the precise control of pedagogic content
Derived System Requirements

that is to be in the final material. Such side effect is highly undesirable in the educational context (Monthienvichienchai et al., 2001). Nevertheless, an automatic video-editing system may be desirable if there is such a large number of tutorial sessions that are captured that it would not be possible for a lecturer, with the constraint of time and resource, to edit them all manually.

11.8 General Recommendations

Recommendation 1: A CSVL implementation must be supported by a system that provides facilities for managing consents of those who have given permission for their activities to be captured, as well as intellectual property rights (IPR) of educational professionals whose work have been captured.

Recommendation derived from: User diary from Phase 3 of the UCL case study, but also in evidence when implementing test materials for all phases of the UCL case study

While this is not a design requirement, it is important to have the organisational structure in place that will allow the implementation of a CSVL system to comply with the requirements of the Data Protection Act. In particular, if the system is to be implemented in a real-world environment such as a first-year undergraduate course (as was one of the empirical settings of this research), then the necessary paperwork will need to be put in place to obtain consent from the students and the teaching staff whose academic activities will be captured and presented to those than can access the materials. There were some instances when students did not consent to having their tutorial sessions recorded for various reasons (see Chapter 10.9.1: Students’ perspective).

Additionally, while this research did not encounter problems with this particular issue, it is worth noting that, if the system is implemented on a wide scale, then some support of Intellectual Property Right (IPR) management may also be required. During this research, every educational professional involved either consented or volunteered to having their work captured in video knowing it to be part of an academic research. However, this research has not investigated issues concerning IPR should the system be implemented outside the ‘haven’ of a research setting (see Chapter 10.9.3: CSVL and the Data Protection Act).
Derived System Requirements

Recommendation 2: Encourage a culture of sharing one’s learning experience and learning from the learning experience of others.

Recommendation derived from: Interviews with students in phase 2 of the UCL case study and user diary from Phase 3 of the UCL case study, but also in evidence when implementing test materials for all phases of the UCL case study

While capturing tutorial sessions for creating test materials for the UCL case study, there was not a shortage of students who were willing to share their experience with other students. However, these students were not in the majority of those on the courses that they were on. During interviews with the students for phase 2 of the UCL case study, students who were reluctant to giving consent for capturing their own tutorial sessions said that they would consent if all the other students’ sessions were also captured.

Additionally, some students expressed concerns with the possibility of plagiarism through such open sharing of the learning experience. However, these students said that they would give their consent if the assignments for each student were different.

The creation of vicarious learning materials is dependent on students being willing to share their experience with others. The promotion of a culture in which students share their learning experience, and also learning from the experience of others, can therefore contribute to the successful implementation of a CSVL system in that environment (see Chapter 12.7.6: CSVL and communities of practice).

11.9 Pedagogic recommendations

So far, this chapter has specified requirements and recommendations that are directly related to a computer system for supporting vicarious learning. However, this research study has also demonstrated, through research design, methodological decisions and empirical contexts, how a certain pedagogic setup can contribute to the successful implementation of CSVL. Although the recommendations specified in this section have been implicit in the thesis, it is worth summarising them in this chapter, as they help to maximise the chances of a CSVL project being successful. The following recommendations details the setting in which an implementation of CSVL will most likely succeed in terms of system adoption, both by educational practitioners and
Derived System Requirements

students, and pedagogic effectiveness. The first four recommendations are concerned with the process of creating tertiary material and the last two recommendations are concerned with the student cohort with which CSVL is to be deployed.

Pedagogic Recommendation 1: The course in which CSVL is to be implemented should have a need for tertiary courseware.

Recommendation derived from: Empirical settings of the UCL and SJU case studies.

This recommendation is concerned with where and when vicarious learning material should be used. Which topics should tertiary courseware be developed for? The recommendation is given within the context of courseware structure as proposed by Mayes (1995), who argued that existing courseware can be classified into primary, secondary and tertiary courseware (see Chapter 2.2.1: Vicarious learning as courseware for further details on courseware structure). This research study has presented evidence to support his argument that tertiary courseware is not a replacement for primary or secondary courseware, but a complement to those courseware.

The empirical settings for the two case studies were courses in which primary and secondary materials failed to meet some pedagogic needs of some students, and the test materials were created to meet those particular needs. In the SJU case study, due to the lack of time and financial resources, it was not possible for students to observe other students working on their group assignments on a regular basis, even though this instructional method is effective for many students on the course. Similarly, many students on the B160 course in all phases of the UCL case study (see Chapter 5.2: Selection of empirical settings for details of the B160 course) needed to see not only what mistakes to avoid, but also how such mistakes came about in the first place and what steps were needed to be taken in order to rectify those mistakes and why. In both cases, vicarious learning material developed during this research study was able to meet the pedagogic needs of the students in these areas. Consequently, the materials created were positively perceived by the student and were pedagogically effective. On the other hand, the initial study (see Chapter 3.5.1: Initial study: perceived quality is important) showed how tertiary material was negatively perceived by the students when it attempted to cover a topic that other courseware had already managed to effectively address, i.e. there was no need for tertiary courseware to cover that particular topic. In
Derived System Requirements

that study, students preferred to use primary courseware and material, such as online lecture notes and course books, to access the same information. Therefore, when considering which topic tertiary courseware should be developed for, lecturers should concentrate their efforts on producing tertiary courseware that addresses the issues or topics in which the pedagogic needs of the students have not been effectively met by primary or secondary courseware.

**Pedagogic Recommendation 2:** When capturing activities for creating vicarious learning courseware, capture activities that are rich in dialogues at the conceptual and experiential knowledge level (if present) of the Laurillard framework.

**Recommendation derived from:** Process of creating test materials for the UCL and SJU case studies

This recommendation is concerned with how a lecturer decides what activities to capture in the material and is derived from this research study's finding that some activities that the students engage in can be more easily captured and used as vicarious learning courseware than others.

This research study defines *vicarious learning* as learning by observation of the learning activities of others. *Learning* is also defined as a dialogue-centric activity whose processes can be categorised into two levels – the conceptual and experiential knowledge levels (see Chapter 2.3.2: *Laurillard's Conversational Framework and dialogue* for more detail of the description of these two levels). Vicarious learning, therefore, is the observation of these processes of learning.

Consequently, when choosing which activities to capture when creating vicarious learning material, the lecturer should choose activities that are rich in dialogue and, ideally, activities that contain processes that can be categorised into the conceptual and experiential knowledge level of the Laurillard framework. For example, in the UCL case study, tutorials were captured, as there were more dialogues between the tutor and the students than during lectures. This is not to say that there must be more than one person present in the activity being captured. Capturing a single student working on a problem could be useful as vicarious learning material, if the internal dialogue of that student is externalised for the observer and the student has achieved the final goal.
Derived System Requirements

This notion of capturing dialogue is important, as without dialogue in the material, the final product will not be tertiary but primary in nature. If there were no dialogues between the student and the tutor in the tutorial, the resulting material will just contain the tutor telling the student how to solve a particular problem, which is not very different from what he/she would be doing in a lecture.

Pedagogic Recommendation 3: The level of the topic under discussion should be such that all the relevant issues concerning that topic at the time can be discussed within the duration of the learning activity being captured.

Recommendation derived from: Creating the test material for the UCL and SJU case study.

This is concerned with choosing the depth at which the material addresses the topic that has been selected as being appropriate for support by vicarious learning courseware. In how much detail should the material address the topic? The recommendation given on this issue is that the level of the topic under discussion should be such that all the relevant issues concerning that issue at the time can be discussed within the duration of the learning activity being captured, e.g. the tutorial session.

Learning activities that have been identified as being suitable for capture as vicarious learning material would cover topics that can be addressed by tertiary courseware. In most cases, it is counter-productive to predict the topics in which students would have the need for support by tertiary courseware. The process of creating tertiary courseware reveals to the lecturer which topics are not being adequately addressed by primary and secondary courseware and such topics may be unforeseen by the lecturer (see Chapter 10.11: CSVL: A tutor’s perspective and Chapter 12.5.3: Purpose of tertiary courseware). Additionally, when such topics are discussed during the learning activity, the level of granularity at which the topics are discussed would be at the suitable level for use as tertiary material, i.e. if an aspect of a topic cannot be covered adequately during a tutorial session, then that aspect of the topic cannot be effectively covered by tertiary courseware, or at least not by the tertiary courseware that resulted from the capture of that particular learning activity. In such cases, another more suitable learning
activity should be identified and captured or, just as appropriate, primary or secondary courseware should be used instead.

**Pedagogic Recommendation 4:** The number of topics under discussion in the material should be secondary to the material having an effective support for navigating through those topics.

**Recommendation derived from:** Producing the test material in phase 1 and 2 of the UCL case study.

This recommendation is concerned with the number of topics that a single unit of vicarious learning material (e.g. a video clip) should contain. Should lecturers try to create materials that deal with as many different topics as possible, or would it be more effective to create materials that deal with only a small number of topics? In a way, this question is similar to asking, “how many topics should a book address?” Nevertheless, it is possible to give some recommendations that concern the creation of a single unit of material (such as a video clip) within the context of two dimensions: quantity and variety of topics.

The number of topics covered by a single unit of material is secondary in importance to providing effective support for navigating through the material. While the test material for the UCL case study was only about 7 minutes long, with 7 topics being discussed, it is possible to create material that is longer in duration and has twice the number of topics under discussion, without sacrificing the usability of the material. However, there are limits as to how many topics a single video clip should contain. It is recommended that when the topics are not obviously connected to each other, those topics should be in different video clips.

**Pedagogic Recommendation 5:** In the initial stage of creating tertiary material for a course, the lecturer should aim to create a collection of materials that covers a wide variety of topics that can be dealt with effectively by using tertiary courseware, rather than a large number of materials that cover only one or two topics. However, once all the relevant topics on a course have been covered, it would also be beneficial to capture activities that cover the same topics with students of varying level of competence.
**Derived System Requirements**

**Recommendation derived from:** Producing the test material in phase 1 and 2 of the UCL case study.

This recommendation is concerned with creating a collection of materials. How much variety should a collection of materials have in terms of the total number of topics covered? In the initial stage of creating tertiary material for a course, the lecturer should aim to create a collection of materials that covers a wide variety of topics that can be dealt with effectively by using tertiary courseware, rather than a large number of materials that cover only one or two topics. This recommendation is derived from the finding that students, in both case studies, still benefited from having access to the test material even when the material did not cover exactly the issues that they perceived themselves to have problems with. In some cases, students did not know that they actually had a problem with a topic until they accessed the material. Moreover, students benefited in different ways from each other, even though they had access to the same material and were all performing the same task while accessing the material (see Chapter 9.8: *Students' perception of vicarious learning resource*). However, once all the relevant topics on a course have been covered, it would also be beneficial to capture activities that cover the same topics (that have already been covered) with students of varying level of competence, to maximise facilitation of vicarious learning rather than learning by observation (see Chapter 12.5.2: Definition of tertiary courseware).

**Pedagogic Recommendation 6:** The duration of the video clip should be as long as the duration of the learning activity that is captured.

**Recommendation derived from:** Capturing test material for the UCL and SJU case study.

This is concerned with how long a single unit of material should be – in this case a video clip. The duration of the video clip should be as long as the duration of the activity being captured, e.g. when capturing a tutorial, the video clip should capture the whole tutorial. This is to ensure that all the context and consequences of the discussion and activities are captured. There is another benefit to fully capturing the activity (i.e. capturing a whole tutorial session as opposed to just a small instance of one). In both the UCL and the SJU case study, students benefited from observing other parts of the tutorial (or studio session) that were not directly related to the instructional objectives of
Derived System Requirements

the materials. Many of these benefits were unforeseen at the time of creating the materials and would not have been present if the materials consist of small snippets of the tutorial (UCL case study) or studio session (SJU case study).

In the UCL case study, students spent on average around 20 minutes on a 7-minute video clip. With hindsight, a video clip capturing the whole of the tutorial would have been a more effective and complete unit of material. However, while the duration of the students’ interaction with the material was influenced by the tasks that they were performing (attempting to answer some questions regarding dataflow diagrams), it shows how long students actually want to spend interacting with tertiary material in a real-world situation. As a result, the appropriate length of a video clip also depends on the context in which the material is to be used.

**Pedagogic Recommendation 7:** The students, on the course in which CSVL is to be implemented, should be experienced in meta-level reflection on learning activities and learning outcome.

**Recommendation derived from:** The teaching practices employed by the lecturers of the courses chosen for the settings for the two case studies.

In both courses of both case studies, the lecturers were already using vicarious learning as a pedagogic tool for teaching certain aspect of their courses. In these cases, the students were experienced in meta-level reflection of not only their own learning activities and outcome, but also those of other students. This helps to ensure that, if CSVL is to be deployed on the course, the system will be addressing a pedagogic need of the students that has not already been addressed (perhaps more efficiently and effectively) by primary or secondary courseware (see **Pedagogic Recommendation 1** above). However, it may also be the case that, if vicarious learning is already used as an instructional method, the culture of sharing one’s learning experience and learning from the mistakes of others may already be present within the student cohort. Consequently, a CSVL system would be more likely to be adopted by the students within such an environment, than one in which the students have never shared their experience with each other.
Derived System Requirements

Another point worth noting is that, if the lecturer is already using vicarious learning as a pedagogic tool, he/she has the necessary teaching skills or preference to foster a dialogue-rich learning environment, which is essential in creating effective vicarious learning material in the first place. Every educational practitioner, who was involved with this research study, had created or was keen to promote a dialogue-rich learning environment for his/her students both during lectures and tutorials.

**Pedagogic Recommendation 8:** Vicarious learning material should be deployed with similar student cohorts to those from which the material was created.

**Recommendation derived from:** The effects of vicarious learning material on the learning output of the student cohorts from the two case studies.

Throughout this research, students who accessed vicarious learning material were either from the same cohort, or were at least taking part in the same course as the student whose learning experience was being observed. This setup has demonstrated that vicarious learning material created as JIT (Just-in-Time) courseware is effective in meeting the students’ pedagogic needs that have not been met by other types of courseware or instructional methods. Additionally, it has also demonstrated that, while students who access vicarious learning material should ideally be in the same student cohort as the students in the material, students from other student cohorts that are similar in terms of pedagogic goals and level of epistemological development also benefited from having access to such material. In such cases, students were given access to the material at about the same stage of progression through the course as the students who were captured in the material. An implication was that students accessing the material also shared the same sense of trajectory and relevancy of the issues being discussed in the material as the students in the material. For example, students accessing the material in the SJU case study were either in the process of producing or were planning to produce their first video programme. Consequently, they were able to directly relate the issues faced by the group of students in the material to their own issues.

**11.10 Summary of requirements**

To conclude this chapter, the requirements that have been highlighted in this chapter are summarised below. As stated at the beginning of the chapter, these requirements are not
Derived System Requirements

intended to be the comprehensive requirements for a CSVL system, but are the requirements that have been derived through the empirical studies of this research. The aim is to contribute to the growing knowledge of what would be required to successfully implement an effective and efficient CSVL system.

• Pedagogic framework for capturing material
  
  o **Requirement 1:** CSVL system should be able to effectively and efficiently capture learning activities at the experiential knowledge level of interaction, as set out in the Laurillard Conversational Framework. This has direct and significant implication on what equipment will be required.

• Capturing experiential knowledge level activities
  
  o **Requirement 2:** The output of these activities (changes made to a diagram or document) or 'prop' should be captured together with timing-data so that the captured material can be efficiently edited with the accompanying video footage.

  o **Requirement 3:** Material should be captured at sufficient resolution so that the content is legible when displayed on the screen.

• Video capture facilities
  
  o **Requirement 4:** simultaneously capture DV footage from more than one camera directly onto a hard disk (array).

• Video-editing facilities
  
  o **Requirement 5:** Video-editing facilities should allow the video clips to be edited post-production using a ‘live’ editing interaction model.

• Material design and presentation
  
  o **Requirement 6:** Video clip and prop view should be synchronised, but facilities should also be provided to allow navigation through the prop view that is independent from the video clip.

  o **Requirement 7:** Use video *chapter* facility to segment the video and provide navigational signposts for students who use the facility to move around the material.

  o **Requirement 8:** The size and resolution of the video clip that accompanies the media that is used to present the activities at the experiential knowledge level, should allow for the content of that media to be legible.
Derived System Requirements

- General design requirements
  - Requirement 9: The equipment used to capture learning activities should be as simple as possible to setup and use, without compromising on its ability to capture key stages of the activities with respect to the Laurillard framework.

- Others
  - Requirement 10: Video streams are automatically edited as they are captured so that the lecturer does not have to spend time editing the material after the tutorial session(s).

- General Recommendations
  - Recommendation 1: A CSVL implementation must be supported by a system that provides facilities for managing consents of those who have given permission for their activities to be captured, as well as intellectual property rights (IPR) of educational professionals whose work have been captured.
  - Recommendation 2: Encourage a culture of sharing one’s learning experience and learning from the learning experience of others.

- Pedagogic recommendations
  - Pedagogic Recommendation 1: The course in which CSVL is to be implemented should have a need for tertiary courseware.
  - Pedagogic Recommendation 2: When capturing activities for creating vicarious learning courseware, capture activities that are rich in dialogues at the conceptual and experiential knowledge level (if present) of the Laurillard framework.
  - Pedagogic Recommendation 3: The level of the topic under discussion should be such that all the relevant issues concerning that topic at the time can be discussed within the duration of the learning activity being captured.
  - Pedagogic Recommendation 4: The number of topics under discussion in the material should be secondary to the material having an effective support for navigating through those topics.
  - Pedagogic Recommendation 5: In the initial stage of creating tertiary material for a course, the lecturer should aim to create a collection of materials that covers a wide variety of topics that can be dealt with effectively by using tertiary courseware, rather than a large number of
Derived System Requirements

materials that cover only one or two topics. However, once all the relevant topics on a course have been covered, it would also be beneficial to capture activities that cover the same topics with students of varying level of competence.

- **Pedagogic Recommendation 6**: The duration of the video clip should be as long as the duration of the learning activity that is captured.

- **Pedagogic Recommendation 7**: The students, on the course in which CSVL is to be implemented, should be experienced in meta-level reflection on learning activities and learning outcome.

- **Pedagogic Recommendation 8**: Vicarious learning material should be deployed with similar student cohorts to those from which the material was created.

**Chapter Summary**

This chapter has presented the requirements specification of a CSVL system constructed from empirical studies conducted in this research. This brings together the findings of the two case studies conducted as part of this research. However, these requirements are not the total contribution of this research to the field of computer supported vicarious learning. In the next and concluding chapter of this thesis, this requirements specification and other contributions of this work are summarised, and a proposal of future works into investigating the implementation of a CSVL system in higher education is given.
12 Conclusions

Introduction
This chapter summarises all the findings of the research reported in this thesis with respect to previously established research questions. Additionally, questions that were raised while conducting this research, but are still unanswered, are included here as proposal for future research into the area. While this work has contributed to the state-of-the-art in the area of providing effective and efficient computer support for vicarious learning, it concludes that there are still significant areas where further investigations are required. For example, due to the scope of this research, issues relating to a wide-scale implementation of CSVL were not investigated. In particular, this work points out the need to investigate how vicarious learning resources should be stored and indexed in order to provide effective mode of access for students when accessing a large array of resources.

12.1 Research problems
The principal goal of this research is to investigate how computers can be used to effectively support vicarious learning. In doing so, it aims to construct a requirements specification for computer supported vicarious learning (CSVL) and explore human factors that can affect a successful implementation of a CSVL system in higher education.

The research began by finding out what previous research studies have already investigated in terms of requirements for effective computer support for vicarious learning. The literature review found that vicarious learning has been demonstrated to be an effective pedagogic tool (McKendree et al. 1998; Cox et al. 1999; Lee et al. 1999). Additionally, vicarious learning has been described with respect to the concept of dialogues as one of the main iterative stages of learning (Mayes, 1995). A possible structure of such dialogue is presented by the Laurillard Conversational Framework (Laurillard, 2002) within the context of teacher-student interaction in higher education environment. Vicarious learning, within this context, is the vicarious experience of these dialogues. This research then argued that, in order to create effective vicarious
learning material, a CSVL system must be able to effectively and efficiently capture these dialogues and present them to the students. To investigate how this can be accomplished, this research examined how previous tutorial/lecture capture and distribution systems have been implemented, as well as how dialogues are captured and presented in TV productions. The review found that some institutions have dedicated large amount of resource into capturing and distributing the classroom experience online (e.g. eClass), while TV productions of public debates (some of which can be used as vicarious learning material) often utilise even larger amount of human and technical resources. These productions often involve the use of multiple cameras and microphones to capture the activities and the accompanying dialogues. However, such productions are not only resource-hungry, but are also time-consuming to setup correctly, and require large amount of time and effort in producing vicarious learning resource from the captured material. An individual or small group of lecturers may not have the required resource in terms of expertise, time or finance to implement or use such a system. Additionally, such a system may not be flexible enough to provide support for the creation of Just-in-Time (JIT) material that can provide the level of customisation that individual or small groups of lecturers may need. Moreover, none of these implementations have justified their implementation from the perspective of providing support for creating effective vicarious learning material.

Consequently, the main problem being tackled by this research study is to enable an individual or small group of lecturers with less resource (in terms of expertise, time and finance) to create video-based vicarious learning material that are as pedagogically effective, if not as aesthetically appealing, as those with the magnitude of resource mentioned above.

12.2 Research questions
There are many angles from which the research problem stated above could have been tackled. However, two concrete questions emerge from the research problems within the context of the literature review:

1. Are all the equipments (e.g. electronic whiteboard, multiple video cameras and microphone-arrays) used by implementations in larger institutions or professional productions required to capture the learning activities for creating pedagogically effective material?
Conclusions

2. What computer support does an individual or small group of lecturers require when capturing, editing and producing video-based vicarious learning material?

In order to answer the first question, it is necessary to find out what needs to be captured in the first place in order to create pedagogically effective video-based vicarious learning material. In this case, ‘pedagogically effective’ is defined in terms of:

1. Perceived quality of the material by the students
2. Material’s effect on students’ learning output

To investigate what needs to be captured, the following research questions have been derived:

1. With respect to the Laurillard Conversational Framework, what parts of a learning activity need to be captured in order to create pedagogically effective video-based vicarious learning material for learning abstract concept?
2. The framework is mainly divided into two levels: conceptual and experiential. Is capturing only one level as effective as capturing both? If both levels should be captured, this has implication for design specification.

The second question is directly concerned with the users of a CSVL system. These are the lecturer who will capture, edit and produce the material and the student who will use the material. How the material is implemented (produced) in the end also depends on the requirements of the students when using the material. The following research questions have been derived from the high-level tasks (capturing, editing, producing and accessing) of the lecturer and student when using a CSVL system:

1. Once what is required to be captured is established, how can materials be captured as efficiently as possible? What are the usability issues when capturing material for producing video-based vicarious learning material?
2. What are the usability issues when editing and producing video-based vicarious learning material? When producing video-based vicarious learning material, what should it contain in order for it to be pedagogically effective?
3. What are the usability issues when students access the material produced? How will the students actually use the material?
12.3 Empirical work

Two case studies form the basis of the empirical work of this research – St. John’s University (SJU) Case Study and UCL Case Study. Each case study is organised into phases – each phase addresses one or more research questions as outlined above (and in more details in Chapter 4: Research Questions). Figure 12.1 gives a summary of the empirical studies conducted during this research.

<table>
<thead>
<tr>
<th>SJ Case Study Phase 1 (Chapter 6)</th>
<th>UCL Case Study Phase 1 (Chapter 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investigates what needs to be captured in order to create pedagogically effective material in terms of the perceived quality of the material</td>
<td>Investigates what needs to be captured in order to create pedagogically effective material in terms of the effect of the material on the students’ learning output</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SJ Case Study Phase 2 (Chapter 8)</th>
<th>UCL Case Study Phase 2 (Chapter 9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confirms the findings of UCL Case Study Phase 1 on what needs to be captured in order to create pedagogically effective material in terms of the effect of the material on the students’ learning output</td>
<td>Investigates and documents how students interact with vicarious learning material to complete certain learning goals</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UCL Case Study Phase 3 (Chapter 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Investigates usability issues facing lecturers when capturing, editing and producing vicarious learning material</td>
</tr>
<tr>
<td>b. Investigates human factors that can affect successful implementation of a CSVL in higher education environment</td>
</tr>
</tbody>
</table>

Figure 12.1: Summary of empirical work

12.4 Substantive research contributions

12.4.1 Framework for developing effective vicarious learning material

This research has adopted the Laurillard Conversational Framework as the framework for analysing the effectiveness of vicarious learning material produced. It has referred
Conclusions

to this framework during all phases of the case study when contextualising the findings with respect to the pedagogic content of the material produced. In doing so, it has demonstrated that, in this case, the framework can be used as a framework for assessing the effectiveness of the material based on its content.

In phase 1 of the SJU case study (Chapter 6), the quality of materials that contains the conceptual and experiential knowledge level activities is perceived more positively than the quality of materials that contain only the conceptual knowledge level activities. In phase 1 of the UCL case study (Chapter 7) and phase 2 of the SJU case study (Chapter 8), students’ interaction with materials, containing similar addition of content with respect to the Laurillard framework, resulted in a positive observable effect on the students’ learning outputs – students were able to give more correct answers when given access to the experiential knowledge level activities in the material.

It was this relationship between materials containing the experiential knowledge level activities and students’ learning output that led the investigation of this research to then focus on exactly how these activities are made available to the students. This indicates how the Laurillard framework can be used as a framework for developing effective vicarious learning material. Firstly, activities that have been captured can be easily represented in the framework, making it possible to check whether certain key activities have been adequately captured. Secondly, materials that are more effective (as defined by this research) can be coded with respect to the framework to reveal that they contain more stages of the framework – more specifically the experiential knowledge level – than less effective material. This provides a clear framework for evaluating materials that are developed.

12.4.2 Requirements specification dependent on pedagogic goals and effectiveness

This work set out to answer many real-world questions concerning the implementation of CSVL in a particular setting in higher education. One of these is what are the requirements for effective and efficient (see Chapter 5.1: Major areas of enquiry for definitions of ‘effective’ and ‘efficient’) capture of a tutorial when creating vicarious learning resource? This research finds that the requirement does not only depend on what is physically going on in the tutorial (number of people talking, the positions of
the participants, etc…), but also on the pedagogic goals or the instructional objectives of the material being produced (see discussion in Chapter 8.7.1: Pedagogic effect of capturing additional stage of the Laurillard Framework). This is significant in that two tutorial sessions with identical physical settings can have two different requirements for effectively capturing the tutorial for use as vicarious learning material. For example, if the instructional objective of capturing tutorial A is to allow other students to see the mistakes that are made in a coursework and how those mistakes are tackled and corrected, the tutorial will need to be captured using a different setup from when capturing exactly the same tutorial if the instructional objective is to allow other students to be able to see how to conduct themselves in a one-to-one tutorial.

Additionally, this research finds that materials whose instructional objectives concern the manipulation of abstract issues or their externalised forms often require less resources to effectively capture the appropriate material than materials whose instructional objectives are social in nature. This is contrary to the critique given in Chapter 2.4: Pedagogic effectiveness of vicarious learning. This is mainly because abstract concepts can be more easily captured once those concepts are externalised, e.g. into DFD diagrams on paper or on screen. Materials that deal with social issues require the capture of conflicts in those areas that are either difficult to capture with little or no personnel support or very rarely happen in front of the camera (i.e. full-time cameramen would be needed in order to ensure that opportunities for capturing relevant materials are not missed and that such events are captured effectively). That is, during this research, social conflicts never happened when students were aware that what they were doing was being recorded and may be made available to other students. In contrast, abstract concepts are routinely externalised as part of everyday learning activities and empirical studies in this research. Additionally, students who took part in this research study said that they were willing to allow their mistakes when dealing with abstract concepts to be shared with other students, but the same group of students were also worried about being embarrassed by those mistakes (see Chapter 9.8.2: Willingness to share the experience and Chapter 10.9.1: Students’ perspective).

12.4.3 Perception of vicarious learning by students
This research has investigated how undergraduate students perceive vicarious learning material as a learning resource (see Chapter 6.5: Focus group findings and Chapter 9.8:
Conclusions

Students' perception of vicarious learning resource. It has found that vicarious learning materials are positively perceived by the students. In both case studies, the students perceived the materials they interacted with to be pedagogically useful to them. Interview transcripts from phase 2 of the UCL case study contain many instances when the students expressed the wish that the test material (which was only created for this study and have not been deployed on the course) was made available to them while they were completing their coursework. Additionally, many students realised specific areas in their understanding of certain concepts that can be or have been corrected through their interaction with the test materials. Overall, the empirical evidence indicates that students would welcome the introduction of vicarious learning materials into their course.

12.4.4 Student interaction with vicarious learning material

Another contribution of this work is the documentation and analysis of student interaction patterns with vicarious learning material (see Chapter 9.6: Students' interaction patterns). The interaction patterns documented can be used to inform material developers of what functionalities are required for students to effectively and efficiently use the material. It has also shed light on the strategies that students have adopted when using vicarious learning material – namely, students adopting a 'serialist' or 'holistic' approach when using the material. The interaction patterns also show how the usability of the material is affected by the nature of the synchronisation between activities of the conceptual and experiential knowledge level (see Chapter 9.8.3: Perceived problems with material). This affects how the material should be captured in the first place, i.e. timing-data should be incorporated so that activities at both level can be synchronised during presentation.

12.4.5 Real-world issues of implementing CSVL

Even if a system is effective and efficient, its implementation in the real world is still uncertain if it infringes on the operational norms of the organisation that it will be used in. This research has found that a video-based CSVL system may have the potential to infringe on some social and cultural norms if inappropriately implemented in a higher education setting (see Chapter 10.9: Social-cultural issues). A CSVL system requires students to be willing to share their learning experience with other students and, in some cases, to also be identifiable as the person sharing that experience by their peers. This
Conclusions

requirement sometimes infringe on certain student’s sense of privacy and what is considered the norm. This research finds that this lack of a culture of sharing learning experience can also hinder the successful implementation of a CSVL system.

Lastly, there are practical preparations in terms of legal paperwork that need to be implemented to ensure that the CSVL implementation conforms to the Data Protection Acts. While it is important to ensure that consent given by students is properly managed, it is also important to consider the consequence of students not consenting to be recorded. That is, while it is possible to argue that such students are contributing less to the course as a whole, their refusal to give consent should not put them at a disadvantage to those who did consent.

12.4.6 Improved mode of interaction in video editing software to enhance usability

This concerns the user interface design of video-editing software that are currently available. More specifically, the problem stems from the use of a design metaphor for editing analogue video sources into one stream. The interface is efficient for post-production editing in TV studios where the precise nature and timing of transitions and the ability to time-shift clips are of the main concern. However, such an interface is inefficient when the producer would like to quickly switch back and forth between different video streams when approximate timing of the switch is sufficient. When producing vicarious learning materials that use multiple camera angles throughout this research, a large majority of the editing time is spent selecting when to switch from one video stream to the other and implementing that switch using the current user interface.

Ironically, this work finds a better design metaphor to be once again within the TV studio. However, the interface is derived from those used in real-time live editing. In this case, in order to switch from one video stream (or camera) to the other, the producer selects which stream should be active at a particular time in real-time without having to stop the clip to precisely place the transition on the timeline. This live editing process was used to create the test vicarious learning material for SJU Case Study Phase 1 and 2 using real-time editing equipments available at St. John’s University’s studio. When using the live editing process, each SJU case study material was created in under ten minutes while each UCL case study material of the similar length each took just
Conclusions

under one hour to produce (excluding rendering time, which varies according to the video codec chosen).

12.4.7 Immediate improvements to current educational video production and delivery system in supporting vicarious learning

The requirements specification constructed by this research can be used to gain immediate improvements to current educational video production and delivery systems in supporting vicarious learning material production. To illustrate this, this section will apply the concrete requirements specification constructed by this research to an existing educational video production and delivery system – VESOL (Video Editing System for Open Learning – see Chapter 2.8: Implementations of CSVL). There are several problems, regarding the use of the current setup of VESOL to support vicarious learning that the findings of this research can point to and improve on:

1. **VESOL camera-setup is currently aimed at using multiple camera angles to capture lectures for online delivery.** Consequently, the camera angles currently used do not effectively capture learning activities that are required to produce effective vicarious learning material (see Figure 12.2 on the next page). The required camera angles should be derived using the Laurillard framework to identify relevant activities (at the conceptual and experiential knowledge level) to capture within the context of the instructional objectives of the vicarious learning material being produced.

2. **VESOL records all edited videos onto SVHS or VHS videotapes.** This recording method is sufficient for delivery of lectures, even those that make use of PowerPoint presentations. However, the video resolution supported by these videotapes is not high enough to display the experiential knowledge level activities of the students (such as those in the UCL case study) in sufficient detail (see Figure 12.3 on the next page). Handwritten materials captured at DV-resolution (superior to SVHS-resolution) during the UCL case study were still illegible when displayed at full-screen. In order to effectively show these activities, it is necessary to implement a capture method that supports higher resolution capture and display the activities in sufficiently high resolution (see below).
3. **VESOL presents conceptual and experiential knowledge level activities within one view only.** The way in which the students in both case studies of this research used the video view and prop view was unpredictable or, at least, did not have an obvious pattern. Consequently, it should be better to present these
activities in two concurrent views (as was the case in the UCL case study), allowing students themselves to choose what to look at. Additionally, this will enable the captured experiential knowledge level activities to be captured and displayed at higher resolution than if they were captured as a conventional video stream, which even at full DV resolution is insufficient for capturing and displaying written material.

4. **VESOL's final video productions do not implement segmentation of video clips and do not support navigation through the video clips via a pedagogic framework.** A typical video clip of a lecture captured via VESOL would be around 60 minutes long with no structure to support navigation through the clip. Consequently, a student might find it difficult to efficiently navigate around the video clip when not using it as a linear resource (as has been observed in the students' interaction patterns in the UCL case study). During this study, students did not use vicarious learning material in a linear manner. Instead, they made extensive use of navigational facilities such as QuickTime™ chapter facilities and URL links to different stages of the experiential knowledge level activities. These facilities should be implemented in vicarious learning material to enable students to efficiently access the content of the material.

12.5 **Pedagogic theory contributions**
While this research study has taken a cross-disciplinary approach to investigating the issue of providing computer support for vicarious learning, it has also contributed to the pedagogic theories that it has adopted.

12.5.1 **Categorisation of courseware**
One of the main pedagogic theories adopted by this research study is the categorisation of courseware by Mayes (1995) into primary, secondary and tertiary courseware. The principal concept behind this division is the theory that each type of courseware deals with certain pedagogic needs of the student. Primary courseware is used to introduce concepts to students and secondary courseware is used to facilitate exploration of those concepts by the students. The aim of tertiary courseware is not to present new ideas, but to clarify and facilitate further reflection of concepts and assist students when they have misconceptions on a topic. Tertiary courseware uses as a learning resource the dialogues that take place within the context of the use of secondary courseware (see
Conclusions

Chapter 2.2.1: *Vicarious learning as courseware* for further details on courseware categorisation).

The findings of this research study support Mayes’ categorisation of courseware. Vicarious learning materials developed during this research, consistent with the aim of tertiary courseware, were able to facilitate further reflection on certain topics, and correct subtle but fundamental misconceptions held by the students. More importantly, the materials met and were perceived to have met the pedagogic needs of the students that were not effectively met by primary or secondary courseware/material. Unsurprisingly, the materials were not effective in meeting the students’ pedagogic needs that were effectively met by primary or secondary courseware.

12.5.2 Definition of tertiary courseware

Additionally, this research study has clarified the definition of tertiary courseware, by making a distinction between courseware that facilitates *vicarious learning*, and courseware that facilitates *learning by observation*.

While this research study has presented evidence that vicarious learning material is effective in meeting the pedagogic needs of some students, there were other students whose access to vicarious learning material did not facilitate deeper understanding of the topic, even though they were in the same student cohort, course and stage of the course (as detailed in the pedagogic recommendations in Chapter 11.9: *Pedagogic recommendations*). These students were only able to copy the works of the student in the material and therefore were not vicariously learning from the experience of that student. If these students had been physically present in the tutorial, the topic discussed and the activities that took place would have been outside their *zone of proximal development* (Vygotsky, 1962). What would have taken place would not have been vicarious learning, but learning by observation or imitation.

There are two consequences to this finding. Firstly, vicarious learning material would be more effective as tertiary courseware if the complexity of the topic discussed is within the zone of proximal development of the students accessing the material (see Chapter 11.9: *Pedagogic recommendations*). Secondly, there is a subtle, but crucial difference between *vicarious learning* and *learning by observation*. In the latter case,
the observer’s competence in the topic is so inferior to that of the person being observed, that the observer does not recognise what the person being observed is learning from the activity. For example, an amateur pianist would learn something from observing a concert pianist performing a Beethoven piano concerto, but she would not be aware of what the concert pianist had learnt from the experience, or any ‘mistakes’ that were made. On the other hand, a fellow concert pianist may have vicariously learnt from the same performance, noticing that the other pianist had initially struggled to perform the piece with a light Beethoven style on a ‘heavy’ Steinway grand piano, and consequently changed to a more Brahmsian style half way through the performance. An example of this occurring within the domain of this research can be found in phase 2 of the UCL case study (see Chapter 9: UCL Case Study Phase 2 – Interaction Patterns). Some students in that study were merely copying the dataflow diagrams (DFDs) that were on the screen as their answers to the questionnaire, without any evidence that they have reflected on the overall design of the system. Such students may have been able to present the ‘correct’ DFDs for the process “authenticate user”, but would not have been aware that the student in the video clip had learnt from the feedback of the tutor, i.e. that the overall design of the system can be improved by implementing a single datastore of user information that can then be accessed by other processes in the system, avoiding the redundant duplication of data in the system.

The notion that the same material facilitates vicarious learning in one student, and learning by observation in another (as outlined in the examples given above), raises the issue of the definition of tertiary courseware. Up until this point, tertiary courseware has been defined by its content and where that content originates from, i.e. the use of secondary courseware. However, with the distinction being made between vicarious learning and learning by observation or imitation, the definition or categorisation of a particular courseware now also depends on how that courseware is used by the student. To the student who is learning by observation, the material may not facilitate deeper understanding of the topic, but instead introduce a topic. Consequently, for that student, the material is primary in terms of its role in the student’s learning. However, the same material could facilitate vicarious learning in another student who has a better grasp of the basic of the topic. For that student, the material is tertiary in its role. The fact that materials developed as tertiary courseware can serve the purpose of primary courseware
Conclusions

for some students is not a weakness of tertiary courseware. It just shows the variety of benefits the development of tertiary courseware can have on a student cohort of mixed abilities.

12.5.3 Purpose of tertiary courseware

One of the benefits of vicarious learning material is its ability to reveal where the difficulties are with a certain topic, both from the point of view of the lecturer and the students. Consequently, this presents the opportunity for those difficulties to be addressed. It is difficult for individuals, both lecturers and students, who have achieved competence in a topic or subject area, to speculate what difficulties novices in the topic may have. By constructing learning material from real difficulties that students are having with a topic, vicarious learning material reveals where potential difficulties are, not only for the students but also the lecturer, who can then make appropriate additional preparations to address such difficulties.

More importantly, this research study has also expanded on what the pedagogic purposes of tertiary courseware are. It has presented empirical evidence (see Chapter 9.8: Students’ perception of vicarious learning resource) that one of the major benefits of vicarious learning is its ability to facilitate student learning about how to learn a certain topic. That is, by observing fellow students engaged in a learning dialogue with the tutor/lecturer, the learner not only learns what the main issues are with a particular subject, but also what questions to ask, how to ask those questions, and why such questions are important for learning the topic. This benefit can be as important as what is being learnt in subjects such as philosophy, where the ability to conduct a debate is part of the demonstration of competence by the students. This is consistent with Mayes’ argument (Mayes et al., 2001) that vicarious learning material does not only present the learner with a model of what it means to be an expert in a certain subject, but also a model of how to be an expert in learning that subject.

12.5.4 Tertiary courseware and the Laurillard framework

This research study’s contributions to pedagogic theory have so far been discussed within the context of Mayes’ (1995) categorisation of courseware. However, such categorisation was made in full awareness of the Laurillard conversation framework (Laurillard, 2002). More specifically, the categorisation reflects the appropriateness of
Conclusions

different types of courseware in meeting with the pedagogic needs of the students during certain activities presented in the framework. For example, it would be appropriate to use primary courseware to support the conceptual knowledge level activities of the students while secondary courseware can be used to support the experiential knowledge level activities. As mentioned earlier (see Chapter 12.4.1: Framework for developing effective vicarious learning material), this thesis has referred to the Laurillard framework during all phases of the case study when contextualising findings with respect to the pedagogic content of the material produced, demonstrating that the framework can be used as a framework for assessing the effectiveness of the material based on its content. This lends support to the view that it is useful to conceptualise vicarious learning material in terms of Laurillard's division of learning or 'mathemagenic' activities, in particular, the division of conceptual and experiential knowledge level activities. Additionally, in the context of the definition of tertiary courseware (see Chapter 12.5.2: Definition of tertiary courseware), the learner needs to be aware these mathemagenic activities in order for vicarious learning to take place instead of learning by observation.

Consequently, a stronger link between the Laurillard framework and vicarious learning has been established. Not only do vicarious learning and the Laurillard framework both emphasise the crucial role of dialogue in learning, the Laurillard framework can also be used to describe what it is in vicarious learning material that makes it effective as courseware.

Paradoxically, this stronger link between vicarious learning and the Laurillard framework contradicts Laurillard's view that "local idiosyncrasies of teaching" (Laurillard, 1993) should be avoided when developing educational multimedia and that such development should be carried out by a central courseware development team. Laurillard's view was formed within the context of the economics of developing e-learning material. The aim of establishing a central courseware development team is to avoid the duplication of effort in creating the same or similar kind of courseware in different educational institutions. However, the research for this thesis has shown that such "local idiosyncrasies" are valuable resources in creating effective educational multimedia, when, as more often than not, the students' pedagogic needs and their goals as a community of learners are very much "local idiosyncrasies". For example, in order
Conclusions

to meet the pedagogic needs of the students in the two case studies of this research, the vicarious learning materials were created from the problems that the students were having while they were on their particular learning trajectories that were determined by their lecturers. This ability for lecturers to be able to control the learning trajectories of their own students has been found to be an important factor in the successful implementation of educational technology (Monthienvichienchai et al., 2001). This sense of trajectory for the student as a learner is missing from Laurillard’s framework, but is a key attribute in Wenger’s community of practice (Wenger, 1998). This also highlights a deficiency in the framework in that, when using it to analyse a learning activity or technology, the framework treats activities with different granularity as if they are the same (Michaelson, 2002). For example, a one-to-one dialogue between a student and tutor on a particular topic is analysed in the same way as a visit to a company’s open day. In the latter case, the visit could help to aim the trajectory of the student towards being a member of the community of practice of professionals within a particular field, whereas the tutorial would deal with a very localised, but equally important, topic within that field. Laurillard’s view on the development of educational multimedia is a reminder that her conversational framework emerged from a distance-learning context, where such “local idiosyncrasies” may be less desirable, as they are more costly to support and manage. This research study finds that such “local idiosyncrasies” are desirable and the cost, in terms of time and money, of developing effective educational material from them is not beyond the resources of most educational institutions. Therefore, efforts should be made to support and manage the creation and usage of such material, e.g. tertiary courseware.

12.6 Methodological research contributions

This research has deployed investigative methods normally used in HCI evaluation during systems analysis and design. These range from data collection methods such as user interviews and observations to on-screen user interaction logging. This research has adopted these methods for evaluating the effectiveness of educational material and constructing requirements specification for producing effective materials.

However, these methods have not been adopted without appropriate augmentations to accommodate the pedagogic goals of this research. For example, the use of on-screen logging is commonly used to log usability problems experienced by the user. While
Conclusions

this was one of the goals of using this method of data collection for phase 2 of the UCL case study, it was possible to log, using the same method, the overall strategy that the student adopts when using vicarious learning material. Additionally, the video analysis method of overlaying the on-screen and off-screen video streams is also a well-established HCI evaluation technique. This technique has proved to be successful in allowing effective analysis of the student’s learning strategies by enabling the on-screen and off-screen activities that were recorded to be studied (see Chapter 9.5.1: Overlaying video streams).

Another successful adoption of HCI data collection techniques was the overall data collection strategy used in phase 3 of the UCL case study. Many of the methods used are again well-established HCI evaluation techniques when performing systems analysis and design. User observations, diaries and interviews were used to determine how a CSVL implementation might infringe on the lecturers’ or students’ behavioural, social, cultural and evaluative norms. The main advantage of these evaluation techniques when used together is to allow the designer to methodically uncover what the problems are in a complex human organisation, in particular those that are caused by conflicts with social and cultural norms. As this was the main focus of this phase of the case study, such analysis and data collection methodology was successful in finding how a CSVL system might infringe on those norms.

Even though this research has adopted many HCI evaluation methodologies, it would be incorrect to say that educational software can be evaluated in the same way as any other software, such as word processors or web browsers. The goals of educational software are harder to derive and the tasks that the users perform often cannot be defined precisely. For example, testing whether an interface allows the user to save a file to hard disk quickly is much more precisely defined than testing to see whether the interface allows the student to learn a topic effectively and efficiently. This research finds that HCI evaluation techniques can be used if the goals of the evaluation have been formulated appropriately, especially by taking into account the pedagogic goals or the instructional objectives of the material.
Conclusions

12.7 Review of research design and methodology

In this section, a review of the overall research design and methodology used during each phase of the two case studies is given. With hindsight, it is possible to see a number of areas that can be improved upon. In such cases, the steps that can be taken to implement the improvements are also given.

12.7.1 Using two case studies

Two case studies were used in this research for conceptual and practical reasons. While the ideal situation would be to have all the issues that are to be investigated by each phase of each case study fully mapped out, this was not possible due to the exploratory nature of this research. Often a phase of one of the studies would uncover issues that have not yet been investigated. Consequently, the next phase of study would then be adapted so that these issues can be investigated. This would not have been a problem if students were available throughout the academic year. In reality, students were only available (willing to participate in the study) during the term in which the topics covered by the test material were being covered. At UCL, this was the first term (October to December) of the academic year, giving a very small window in which data could be collected. To deal with this problem, a second case study was setup at St. John’s University, Bangkok where the optimum time for gaining access to students was once again the first term of the academic year. However, in Thailand, this was the period from May to August. With this setup, it was possible to have two ‘vintages’ of data collection rather than one in each academic year.

12.7.2 Subjects for case studies

Due to the nature of vicarious learning material, studies conducted for this research had a subject pool of limited size. This was due to the fact that, for materials to be vicarious in nature, the subjects involved in the study must come from the same course or at least share the same pedagogic experience (students may come from different courses, but attend the same lectures). This affected the size of the subject pool at the following two stages of this research:

1. while conducting case studies concerning capture of vicarious learning materials (UCL Case Study Phase 1), and
2. while conducting case studies concerning usage of vicarious learning materials (UCL Case Study Phase 2).
Conclusions

Consequently, these phases of the UCL case study suffered from having a smaller number of participants than expected. UCL case study phase 1 had only five student volunteers in total. If there were more subjects for phase 1 (see Chapter 7: UCL Case Study – Phase 1), then it may have been possible to gather more diverse data on the kind of amendments students make to their answers, or to see emerging a general pattern in the kind of amendments made. The main cause of this could have been because the study was not conducted during the same term as the B160 course, as that term was used to capture the test material in the first place. Consequently, students may not have seen enough immediate benefit for them to participate in the study. This suspicion was confirmed when phase 2 of the study (see Chapter 9: UCL Case Study – Phase 2) received more than four times the number of volunteers (twenty in total) of phase 1 when it was conducted during the same term as the B160 course. However, this phase of the study suffered from eight students failing to show up at the last minute and two students invalidating the sessions. If it was known before the study that there would be only ten subjects, then it may have been more appropriate to alter the study setup to have less material sets with which the subjects would interact with, i.e. only use MS1 and MS3 in the study. This would still allow the comparisons between interaction patterns of synchronised and unsynchronised material. Additionally, with more subjects per material set, it may have been possible for more patterns concerning usability issues and interaction tasks to emerge.

Overall, while the number of students in each study was limited, they were in sufficient number to allow each phase of the case study to explore issues allocated for that phase. In most of these cases, issues were discovered during each phase of the case study that warranted deeper investigation using more controlled conditions and larger number of subjects (see Chapter 12.7: Future work).

Conversely, the SJU case study did not suffer from the lack of subjects in terms of the percentage of the subject pool that volunteered for the study. As a matter of fact, the subjects in both phases of the study represented the total population of the available subject pool. In order to obtain a larger subject pool, it would have been necessary to involve students from another course, which would have made the process of creating the appropriate vicarious learning material for that student cohort more complex and
time-consuming. Without significantly more resource (in terms of time and money), it would not have been possible to perform the same manner of investigation, using the same depth of analysis, with a significantly larger subject pool. Nevertheless, phase 2 of the SJU case study had only ten subjects. A consequence of this on experimental setup was that only one comparison between two different material sets was possible, i.e. subjects were first exposed to MS1 and then MS2. It would have been preferable to expose the subjects to three other comparison conditions: (MS1, MS1), (MS2, MS2) and (MS2, MS1). This would have enabled confirmation of the effect of MS2 on the students' learning output, by discounting the effects that may have been observed in these three comparison conditions.

12.7.3 Emphasis on qualitative rather than quantitative research

As the size of the subject pool for both case studies was small, it was not possible to perform a large-scale statistically significant quantitative investigation of CSVL. However, the small subject pool presented an opportunity to conduct detail studies that focused on gaining a deeper understanding of lecturer and student interaction with CSVL. This line of inquiry was more consistent with the direction of this research.

In the majority of phases of both case studies, the data collection methods deployed were successful in collecting the relevant data with the appropriate level of detail for analysis. However, an improvement in the data collection method of phase 1 of the SJU study would have resulted in a more revealing data set concerning the perceived quality of the material by the students. That is, videotaping the focus groups, when they were watching each material set as well as when they were making comments, would have captured the reactions of the students to each material set more effectively. There were instances when some students in the focus groups, while they were watching a material set, started to point to certain parts of the material and began talking to other students about what they had just seen. Their comments at this point were not recorded on the audiotapes, as the equipment was setup to only capture comments after both material sets have been shown. Additionally, having the video of the focus groups would have made it much easier to transcribe and analyse which students were saying what during the session. It was often difficult to distinguish between different students in a focus group using only the audio recording, even though the quality of the recording was sufficient for accurate transcriptions of each session to be made.
12.7.4 Student anonymity

More vicarious learning material could have been created during this research by anonymising the material that have been captured. At times, some students were reluctant for their tutorial sessions to be used as material for further studies, let alone made available to every student on the course in the current or the following academic years. However, these students were willing to give their consent if the material could be anonymised before being distributed. For practical reason, the decision was made to only use material that do not require anonymisation as the process of anonymising a video clip requires a large amount of time and effort to accomplish effectively. Additionally, the effect of anonymising a vicarious learning video clip on its pedagogic effectiveness is unpredictable. If the material is text-based or only contains audio, it may be easier to anonymise and the students may be more willing to have their works used as vicarious learning material. However, the creation of text-based or audio-only vicarious learning material is not within the scope of this research.

12.8 Future work

This section outlines outstanding challenges that have been identified, but have not yet been addressed by this research. The issues raised here generally concern the issues of implementing CSVL on a wide scale and additional requirements that such an implementation may entail.

12.8.1 Large-scale implementation of CSVL

12.8.1.1 Archiving dialogues

If CSVL is implemented on a wide scale with a widespread user base in terms of both lecturers and students, the issue of how materials should be archived, to optimise the students’ ability to search, retrieve and share materials, will need to be fully investigated. This is not yet an issue that needs immediate attention, as CSVL is still not yet widely used within the empirical setting of this research, due to the fact that many of the obstacles presented still need to be addressed. However, at this stage, the following issues can provide a starting point for further research looking at how to archive vicarious learning materials.
Conclusions

Once the material has been captured, be it a transcript, audio recording or a video, how should it be archived? This depends on how the material is to be accessed and used by the student or lecturer. From the lecturer's point of view, the basic requirements for storing materials include:

- Ability to organise the materials into a coherent structure
- Ability to search for materials

There are many research studies that have been done on indexing, storing and retrieving multimedia material. Many of these involve the use of metadata to provide additional structure and information on the material stored. For example, works have been done on thematically indexing video for database retrieval and query processing (Khoja and Hall, 1999). From the metadata point of view, perhaps similar implementation could make use of Laurillard's framework or even categories derived from a phenomenographic study (Marton and Booth, 1997) of the students' understanding of the topic to provide structure of framework for organising material. Additionally, instructional objectives (Gronlund, 2000), mentioned in the previous section, can give additional information to the student about what they are expected to learn.

12.8.1.2 CSVL and educational metadata

While it is possible for vicarious learning to be effectively used in a different student cohort from the one that the materials originated from, it is not known at what scale or whether such activity will take place. Early reports from the Candle Project (http://www.ee.ucl.ac.uk/~pants/projects/candle/) suggest that teachers/lecturers are not using as much materials from outside their course as expected, even when those materials are tagged with metadata. If vicarious learning in general, or the material that has been produced for a specific student cohort, is only applicable in small or specific context, then the need for metadata tagging and database archiving is greatly reduced.

12.8.1.3 How reusable are vicarious learning materials?

A possible debate concerning the use of vicarious learning materials is how reusable the materials actually are. The nature of vicarious learning itself dictates that materials are captured from students who have gone through the learning process before those who are observing the dialogues. In cases when the content of the course changes dramatically over the course of one academic year, the usefulness of vicarious learning
material is debatable. However, in most cases, even in programming courses where the
programming language being taught changes to follow the current trend of the industry,
the core concepts remain the same. It is perhaps in this area that vicarious learning
materials will be most reusable.

12.8.1.4 How does a student know which part of which material to access?
Again, this is returning to the problem of how materials should be archived. How
vicarious learning material is archived will affect how students would know which part
of which material to access. This also raises the issue of how or whether metadata can
be used to support this aspect of CSVL. However, this is outside the scope of this
thesis, but is an issue that needs to be investigated fully if CSVL is to be implemented
widely.

In order to investigate issues concerning large-scale implementation of CSVL, it would
be necessary to recruit more educational professionals, who teach courses that are
conducive to deploying CSVL (see Chapter 11.9: Pedagogic recommendations), and
their students into this investigation. A study of tasks that lecturers and tutors perform
while capturing and authoring material should be conducted in the same manner as this
research study, i.e. investigating the issue of providing computer support from a cross-
disciplinary perspective. This would allow an investigation into what additional
computer support a large group of material authors would need to create and share
effective vicarious learning material. A similar setup in the MANTCHI project (Gong
and Newman, 2002) has enabled requirements concerning an efficient access control
model for a distributed authoring environment to be constructed.

Once a large array of vicarious learning materials has been created, it would be possible
to study how the archive and access of these materials can be effectively and efficiently
supported. Substantial research studies into facilitating efficient access to learning
objects in general are already taking place in the forms of investigations into IEEE
LOM and Dublin Core metadata schemas. However, a large majority of these studies
have approached the issue of supporting efficient access to learning objects from an
information archivist point of view, often resulting in implementations of a very large
array of metadata fields that, in turn, causes usability problems for those creating or
accessing the objects (Monthienvichienchai et al., 2001). Moreover, such studies have
Conclusions

not investigated what additional requirements for archiving or accessing learning object vicarious learning material may have. This research study has already highlighted the possibility of using categories based on a phenomenographic study of the students’ understanding of the topic to enhance the effectiveness of metadata for describing learning objects containing vicarious learning material. Having a greater number of material authors, creating a large number of materials, would also allow an investigation into whether material authors would actually share and use each other’s materials.

12.8.2 How can the authoring process be optimised?

One important point not to overlook is how much effort it would take for the lecturer to use the system. Lecturers are under constant pressure to do too many tasks in too little time. For a CSVL system to work, it needs to require only reasonable effort from the lecturer. One way to minimise efforts required from the lecturer is to make the process of publishing material on the web an automatic process. This is possible if the system makes use of metadata and structure of the material provided by the lecturer when the material is being stored. It may also be possible to automatically generate metadata from the captured material by using speech recognition to identify the main concepts under discussion.

12.8.3 Will support for off-line access be useful to students?

This is a design requirement that was derived in another project in the department of computer science at UCL. One of the requirements of the TACO (Teaching and Coursework Online) project (http://taco.cs.ucl.ac.uk:8080/taco/www/), which is investigating the use and implementation of computer-aided assessment, includes the ability for student to work at home either via the Internet or off-line. As the CSVL system requires even higher bandwidth than TACO for video/audio viewing, it would not be practical for students to access materials from home over a 56K modem connection. Of course, if the student lives in a hall of residence with a network connection, then there is no longer a bandwidth problem and the system can be used online.

12.8.4 More detailed investigation of student’s interaction with material

This need for further investigation in this area stemmed from an observation during the phase 2 of the UCL case study. Students who used ‘manual prop access’ materials,
where the prop access method was not supported by a temporal stamp, had to click on the browser window to access ‘Student Action’ stage of the interaction. For these students, this lifted the browser window above the QuickTime™ video clip window – covering the QuickTime™ window altogether. However, this did not stop the video clip from playing and the audio track could still be heard as before. Some students did not return to the QuickTime™ window (i.e. promote it to the top again) for some time. This prompts the question, how often do the students, including those interacting with the in-line video clip, really look at the video clip? Although using the video clip in the material had a positive effect on the perceived quality of the material by the student, it is not clear when the students actually looked at the video clip. For example, what proportion of the time spent interacting with the material was spent viewing the video clip compared with the time spent looking at the action of the student and tutor in the prop view? Theoretically, this is concerned with what strategies students employ when presented with vicarious learning materials containing activities from both the conceptual and experiential knowledge level of interaction. A possible approach to investigating this issue includes the use of an eye-tracking device for investigating students’ interactions with the material. This will allow for a more detailed analysis of their interactions, as the device will enable more detailed analysis of what visual resource the students make use of on the screen.

12.8.5 CSVL and communities of practice

While this research made a conscious decision to adopt the Laurillard Conversational Framework as the theoretical foundation for its empirical works, Wenger’s concept of Communities of Practice (COP) also provides a major area of research in terms of what role CSVL can play to support such learning structure. There are some immediate learning needs within the realm of COP that CSVL can support. Some of these needs are highlighted below:

- Effective CSVL will allow for shared experience to be conveyed more effectively, i.e. people will be able to learn from the experience of their peers in the community through vicarious learning materials that address relevant real-world needs of the community.
- CSVL can be used as a mean to generate meaningful discussions on topics that matter to the community.
Conclusions

- CSVL can be used as a way to emphasise or define what is knowledge within a particular community, i.e. what the community wants to learn or values as knowledge. Real-world vicarious learning materials can allow members of the community to learn knowledge that the community really values – not just generic content which may already be out of date.

These issues are not representative of everything that CSVL has to contribute to the development of COP. However, they do illustrate that such contribution is non-trivial and research into the requirements of CSVL that can effectively support COP would constitute a major benefit and progress to the development of vicarious learning material.

On the other hand, the development of COP could also aid an effective implementation of video-based CSVL. For example, there were some issues concerning invasion of privacy of the students when video-based material was used to support vicarious learning. In phase 2 and 3 of the UCL case study, some students did not or were reluctant to give their consent for their tutorial sessions to be recorded because they were too embarrassed to show their mistakes to other students. Additionally, Adams (2001) reported some misuse of video-based material that resulted in the privacy of students in the material being invaded. Such invasion of privacy resulted from a mismatch of the assumption of the student on how the material will be used and what it will show. What COP could contribute to this is the promotion of common practice in a domain within the context of a community. The promotion of a COP within the student community could help to clarify for the individual what the expectations of a community of students are, making practices that may now seem uncommon, a familiar and acceptable practice for creating and sharing knowledge. For example, many students in the UCL case study said that they would be more comfortable and willing to give their consents if all the other students were also sharing their mistakes. Such observations indicate that there is a limit as to how issues concerning invasion of privacy can be solved through technology alone. Consequently, it is in this area that COP could make significant contributions to ensuring a successful implementation of CSVL.
References

13 References

Books and Journals Articles


References


Poole, M. (1685). “A Dialogue between a popish priest and an English protestant: wherein the principal points and arguments of both religions are truly proposed, and fully examined.”. London, Tho. Cockeril.


References


Borehamwood, Herts., Lontec.


Web References

All sites listed were last accessed on 1st July 2003

**CANDLE Project** at http://www.ee.ucl.ac.uk/~pants/projects/candle/


**The Dissemination Tutoring System** at http://www.hcrc.ed.ac.uk/Vicar/TT/

The Computers in Teaching and Learning course was a module of an MSc in Human Computer Interaction at Heriot-Watt University.

**Dublin Core Metadata Initiative** at http://dublincore.org/

**eClass Project** at http://www.cc.gatech.edu/fce/eclass/index.html
References

A project within the Future Computing Environments group of Georgia Institute of Technology, Atlanta, Georgia. The project’s mission is to study a general ubiquitous computing research theme, automated capture of live experiences for later access.

**Human Communications 1h**: at
http://www.informatics.ed.ac.uk/teaching/classes/hc1h/

A first year undergraduate course taught at HCRC (University of Edinburgh).


**MIMIO™ Whiteboard** at http://www.mimio.com/

**ReLaTe** at http://piglet.ex.ac.uk/pallas/relate/

ReLaTe is developing and testing video conferencing software for use in language teaching. It is a joint project between the University of Exeter and University College London (UCL). Originally funded by BT as part of the BT/JISC SuperJANET initiative, it has now received further funding from the JISC/JTAP programme.

**TACO (Teaching and Coursework Online)** at
http://taco.cs.ucl.ac.uk:8080/taco/www/

**TechSmith’s Camtasia Studio** at

**VESOL (Video Editing System for Open Learning)** at
http://www.sar.bolton.ac.uk/diverse/overview/vesol.htm

**Vicarious Learner Project** at http://www.hcrc.ed.ac.uk/gal/vicar/index.html

Appendix A: SJU Case Study Phase 1 - Transcript of Focus Groups

Appendix A: SJU Case Study Phase 1 Transcript of Focus Groups.............................220
Appendix B: SJU Case Study Phase 1 Transcript of Video Clip..................................226
Appendix C: UCL Case Study Phase 1 Example of Completed Questionnaire ..........229
Appendix D: SJU Case Study Phase 2 Example of Completed Questionnaire ............231
Appendix E: SJU Case Study Phase 2 Students' Tabulated Answers..........................233
Appendix F: SJU Case Study Phase 2 Students’ Raw Comments..............................243
Student 1 ......................................................................................................................243
Student 2 ......................................................................................................................243
Student 3 ......................................................................................................................243
Student 4 ......................................................................................................................244
Student 5 .......................................................................................................................244
Student 6 ......................................................................................................................244
Student 7 ......................................................................................................................244
Student 8 ......................................................................................................................245
Student 9 ......................................................................................................................245
Student 10 ..................................................................................................................245
Appendix G UCL Case Study Phase 2 Students’ Interaction Profiles.........................246
Appendix H: UCL Case Study Phase 2 Transcript of Interviews...............................261
Time Synchronised........................................................................................................261
Manual Navigation Subjects .........................................................................................267
Time-Synchronised and Manual Navigation ..............................................................273
Appendix I Published Paper (E-Learn 2002)..............................................................285
1 of 6 .............................................................................................................................286
Appendix J Published Paper (LTSN-ICS) .................................................................294
Appendix A: SJU Case Study Phase 1
Transcript of Focus Groups

When a new paragraph is used in the transcript, this signifies a comment made by a
different student in the focus group.

Focus Group 1

Interviewer: Is there a lot of difference in terms of ... look at ...
Group: Lots.
Interviewer: You mean ...
Group: If you are looking at using this video for seeing how people work, there is a lot
of difference because in video 1, we hear how they give orders, pan the camera this way
and that way, but we don't know what happens. But in video 2 we can hear the order
and then we can see what happens.
Interviewer: And do you think it will be help in learning and teaching [the subject]?
Group: Well, you see more in the picture, but what you see is still not very good.
Interviewer: Not very good. As in ...
Group: It's not detailed enough and the angle of the camera is not beautiful. That's just
an example.
Interviewer: Uh-huh. What do the people at the back think?
Group: There should be a feed from the monitor straight to the camera.
Interviewer: Uh-huh.
Group: That should be more visible. When the switcher or the director orders to pan
left or right, we can then see what happens. What we can see [the PIP] is the picture
that has already been edited.
   And the camera could focus on ... when ordered to slice the picture then it's the
   hand slicing and cutting to the director when he orders.
   The thing is we can only see the back of each person we don't know what they
   are doing. We can hear the order but we don't know what happens.
   The sound is very "oo-ee" [muffled].
   There are too many people being the director. They are competing with each
   other to make the order.
   In video 2, it may be that the viewer may be more focused on the smaller picture
   than the order from the control room. It makes us just look at that picture and listen to
   the music and not pay attention to what they are talking about. But in video 1, we can
   hear them but we can't see.
Interviewer: There was someone at the back who said that the sound is very oo-ee.
Group: The music?
Interviewer: And when people speak, can you understand what they are saying?
Group: The order. Yes.
Interviewer: but ...
Group: I can only understand the lecturer but not the other people.
Lecturer: That's because in this case it's like I was the director [students laughs!]
Interviewer: There is also another lecturer at the back.
Group: I can hear him order cut but the student always dissolved.
Interviewer: So you were looking at the student's production. You can hear ...
Group: I heard cut, cut from camera 1 to camera 2 but the students dissolved instead.
But having seen all this, video 2 is more comprehensible.
Both videos were not good.

**Interviewer:** Uh-huh.

**Group:** But if we watch video 2, we’ll understand how things work but in video 1, we don’t know what they are doing.

**Lecturer:** So, it’s not detailed enough for work, but the second one is still better.

**Group:** Video 2 is easier to understand

If it’s for people who have never studied this before, never done this. People, what they were ordering, they won’t be able to understand.

**Interviewer:** And if the lecturer before he shows the video explains that these are the people who are in the controller room, what they do, do you think for people who have never done it before will be able to understand.

**Group:** No.

The video should have people who can use the machines better than this in it instead. If for example, you [the lecturer] give an order and the cameraman is new. The headroom may not have the right proportion in the frame but if you [the lecturer] use people who knows how to use the camera ... because the juniors may not be fluent

**Interviewer:** but although they are not fluent, but if for instance we are not UBC [a local cable network]

**Group:** When an order is given, and this person orders this, the jargon they use isn’t understood. If it’s people who haven’t previously studied this, they know what’s going on but they need to continue watching that this is what happens, but they won’t know immediately at the first instant. Needs to work things out again afterwards.

**Interviewer:** but you can see what went wrong for another student. Do you think that that would be useful? For example, if you are assigned a project, each group has to do a project, and you can see what problems other groups are experiencing, would that be useful?

**Lecturer:** If we are going to use this. If we make this kind of video and we keep this on a server. If a first year or second year who have just started, come in and look at [this]. This is the work of second years. This is how they work. This is the forth year’s. If the first year starts doing this, they won’t be as good as the forth year right?

**Group:** Yes.

**Lecturer:** If we keep this video. Let them see that this is how first years do it, a bit wrong. When you see the forth year, you can see that ...

**Group:** O, so that you can see the developments?

**Lecturer:** Do you think that’ll be useful?

**Group:** Yes [unanimous].

**Lecturer:** So that we can use it to see ... the development. For this one, we used second years so that there are some problems.

**Group:** Yes, you can see. But those people are third years.

**Lecturer:** But they are still just beginners for this course though aren’t they?

**Group:** Yes, just started.

**Lecturer:** in some courses you might start [recording] from the second year, second term.

**Group:** You should start with the second years. Then you’ll see. So, for people who have just started you can see that there are problems here and how do we fix it.

**Interviewer:** you have a problem but you aren’t alone.

**Group:** Yes, I can see that.
Lecturer: And compared with how the lecturer teaches in class that the switcher needs to order, need to count down five, four, three, two, one, before recording the tape, but if this is used as well, compared with teaching with just the lecture.

Group: Better. Using video is much better.

Lecturer: Use this to supplement what the lecturer is teaching. So that you can see.

Group: Better.

Lecturer: You think it's better?

Group: It's better because you can see the picture as well. You can see them working straight away.

Interviewer: You all said that this would be better.

Lecturer: Is there anyone who thinks that it won't be better?

Group: Good, but you need to improve the sound.

It's good but are you going to use this exact video?

Interviewer: Not exactly like this but this style of video.

Group: Would it be better if we see what they should be doing? With this one, it's as if we are watching people just chatting to each other.

You should be able to see more. Equipment, get closer to the people.

Lecturer: more detail?

Group: With this one you can see the wide angle, it's too far, we don't know what they are talking about, we don't know what the agendas are, it looks like they are just chatting.

[End of Session]

Focus Group 2

Interviewer: Any difference?

Group: Yes.

Interviewer: You can comment on whatever you want.

Group: In the first one you can only see the wide angle of the control room. You can see more in the second one. Better.

I like the second one more

The first one is boring.

It's just the same shot all the time and it's far away.

It's just a wide-angle shot. It doesn't focus on any thing

Interviewer: What are you thinking?

Group: It'd be good to see how the hands work, moving switches, something like that.

Should focus more on that rather than use the wide-angle shot. You can hear the order but, each person has an order but viewer won't know that this was ordered here and there.

I think in video one the sound was out of sync. When they counted down, five, five, four, four, the soundtracks were on top of each other.

Interviewer: O, they were on top of each other? And in video two?

Group: That was the same. The same.

Lecturer: That was just the switcher counting down after the director. That's why it was on top of each other.

Interviewer: And the differences between the video, was there a lot of difference?

Group: Lots.

Interviewer: If you can choose?

Group: If I can choose as a viewer, if I really need to choose then the second one is the best.
Appendix A: SJU Case Study Phase 1 – Transcript of Focus Groups

Interviewer: And you said about the first one being boring?
Group: The first one is more boring.
Lecturer: Much more boring?
Group: You can only see the inside [of the control room]. You wonder what they are doing.
Interviewer: And the second one, how boring is that one?
Group: Much less.
Interviewer: Uh-huh
Group: Compare it with the lecturer using transparencies. In the first video, the lecturer is just talking without transparencies and the second one the lecturer has transparencies allowing us to understand more.
[At this point, the lecturer joked about this being relayed to other lecturers, but the students were assured that the recording of the session will go straight to England after translation.]
Interviewer: So, the camera inside [the studio], can you see a lot more then?
Group: Yes. [The group seemed confused why such an obvious question was asked]
Interviewer: And can you understand what is being said?
Group: The sound? When giving order?
   If you ask me, yes, because I know the jargon that were being used. But if other people hear that, if the juniors who have never studied this before, then they might get confused.
Interviewer: and if for instance, you are students who have been assigned assignments in group and then you can see that each group have had these problems, do you think this will help?
Group: Yes, that would help. Yes.
Lecturer: And do you think this video, if we use it as teaching resource together with the lecture, do you think it would have benefits on top of the lecturer lecturing alone? Do you think it would have benefits or not?
Group: Yes, but it’s not comprehensive. The orders don’t cover every topics. And you can’t hear. But still not perfect. If you can see only the outside and inside, then you can see in detail what each person is doing.
Lecturer: But it still has benefits? But not comprehensive enough?
Group: Yes, but not perfect. Because normally, when the lecturer teaches, things are taught in detail. This is how you do things, this is how to do make up, this is how to test the lighting. It’s very detailed, but there are only two shots here.
[The lecturer then ask about whether the students see the benefits of archiving the materials]
Lecture: Ok, there is one question left. If we use this video, maybe video 2 that we saw, and archive it in the university’s server and if the juniors want to go and see and download to see how year three and year four work (in the studio). That kind of thing. Do you think there will be benefits for those who click and download [the video] and see how the how the second-years work, how the third-years work, how the fourth-years work. Do you think there will be benefits for the students? Those who are still novices.
Group: Yes there are.
Lecturer: Yes? How? Don’t just nod, as it won’t come up on tape. There are?
Group: Yes there are. More than the third year.
Lecturer: Well, at least we can see, for the first year who has never done this.
Download the second year’s work. It’s not quite right. Then go and download the fourth year’s work and see that the standard is better. Do you think there’ll be benefits for the students?
Appendix A: SJU Case Study Phase 1 – Transcript of Focus Groups

**Group:** but the forth year will still not be perfect. But the ones we saw there were problems with cameras, dropping, etc... The switcher and the controller needs to work better with each other.

**Lecturer:** but it’s mistakes that the juniors

**Group:** can improve on. Yes.

**Lecturer:** So you think it has benefits?

**Group:** Yes.

**Lecturer:** Is there anyone who doesn’t agree?

**Interviewer:** I’m really interested to hear those who don’t agree... Ok, so is there anything that you can think of that will make this not work. No?

[End of Session]

**Focus Group 3**

**Interviewer:** Having watched the two videos, any differences?

**Group:** They are different.

**Interviewer:** Different, how?

**Lecturer:** How are they different?

[Silence from group then]

**Group:** There’s another camera

**Interviewer:** Do you think it makes a lot of difference then? If there isn’t another camera, is there a lot of difference?

**Lecturer:** Is there a lot of difference? Between

**Group:** Not much.

**Lecturer:** there is another camera, much difference?

**Group:** Not much. In terms of using video 1 and 2 for teaching for real, they are both not appropriate for teaching.

**Lecturer:** because?

**Group:** There are a lot of things.

**Lecturer:** Not enough details?

**Group:** Yes, yes,

**Lecturer:** Wait you have to answer I shouldn’t ask leading questions. How is it? Why won’t it work?

**Group:** As far as I’ve learnt, in the use of the control room, there are more details. You can’t just have three cameras capturing. It can’t convey what the lecturer teaches.

**Interviewer:** And if it’s more details but still with just three cameras. If it has more details...

**Group:** I don’t think it’s just about details. I don’t think it will make any difference either two cameras or three.

**Interviewer:** And for the questionnaire question about which one is more boring, did anyone answer “both”?

[No reaction from group]

**Interviewer:** And did anyone answer that one is more boring than the other?

**Group:** The second one.

**Interviewer:** The second one is more boring than the first?

**Group:** Because it seems like it’s focused too much on the controller. The camera focused too much on this view.

**Interviewer:** If there is a video with more details of the work of each year and if for a second year and want to see what the work of the third years and the fourth years. Do you think this would be useful?
Lecturer: Say our university has a server and it stores videos of work of different years, second year, third year, forth year. And the first year access it and see how the second years work. It’s not perfect. Let’s see the work of the third years. It’s still not perfect. Let’s see the work of the final years. Do you think this will have benefits for the first years? If they get to see it. Do you think this will have benefits for the first years who have never seen how things are done?

Group: Yes, there are benefits. More benefits. To compare, if a first year can see how the second years do things, and if they didn’t do quite what the lecturer told them to, we can then see how the third years do and then we can choose to follow the workings of which year.

Interviewer: So, if it were like that, it would be more appropriate?

[Mute affirmation from students]

Lecturer: And if we use this kind of video, we’re not talking about video 1 or video 2 yet, but if there is more detail and if it’s used to compliment the lecturer, before the lecturer starts teaching.

Group: As teaching and learning material?

Lecturer: Before the lecturer starts to explain that there are two parts to the studio, who is where, this room as cameras. Show this first. Do you think there’ll be benefits? If you haven’t seen all this yet?

Interviewer: Or do you think the lecturer speaking alone is enough?

Group: Yes, [there are benefits]

More detail than this?

Lecturer: No, you’ll be able to see just ... maybe slightly more detail. For example, if we just take video two, will it be better than just having the lecturer talk about it? Just the lecturer talking. Is showing this as well better than that?

Group: Much better.

Interviewer: Better but still not appropriate?

Group: Yes.

Lecturer: But with more detail?

Group: I think that it would be better if the lecturer just bring us down to show us how things work. However, if it’s the steps in the production, then if the lecturer first covers the theory, then show us this tape with more detail then that would be appropriate.

Lecturer: So if it’s to be used as material, it needs to be have more detail.

[End of Session]
Appendix B: SJU Case Study Phase 1
Transcript of Video Clip

Readers who are familiar with broadcasting jargons in English will notice inconsistencies between some terms used in this video clip and those commonly used in studios where English is the principal language of communications. This is due to this transcript being a literal translation of the Thai jargons used in the video clip.

Talent 1: Nat  Cameraman 1: Tui
Talent 2: Ed  Cameraman 2: Puk

**Producer:** OK, we’ll do it now. Play tape. **Five**

**Switcher:** Five

**Producer:** Four

**Monitor 1:** Wait, wait. Start again.

**Switcher:** Four. Three

**Producer:** Start again.

**Switcher:** Wait, wait.

**Producer:** Five four.

**Switcher:** Four

**Producer:** Three

**Switcher:** Three

**Producer:** Two

**Switcher:** Two

**Producer:** Music, go.

**Switcher:** Go

<Music starts>

**Switcher:** Zoom out slowly slowly.

**Producer:** Should have found the talent by now.

**Mixer:** <mumble>

**Producer:** O it’s slipped.

**Switcher:** Tui, where were you? Tui. Were you sleeping?

**Mixer:** <mumble>

**Observing Lecturer:** Cut for now, cut for now.

**Monitor:** Start again.

**Producer:** Cut, cut, cut.

<Video clip cuts to the second take>

**Producer:** Standby.

**Switcher:** Standby.

**Mixer:** Standby <mumbles out of turn>

**Producer:** Five

**Switcher:** Five

**Producer:** Four

**Switcher:** Four

**Producer:** Three

**Switcher:** Three

**Producer:** Two

**Switcher:** Two

**Producer:** Music
Appendix B: SJU Case Study Phase 1 – Transcript of Video Clip

Mixer: <mumble>
Switcher: Go
<music starts>
Producer: Catch the bloke so it's ready. Yeah yeah ok.
Switcher: Zoom out a little
Monitor: <mumble>
Producer: With slow music you shouldn't move too much. Should move back and forth as little as possible.
Switcher: Try to move the camera slowly.
Producer: The head. The head. Don't let it slip <out of shot>.
Switcher: Puk, the head is still slipping <out of shot>
Producer: Yeah, yeah, yeah.
Switcher: Tui, catch Nat.
<mumble and laughter in the studio>
Producer: Two. Two. Camera. Which camera is this? Is this camera 1? Camera two, catch the one person. Puk. Whoever, zoom in there. Tui. Give your order. There only one <camera> left <that is capturing the talents properly>
Monitor: It's gone.
<Video clip cuts to the third take>
Producer: Five
Switcher: Five
Producer: Four
Switcher: Four
Producer: Three
Switcher: Three
Producer: Two
Switcher: Two
Producer: Music go
Switcher: OK
<music starts>
Switcher: That's fine, that's fine. Try to catch the middle section.
Producer: You can look at the next shot now.
Switcher: Camera 2 run out a bit.
Observing Lecturer: Get Pon <character of Ed> to be roughly on the right.
Monitor: Head, head, head, head, head.
Producer: Pair them up, pair them.
Switcher: Camera 1. Camera 1, catch Nat.
Producer: Close up. Close up.
Switcher: Really close up. Really close.
Monitor: Lower, lower.
Producer: Pan right, pan right.
Switcher: Pan right
Producer: Yeah. Is that the closest you can zoom in?
Switcher: Camera 2 camera 2
Mixer: Ed is curling his mouth.
Producer: Down at bit, down a bit.
Mixer: Do we really want to see the whole body? <off-topic comment>
Switcher: Tui, catch Nat.
**Observing Lecturer:** Still, still

**Producer:** Yeah. Focus. Tui. Focus. Camera 1. Focus.

**Switcher:** Camera 1. Focus on Pon too.

**Observing Lecturer:** Yeah that’s it. Cut alternately. Change camera 1 to catch more of Pon.

**Switcher:** Keep on alternating. Whoever is singing, order camera 1 <to catch the talent>. Camera 1 that’s already beautiful <fine>. Centre a bit. Camera 1, centre a bit.

**Zoom out a little**

**Monitor:** Focus

**Mixer:** Focus, focus

**Switcher:** Camera 2, zoom out a little

**Mixer:** <mumbling something about focusing>

**Observing Lecturer and producer:** <mumbling dialogue about the choice of talents>

**Switcher:** Camera 1, catch Nat first. Go on, zoom in, camera 1.

**Monitor:** It’s not clear at all. Tui’s camera. Yeah, why is Tui’s camera blurry?

**Producer:** Pui? Her name is Pui, right?

**Monitor:** Tui

**Producer:** Tui.

**Switcher:** Camera 2 that’s beautiful.

**Producer:** <to someone coming into the studio> Don’t walk pass <the cameras>

**Switcher:** Camera 1 catch centre, the pair. Zoom out a little.

**Mixer:** Serious.

**Producer:** Tell that one to come down a bit.

**Switcher:** Too much.

**Producer:** Camera 1

**Observing Lecturer:** Push the camera down.

**Producer:** Yeah.

<At this point, the talents start hugging each other>

**Mixer:** Oh dear. Life.

**Switcher:** Life.

**Producer:** Mermaids mating.

**Switcher:** Camera 2, zoom in a little.

**Producer:** Go right in. Go right in quickly. Camera 2.

**Switcher:** Watch out for the head. Watch out, camera 2. Camera 1 catch <incomprehensible> a bit. Centre. Camera 1, stay centred.

**Producer:** Not every shot is good but some shots are ok.

**Mixer:** Not every shot is great. So, the shots that are good, how many are there?

**Producer:** First works are like this.

**Switcher:** Camera 2, zoom out.

**Producer:** Camera 2 isn’t very beautiful

**Switcher:** Camera 1, catch Nat only.

**Observing Lecturer:** Camera 1 is fine. Left a bit.

**Switcher:** Watch out for the head. Too much.

**Observing Lecturer:** Why did you choose <another piece of music>? They’ll <the talents> both like it.

**Producer:** Nearly. It’s near the end.

**Observing Lecturer:** Cut to camera 1 more.

**Producer:** Cut, cut, cut.

<End of Video Clip>
Appendix C: UCL Case Study Phase 1
Example of Completed Questionnaire

Computer Support for Vicarious Learning – Experiment 2 Questionnaire

1. The student can ask the tutor to have a look at the coursework in general and tell him/her what’s wrong with it.
   
   True  False  Don’t know

2. In a tutorial, the student can ask the tutor to mark the coursework as if it was handed in “as is” so that an estimated mark can be given.
   
   True  False  Don’t know

3. The student should bring works that he/she has already done so that it can be shown to the tutor in the tutorial.
   
   True  False  Don’t know

4. Do you think the student’s decomposition of process 1 contains problems concerning logical vs. physical DFDs?
   
   Yes  No  Don’t know

   a. If yes, please describe the problem as best as you can in the space provided below:

   Input password and ID is more of a physical process than logical i.e. going from store to process.

5. What was wrong with DFD 1.1?

   a. How was this rectified in the tutorial?

   Told that you can when output is to a different process, but can’t break it down on that level.
6. What was wrong with student's pseudo-code for process 1.2?

- Reducing error message did not have anything for those students who may be rejected.
- Does not need to have return invalid student ID+ just student would do.

7. In the discussion, what was the main flaw with student's top-level DFD? Give as detail an answer as you can.

- The student should be deleted from the store so that if they try to access it again they won't be matched with what's in the store and not authenticated.
- Otherwise having password to expire, it would be better to have a process saying 'delete student' after the 'authentication' process.
Appendix D: SJU Case Study Phase 2
Example of Completed Questionnaire

Questionnaire -- St. John’s Experiment 2
22nd July 2002

Please indicate your answer by circling the option(s). Select ONE answer per question, except when the options are indicated by letters of the alphabets.

General
The student production was filmed in one take.
- True
- False
- Don’t know

It is essential to count down from five before starting a take.
- True
- False
- Don’t know

Conversations inside the control room is kept to a minimum.
- True
- False
- Don’t know

Production
How many cameras were used in the production?
- 1
- 2
- 3
- Don’t know

When the music is slow, how should the cameraman pan the camera?
- Pan it slowly
- As normal
- Don’t know

The student production used too many fade-in’s effects.
- True
- False
- Don’t know

The camera(s) is/are
- Tripod-mounted
- Shoulder-mounted
- Don’t know

How is/are the camera(s) positioned relative to the stage in the studio?
- All on Left
- Centre
- All on right
- Left & Right
- Don’t know

What kind of programme are the students making?
- Music video
- Quiz game
- Documentary
- Talk show
- Don’t know

Production Team
How many talents are involved in this production?
- 1
- 2
- 3
- 4
- Don’t know

The producer’s role is a passive one.
- True
- False
- Don’t know
Appendix D: SJU Case Study Phase 2 – Example of Completed Questionnaire

The talents caused problems for the cameraman by moving too much.

True   False   Don't know

The producer indicated during the studio session that the students' production had which of the following faults?

- The camera's vertical position is incorrect (too low/high)
- The camera's horizontal position is incorrect (too far left/right)
- The cameraman is too slow in capturing the talent
- There are not enough cameras to capture the production
- The students have not planned this session well enough

The producer performs which of the following tasks during the production?

- Takes over the switcher
- Tells the cameraman what angle he wants
- Changes the script of the programme
- Gives instruction to the switcher to change camera
- Gives feedback to the studio team how they are doing

What was wrong with cameramen's coverage of the programme?

- One of the cameramen was capturing only one talent all the time
- The focus isn't very good
- Zoomed out too much
- The camera shot was too high
- Too much headroom above talents' heads

In the video clip, what are two busiest position in the control room?

- Switcher
- Producer
- Sound mixer
- Lighting technician
- Boom operator

Overall Production

What improvements on the production would you implement if you were to make a similar programme?

Thank you for your co-operation.
## Appendix E: SJU Case Study Phase 2
### Students' Tabulated Answers

1st Pass (after MS1)

<table>
<thead>
<tr>
<th>Question 1</th>
<th>Choice</th>
<th>Correct Ans</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/T/a</td>
<td>2/b</td>
</tr>
<tr>
<td>Script #</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question 2</th>
<th>Choice</th>
<th>Correct Ans</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/T/a</td>
<td>2/b</td>
</tr>
<tr>
<td>Script #</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Question 3</th>
<th>Choice</th>
<th>Correct Ans</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/T/a</td>
<td>2/b</td>
</tr>
<tr>
<td>Script #</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>
### Question 4

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

### Question 5

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

### Question 6

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>9</td>
</tr>
</tbody>
</table>

### Question 7

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

234
### Appendix E: SJU Case Study Phase 2 – Students' Tabulated Answers

#### Question 8

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknov/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

#### Question 9

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknov/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

#### Question 10

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknov/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>
**Appendix E: SJU Case Study Phase 2 – Students’ Tabulated Answers**

### Question 11

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

**Total:** 4 0 5 0 1

### Question 12

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

**Total:** 0 0 4 0 6

### Question 13

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

**Total:** 1 3 4 2 4

---

236
### Question 14

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total**: 1 6 0 7 1

### Question 15

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total**: 0 5 2 1 1

### Question 16

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total**: 10 10 0 0 0
### Appendix E: SJU Case Study Phase 2 – Students' Tabulated Answers

#### 2nd Pass (after MS2)

**Question 1**

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Question 2**

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Question 3**

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>4</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
### Question 4

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### Question 5

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

### Question 6

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>5</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

### Question 7

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
## Appendix E: SJU Case Study Phase 2 - Students' Tabulated Answers

### Question 8

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

**Total**: 0 1 1 8 0 0

### Question 9

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

**Total**: 10 0 0 0 0

### Question 10

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

**Total**: 0 10 0 0 0
### Appendix E: SJU Case Study Phase 2 – Students' Tabulated Answers

#### Question 11

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Question 12

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Question 13

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>7</td>
<td>6</td>
<td>9</td>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>
### Question 14

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2</td>
<td>8</td>
<td>0</td>
<td>9</td>
<td>4</td>
</tr>
</tbody>
</table>

### Question 15

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2</td>
<td>7</td>
<td>8</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

### Question 16

<table>
<thead>
<tr>
<th>Script #</th>
<th>1/T/a</th>
<th>2/b</th>
<th>3/F/c</th>
<th>4/d</th>
<th>5/Dknow/e</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>10</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Appendix F: SJU Case Study Phase 2 Students' Raw Comments

Student 1

Comments after video clip 2
Will use Dissolve effect less, i.e., will let the camera rest on the picture more before dissolving. This program dissolves too quickly. Will use cameramen or rehearse with the cameramen so that framed shots are more fluent as, from the video clip, the cameramen used are not yet sufficiently competent. Also, people in the control room are talking too much. If it was me [producing], then I will speak only about the production, so that I won’t disturb [or interfere] with orders given by the producer to the switcher. Additionally, I will use [instead of how it is setup] a still camera angle on a tripod and another shoulder-mounted or maybe even two shoulder-mounted cameras because in a music video, the camera has to move a lot more so that they’ll be able to capture the talent more quickly than this. [because] the cameramen are responsible for most of the faults with this program.

Words: 154

Student 2

Comments after video clip 2
I will study the script better than this, so that if I was making this program, I’ll consider how the picture will come out so that the editing process won’t be complicated.

Words: 32

Student 3

Comments after video clip 1
The producer should be the only person giving orders. The switcher shouldn’t make the orders. He should relay the orders from the producer.

Words: 23

Comments after video clip 2
There were no planning or rehearsal. The people did not do their jobs correctly. The producer should be more active in giving orders than this. The cameramen do not know what they are doing.

Words: 34
Appendix F: SJU Case Study Phase 2 – Students’ Raw Comments

Student 4

Comments after video clip 2
There must be planning before carrying out the work, more specifically, must choose team members that are more competent and appropriate. Especially cameramen, must use more competent cameramen – must be able to follow the talents and focus the camera more sharply. The switcher must be someone who is more knowledgeable about framing pictures. The switcher must know when to use which camera and when cameras should exit, so that the cameramen could follow his orders. Will make things work better than this.

Words: 82

Student 5

Comments after video clip 2
I want to reduce noise from conversations in the control room. And concerning the production, the job of the cameramen, I want the cameramen to study more about how to frame the picture, the size of the picture, because the way the pictures are captured are not good at all. And in terms of effect, they used Dissolve too often, making the viewer bored. What I want to add is the stage. In the video, it looks that there is nothing. I want to add more props on stage.

Words: 89

Student 6

Comments after video clip 2
I will write a script before the production because it looks like there were no script. I will plan the camera angles and the size of the picture [the zoom] beforehand. There should be [before the production] a dialogue between the cameramen and the switcher so that good camera shots are obtained.

Words: 52

Student 7

Comments after video clip 2
There should be prior agreement [arrangement] with the cameramen about what camera angles will be needed, what size – to improve the look of the shots. The producer and switcher should have a good plan so that the cameramen can better follow the orders given.

Words: 44
Student 8

Comments after video clip 2
Must reorganize how people work, i.e., must have a script ready both for the talents and for the production team. Must have clear division of tasks and each person must know exactly what he/she is responsible for. There should be a rehearsal before shooting the production and check all equipments and props, including the readiness of the talents and the production team. The producer should have the most important role, he must give clear and definite orders, must be able to control the situation, maintain concentration and attention so that he can deal with problems that arises as quickly and as well as possible. Most importantly, there must be a clear script and understanding of that script by having a meeting to discuss the script before shooting the production, because if the producer, production team and talents don’t understand the script then there will be problems with the production. Understanding the script is an important part of programme production, because everyone will understand what they are responsible for and what they’ll have to do. For the producer, the

Words: 178

Student 9

Comments after video clip 2
Will plan the show in advance so that the cameramen can work more conveniently and capture the shots more correctly.

Words: 20

Student 10

Comments after video clip 2
I’ll have an “AP” director for directing the talents. I’ll decorate the stage to have more colours than this. I’ll train the cameramen to be more competent, so that they’ll be more fluent. I’ll plan in advance various things so that things will fit together more.

Words: 46
Appendix G
UCL Case Study Phase 2
Students’ Interaction Profiles
**Interaction Profile - Student 1  Holist**

**Features Used (Chronological)**

<table>
<thead>
<tr>
<th>Pause</th>
<th>Rewind (B)</th>
<th>Forward (B)</th>
<th>Rewind (DM)</th>
<th>Forward (DM)</th>
<th>Chapter</th>
<th>TC</th>
<th>Note</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>00:01</td>
<td>Play</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>01:01</td>
<td>Pause</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>01:54</td>
<td>Skips forward to 3rd chapter from 2nd</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>02:49</td>
<td>Skips to 4th chapter from 3rd</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>03:34</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>04:24</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>09:05</td>
<td>Move back to 3rd chapter (prop does not update)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>09:58</td>
<td>Answered &quot;Don’t know&quot; to q.4</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10:07</td>
<td>Answers q.5 1st line</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10:34</td>
<td>Look at side 2 of questionnaire</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11:12</td>
<td>Answers q.6 while screen shows pseudocode view</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12:33</td>
<td>Read q.6a</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12:55</td>
<td>Search but prop did not update</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14:06</td>
<td>Answers q.6a while looking at top level dfd</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14:31</td>
<td>Just trying it out (looking at chapter items?)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14:56</td>
<td>Tried to do something but didn’t work (searching?)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15:41</td>
<td>Tried moving through clip through this interface instead</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17:12</td>
<td>Answers q.7 while viewing discussion about authentication process</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17:28</td>
<td>Turns questionnaire over</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17:52</td>
<td>Move back to 2nd chapter</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18:40</td>
<td>Answers q.5 2nd &amp; 3rd line</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19:05</td>
<td>Answers q.5a</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19:10</td>
<td>Finish</td>
</tr>
</tbody>
</table>
### Interaction Profile - Student 2  

**Holist**

#### Features Used (Chronological)

<table>
<thead>
<tr>
<th>Pause</th>
<th>Rewind (B)</th>
<th>Forward (B)</th>
<th>Rewind (DM)</th>
<th>Forward (DM)</th>
<th>Chapter</th>
<th>URL</th>
<th>TC</th>
<th>Note</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>00:01</td>
<td>Play</td>
<td>Starts answering MCQ before playing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>00:46</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>2:25</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>3:08</td>
<td>1 to 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4:07</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4:09</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4:27</td>
<td></td>
<td>Answers q.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5:36</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5:42</td>
<td></td>
<td>Play</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5:52</td>
<td>Back to ch. 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5:59</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6:08</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6:22</td>
<td>3 to 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6:35</td>
<td>1 to 3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6:40</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6:42</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6:52</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6:54</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7:13</td>
<td></td>
<td>Answers q.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7:19</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7:20</td>
<td></td>
<td>Answers q.4a while looking at &quot;Authenticate Student&quot; DFD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9:10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9:13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9:14</td>
<td>Play</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10:11</td>
<td></td>
<td>Crosses out answer to q.5 (correction)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10:15</td>
<td></td>
<td>Continue answering q.5 (correction)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10:29</td>
<td>Play</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11:00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11:07</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11:12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11:15</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11:35</td>
<td></td>
<td>Answers q.5a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12:09</td>
<td>Play</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12:22</td>
<td></td>
<td>Continues answering q.5a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12:51</td>
<td>Play</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12:55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pause</td>
<td>Rewind (B)</td>
<td>Forward (B)</td>
<td>Rewind (DM)</td>
<td>Forward (DM)</td>
<td>Chapter</td>
<td>URL</td>
<td>TC</td>
<td>Note</td>
<td>Task</td>
</tr>
<tr>
<td>-------</td>
<td>------------</td>
<td>-------------</td>
<td>-------------</td>
<td>--------------</td>
<td>---------</td>
<td>-----</td>
<td>-----</td>
<td>-------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>22:12</td>
<td>2 to 1</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>22:16</td>
<td>1 to 2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>22:19</td>
<td>2 to 1</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>22:28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>22:30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>22:31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>22:49</td>
<td>1 to 2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>22:55</td>
<td>2 to 1</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>22:58</td>
<td>1 to 2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>23:04</td>
<td>2 to 1</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>23:08</td>
<td>1 to 2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>23:13</td>
<td>2 to 1</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>23:17</td>
<td>1 to 2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>23:33</td>
<td>2 to 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>23:53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>23:55</td>
<td>Back to ch. 1</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>23:56</td>
<td>Play</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>24:03</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>24:04</td>
<td></td>
<td>Answers q.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>24:07</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>25:01</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>25:02</td>
<td>Play</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>25:36</td>
<td></td>
<td>Back to ch. 1-ch.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>25:44</td>
<td></td>
<td>Continues answering q.7</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>26:04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>27:22</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>28:17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>28:21</td>
<td>Back to around ch.2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>28:44</td>
<td>Back to ch. 2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>28:45</td>
<td>Back to beginning</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>29:23</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>29:24</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>29:40</td>
<td>Finish</td>
<td></td>
</tr>
</tbody>
</table>
### Interaction Profile - Student 3  
**Holist**

Features Used (Chronological)

<table>
<thead>
<tr>
<th>Pause</th>
<th>Rewind (B)</th>
<th>Forward (B)</th>
<th>Rewind (DM)</th>
<th>Forward (DM)</th>
<th>Chapter</th>
<th>TC</th>
<th>Note</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>24:45</td>
<td>Play</td>
<td>Answers MCQ</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>27:25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>29:03</td>
<td>Back to chapter 2</td>
<td>Answers q.4a while watching ch.2</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>29:24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>30:08</td>
<td>Back to chapter 3 beginning</td>
<td>Searching?</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>30:13</td>
<td>Back to chapter 2</td>
<td>Reviewing?</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>30:36</td>
<td></td>
<td>Finishes answering q.4a (answer in bracket)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>31:11</td>
<td></td>
<td>Looks at chapter items</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>31:23</td>
<td>Forward to ch. 4</td>
<td>Turns questionnaire over when she heard</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>32:16</td>
<td></td>
<td>&quot;Where's your pseudocode for that then?&quot;</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>32:50</td>
<td></td>
<td>Answers q.6 while watching discussion</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>34:10</td>
<td>Tried using it but button did not work as expected</td>
<td>Looking for Diagram 1</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>34:13</td>
<td>Used DM instead to move within ch. 5</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>34:24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>34:39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>34:50</td>
<td>1st and only time pausing the video</td>
<td>Found and Looking at diagram 1</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>35:58</td>
<td></td>
<td>Answers q.6a</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>36:17</td>
<td>Play again (long pause)</td>
<td>Looking for info for q.7</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>37:44</td>
<td></td>
<td>Answers q.7</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>38:54</td>
<td>End of video clip.</td>
<td>Turns questionnaire over</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>38:01</td>
<td>Back to Ch. 1</td>
<td>Looking for DFD 1.1</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>39:07</td>
<td>Play</td>
<td>Answers q. 5</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>39:39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>41:53</td>
<td>Forward to final ch.</td>
<td>Looking for DFD 1.1</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>42:08</td>
<td></td>
<td>Answers q.5a (decided she can't find DFD 1.1)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>43:07</td>
<td></td>
<td>Answers q.5a</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>43:30</td>
<td></td>
<td>Turns questionnaire over</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>43:55</td>
<td>Finish</td>
<td></td>
</tr>
</tbody>
</table>
## Interaction Profile - Student 4  
*Serialist*

### Features Used (Chronological)

<table>
<thead>
<tr>
<th>Time</th>
<th>Task</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:33:38</td>
<td>Start of session</td>
<td></td>
</tr>
<tr>
<td>0:33:47</td>
<td>Answers q.1</td>
<td></td>
</tr>
<tr>
<td>0:34:11</td>
<td>Answers q.2</td>
<td></td>
</tr>
<tr>
<td>0:34:19</td>
<td>Answers q.3</td>
<td></td>
</tr>
<tr>
<td>0:34:47</td>
<td>Forward to Authenticate Student</td>
<td></td>
</tr>
<tr>
<td>0:35:37</td>
<td>Answers q.4</td>
<td></td>
</tr>
<tr>
<td>0:36:08</td>
<td>Forward to Authenticate Student - Forms Database</td>
<td></td>
</tr>
<tr>
<td>0:36:15</td>
<td>Back to Authenticate Student</td>
<td></td>
</tr>
<tr>
<td>0:36:20</td>
<td>Answers q.4a</td>
<td></td>
</tr>
<tr>
<td>0:37:06</td>
<td>Forward to Choose Course DFD</td>
<td></td>
</tr>
<tr>
<td>0:37:13</td>
<td>Forward to Authenticate Student - Process 2 added</td>
<td></td>
</tr>
<tr>
<td>0:37:26</td>
<td>Answers q.5 (1st two lines)</td>
<td></td>
</tr>
<tr>
<td>0:38:19</td>
<td>Forward to Authenticate Student - Forms Database</td>
<td></td>
</tr>
<tr>
<td>0:38:29</td>
<td>Play</td>
<td></td>
</tr>
<tr>
<td>0:38:47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:38:50</td>
<td>continues answering q.5 (3rd line)</td>
<td></td>
</tr>
<tr>
<td>0:40:03</td>
<td>Play</td>
<td></td>
</tr>
<tr>
<td>0:40:11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:40:12</td>
<td>Finishes answering q.5 (heard the explanations in the video clip)</td>
<td></td>
</tr>
<tr>
<td>0:40:29</td>
<td>Play</td>
<td></td>
</tr>
<tr>
<td>0:40:40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:40:43</td>
<td>Answers q.5a</td>
<td></td>
</tr>
<tr>
<td>0:41:17</td>
<td>Turns questionnaire over to 2nd page</td>
<td></td>
</tr>
<tr>
<td>0:41:26</td>
<td>Forward to Data Dictionary</td>
<td></td>
</tr>
<tr>
<td>0:41:40</td>
<td>Forward to Data Dictionary - &quot;ID and Password&quot; Correciton</td>
<td></td>
</tr>
<tr>
<td>0:41:45</td>
<td>Forward to Data Dictionary (Final)</td>
<td></td>
</tr>
<tr>
<td>0:41:55</td>
<td>Played around with chapters but didn't move anywhere</td>
<td></td>
</tr>
<tr>
<td>0:42:16</td>
<td>Played around with chapters but didn't move anywhere</td>
<td></td>
</tr>
<tr>
<td>0:42:26</td>
<td>Play</td>
<td>Looking at the right part of props but wrong part of the video</td>
</tr>
<tr>
<td>0:42:36</td>
<td>Back to Data Dictionary - &quot;ID and Password&quot; Correciton</td>
<td></td>
</tr>
<tr>
<td>0:43:36</td>
<td>Didn't go back fast enough so...</td>
<td></td>
</tr>
<tr>
<td>0:43:54</td>
<td>Started at the beginning of clip Mistake? Went too far?</td>
<td></td>
</tr>
<tr>
<td>0:44:02</td>
<td>Forward to Linking different levels of DFD</td>
<td></td>
</tr>
<tr>
<td>0:44:15</td>
<td>Back to end of Physical vs. Logical So that she can see the beginning of Linking different...</td>
<td></td>
</tr>
<tr>
<td>0:45:26</td>
<td>Back to Data Dictionary</td>
<td></td>
</tr>
<tr>
<td>0:45:48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:45:52</td>
<td>Forward to Data Dictionary - &quot;ID and Password&quot; Correction</td>
<td></td>
</tr>
<tr>
<td>Pause</td>
<td>Rewind (B)</td>
<td>Forward (B)</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></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></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></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></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></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>
</tbody>
</table>
## Interaction Profile - Student 5

**Holist**

**Features Used (Chronological)**

<table>
<thead>
<tr>
<th>Time Code</th>
<th>Note</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>49:09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50:51</td>
<td></td>
<td>Answer q.4a</td>
</tr>
<tr>
<td>51:44</td>
<td></td>
<td>Answer q.3</td>
</tr>
<tr>
<td>52:02</td>
<td></td>
<td>Continues answering q.4a</td>
</tr>
<tr>
<td>53:09</td>
<td>Tried rewinding</td>
<td>Back to beginning of clip</td>
</tr>
<tr>
<td>53:13</td>
<td></td>
<td>Reviewing? Reading q.4</td>
</tr>
<tr>
<td>53:52</td>
<td></td>
<td>Looked at the other side of questionnaire but does not turn over</td>
</tr>
<tr>
<td>53:59</td>
<td></td>
<td>Forward to ch. 5</td>
</tr>
<tr>
<td>54:03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>54:11</td>
<td></td>
<td>Fine adjustment to ch. 5</td>
</tr>
<tr>
<td>54:45</td>
<td></td>
<td>Back to ch. 3</td>
</tr>
<tr>
<td>55:03</td>
<td></td>
<td>Looking at data dictionary</td>
</tr>
<tr>
<td>56:13</td>
<td></td>
<td>Searching? For DFD 1.1 info</td>
</tr>
<tr>
<td>56:27</td>
<td></td>
<td>Answers q.5</td>
</tr>
<tr>
<td>57:27</td>
<td></td>
<td>Answers q.5a</td>
</tr>
<tr>
<td>58:13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>58:27</td>
<td></td>
<td>Turn over questionnaire</td>
</tr>
<tr>
<td>59:51</td>
<td></td>
<td>Answers q.6 while viewing data dictionary</td>
</tr>
<tr>
<td>1:00:00</td>
<td></td>
<td>Answers q.7 while &quot;system state vs. process&quot;</td>
</tr>
<tr>
<td>1:00:29</td>
<td></td>
<td>Looks at top-level DFD</td>
</tr>
<tr>
<td>1:00:50</td>
<td></td>
<td>Reviewing?</td>
</tr>
<tr>
<td>1:00:52</td>
<td></td>
<td>Turn over questionnaire</td>
</tr>
<tr>
<td>1:02:29</td>
<td></td>
<td>Turn over questionnaire</td>
</tr>
<tr>
<td>1:02:35</td>
<td></td>
<td>Forward to ch. 4</td>
</tr>
<tr>
<td>1:02:44</td>
<td></td>
<td>Forward to ch. 5</td>
</tr>
<tr>
<td>1:02:53</td>
<td></td>
<td>Selected ch. 5</td>
</tr>
<tr>
<td>1:03:22</td>
<td></td>
<td>Continues answering q.6</td>
</tr>
<tr>
<td>1:04:32</td>
<td>Selected ch. 5</td>
<td>Reviewing for q.6</td>
</tr>
<tr>
<td>1:05:16</td>
<td></td>
<td>Starts to answer q.6a</td>
</tr>
<tr>
<td>1:05:47</td>
<td></td>
<td>Continues answering q.6a</td>
</tr>
<tr>
<td>1:06:04</td>
<td></td>
<td>Back to ch. 3</td>
</tr>
<tr>
<td>1:06:43</td>
<td></td>
<td>Waiting for diagram to come up.</td>
</tr>
<tr>
<td>1:06:47</td>
<td></td>
<td>Diagram didn't come up so going somewhere else</td>
</tr>
<tr>
<td>1:07:14</td>
<td></td>
<td>Searching</td>
</tr>
<tr>
<td>1:07:30</td>
<td></td>
<td>Continues answering q.7</td>
</tr>
<tr>
<td>1:09:52</td>
<td>Found the diagram so paused here</td>
<td>Continues answering q.6a by referring to diagram on screen</td>
</tr>
<tr>
<td>1:10:33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1:11:33</td>
<td></td>
<td>Finish</td>
</tr>
</tbody>
</table>

*Notes:*
- **Pause:** Indicates a pause in the interaction.
- **Rewind (B):** Indicates a rewind action.
- **Forward (B):** Indicates a forward action.
- **Rewind (DM):** Indicates a forward action.
- **Forward (DM):** Indicates a forward action.
- **Chapter:** Indicates the chapter being accessed.
- **TC:** Time code for each interaction event.
Interaction Profile - Student 6  
Holist

Features Used (Chronological)

<table>
<thead>
<tr>
<th>Pause</th>
<th>Rewind (B)</th>
<th>Forward (B)</th>
<th>Rewind (DM)</th>
<th>Forward (DM)</th>
<th>Chapter</th>
<th>URL</th>
<th>TC</th>
<th>Note</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:01:44</td>
<td>Play</td>
<td>Answers q.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:02:12</td>
<td></td>
<td>Tries to fast forward - a couple of clicks</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0:02:42</td>
<td></td>
<td>Writes &quot;only specific questions&quot; in q.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:03:12</td>
<td></td>
<td>Answers q.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:03:23</td>
<td></td>
<td>Answers q.3</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:03:25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:03:35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:03:43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:03:54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:04:22</td>
<td></td>
<td>Forward to Authenticate Student - Process 2 added</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:04:47</td>
<td></td>
<td>Answers &quot;Don't know&quot; to q.4</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:05:27</td>
<td></td>
<td>Answers q.5</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:05:47</td>
<td></td>
<td>Pressed button that takes her to the start of the clip - Mistake?</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:05:52</td>
<td></td>
<td>Realised her mistake so now fast forwarding.</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:07:10</td>
<td></td>
<td>Answers q.5a</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:07:33</td>
<td></td>
<td>Turns Questionnaire over to 2nd page</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:07:41</td>
<td></td>
<td>Looks at the 1st page of questionnaire but returns to 2nd page</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:08:15</td>
<td></td>
<td>Clicked on Data Dictionary but didn't work</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:08:36</td>
<td></td>
<td>Forward to Data Dictionary (Final)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:09:42</td>
<td></td>
<td>Answers q.6 (1st point)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:10:22</td>
<td></td>
<td>Answers q.6 (second point)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:12:01</td>
<td></td>
<td>Back to Data Dictionary - &quot;ID and PA clicked on this at the right moment in the video clip</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:12:03</td>
<td></td>
<td>Back to Authenticate Student</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:12:49</td>
<td></td>
<td>Forward to Authenticate Student (Final)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:13:08</td>
<td></td>
<td>Answers q.5a</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:17:10</td>
<td></td>
<td>End of Clip</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:17:56</td>
<td></td>
<td>Didn't get very far with this interface so...</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:18:09</td>
<td></td>
<td>Back to Dealing with duplicate form submissions</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:15:54</td>
<td></td>
<td>Back to Top Level</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:16:11</td>
<td></td>
<td>Back to Dealing with duplicate form submissions</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:16:17</td>
<td></td>
<td>Back to around Pseudocode for 1.2</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:16:26</td>
<td></td>
<td>Forward a little bit in the same chapter</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:17:56</td>
<td></td>
<td>Forward to System state vs process</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:18:02</td>
<td></td>
<td>Back a little bit in the same chapter</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:18:07</td>
<td></td>
<td>Back to Dealing with duplicate form submissions</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:18:16</td>
<td></td>
<td>Answers q.7 (1st point)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:19:26</td>
<td></td>
<td>Answers q.7 (2nd point)</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:20:47</td>
<td></td>
<td>End of Clip</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1:21:01</td>
<td></td>
<td>Finish</td>
</tr>
</tbody>
</table>

Appendix G: UCL Case Study Phase 2 - Students' Interaction Profiles
## Interaction Profile - Student 7  
*Serialist*

### Features Used (Chronological)

<table>
<thead>
<tr>
<th>Pause</th>
<th>Rewind (B)</th>
<th>Forward (B)</th>
<th>Rewind (DM)</th>
<th>Forward (DM)</th>
<th>Chapter</th>
<th>TC</th>
<th>Note</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:00</td>
<td>0:00</td>
<td>0:00</td>
<td>0:00</td>
<td>0:00</td>
<td>Play</td>
<td>0:00:16</td>
<td>Play</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0:01:00</td>
<td>0:01:16</td>
<td>0:01:49</td>
<td>Answers q.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0:01:59</td>
<td>Answers q.2</td>
<td>0:02:07</td>
<td>Answers q.4</td>
<td>0:02:58</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:03:01</td>
<td>Play</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0:03:31</td>
<td>0:03:37</td>
<td>Rewind to around Physical vs Logical DFD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:04:16</td>
<td>Corrects q.4</td>
<td></td>
<td>0:04:24</td>
<td>Answers q.4a</td>
<td>0:04:55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:05:31</td>
<td>Play</td>
<td></td>
<td></td>
<td>Answers q.5</td>
<td>0:06:39</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:06:50</td>
<td></td>
<td>0:08:17</td>
<td>Turns over questionnaire</td>
<td>Answers q.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:10:01</td>
<td>Rewind to around Pseudocode for 1.2</td>
<td>0:10:28</td>
<td>0:11:10</td>
<td>Plays off-screen to confirm which process is 1.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:11:16</td>
<td>Starts rough answer for q.6a</td>
<td>0:11:32</td>
<td>0:11:43</td>
<td>Continues rough answer for q.6a</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:11:47</td>
<td>Continues rough answer for q.6a</td>
<td>0:12:29</td>
<td>0:13:42</td>
<td>Answers q.6a from rough answer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:14:54</td>
<td>Play</td>
<td></td>
<td></td>
<td>Answers q.7</td>
<td>0:16:30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:18:12</td>
<td>Rewind to System state vs. process</td>
<td>0:17:46</td>
<td>0:18:21</td>
<td>Finish answering q.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:18:12</td>
<td></td>
<td>0:18:21</td>
<td></td>
<td>Finish</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Interaction Profile - Student 8  **Holist**

### Features Used (Chronological)

<table>
<thead>
<tr>
<th>Pause</th>
<th>Rewind (B)</th>
<th>Forward (B)</th>
<th>Rewind (DM)</th>
<th>Forward (DM)</th>
<th>Chapter</th>
<th>URL</th>
<th>TC</th>
<th>Note</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0:16:19</td>
<td>0:16:20</td>
<td></td>
<td>0:00:00</td>
<td>0:00:00</td>
<td></td>
<td>0:24:51</td>
<td>Play</td>
<td>Answers q.2</td>
</tr>
<tr>
<td>0:26:39</td>
<td></td>
<td>0:26:40</td>
<td>0:26:40</td>
<td>0:26:40</td>
<td>0:26:40</td>
<td>0:26:40</td>
<td>0:27:36</td>
<td>Answers q.3</td>
<td></td>
</tr>
<tr>
<td>0:27:59</td>
<td></td>
<td>0:27:59</td>
<td>0:27:59</td>
<td>0:27:59</td>
<td>0:27:59</td>
<td>0:27:59</td>
<td>0:28:50</td>
<td>Turns questionnaire over</td>
<td></td>
</tr>
<tr>
<td>0:30:15</td>
<td>1</td>
<td>0:30:16</td>
<td>0:30:16</td>
<td>0:30:16</td>
<td>0:30:16</td>
<td>0:30:16</td>
<td>0:31:01</td>
<td>Answers q.6</td>
<td></td>
</tr>
<tr>
<td>0:32:25</td>
<td></td>
<td></td>
<td></td>
<td>0:32:25</td>
<td>0:32:25</td>
<td>0:32:25</td>
<td>0:32:25</td>
<td>Back to beginning of clip</td>
<td></td>
</tr>
<tr>
<td>0:32:40</td>
<td></td>
<td>0:32:40</td>
<td>0:32:40</td>
<td>0:32:40</td>
<td>0:32:40</td>
<td>0:32:40</td>
<td>0:32:40</td>
<td>Answers q.1</td>
<td></td>
</tr>
<tr>
<td>0:32:49</td>
<td></td>
<td>0:32:49</td>
<td>0:32:49</td>
<td>0:32:49</td>
<td>0:32:49</td>
<td>0:32:49</td>
<td>0:32:49</td>
<td>Answers q.2</td>
<td></td>
</tr>
<tr>
<td>0:32:52</td>
<td></td>
<td>0:32:52</td>
<td>0:32:52</td>
<td>0:32:52</td>
<td>0:32:52</td>
<td>0:32:52</td>
<td>0:32:52</td>
<td>Corrects q.2</td>
<td></td>
</tr>
<tr>
<td>0:32:58</td>
<td></td>
<td>0:32:58</td>
<td>0:32:58</td>
<td>0:32:58</td>
<td>0:32:58</td>
<td>0:32:58</td>
<td>0:32:58</td>
<td>Corrects q.3</td>
<td></td>
</tr>
<tr>
<td>0:33:46</td>
<td></td>
<td>0:33:46</td>
<td>0:33:46</td>
<td>0:33:46</td>
<td>0:33:46</td>
<td>0:33:46</td>
<td>0:33:46</td>
<td>Answers q.5</td>
<td></td>
</tr>
<tr>
<td>0:34:10</td>
<td>1</td>
<td>0:34:11</td>
<td>0:34:11</td>
<td>0:34:11</td>
<td>0:34:11</td>
<td>0:34:11</td>
<td>0:34:10</td>
<td>Rewind to Physical vs Logical DFD</td>
<td></td>
</tr>
<tr>
<td>0:34:04</td>
<td></td>
<td>0:34:05</td>
<td>0:34:05</td>
<td>0:34:05</td>
<td>0:34:05</td>
<td>0:34:05</td>
<td>0:34:05</td>
<td>Adds to answer to q.5</td>
<td></td>
</tr>
<tr>
<td>0:34:00</td>
<td></td>
<td></td>
<td>0:34:00</td>
<td>0:34:00</td>
<td>0:34:00</td>
<td>0:34:00</td>
<td>0:34:00</td>
<td>Answers q.5a</td>
<td></td>
</tr>
<tr>
<td>0:35:08</td>
<td>1</td>
<td>0:35:09</td>
<td>0:35:09</td>
<td>0:35:09</td>
<td>0:35:09</td>
<td>0:35:09</td>
<td>0:35:08</td>
<td>Rewind to DFD decomposition</td>
<td></td>
</tr>
<tr>
<td>0:35:00</td>
<td></td>
<td>0:35:01</td>
<td>0:35:01</td>
<td>0:35:01</td>
<td>0:35:01</td>
<td>0:35:01</td>
<td>0:35:01</td>
<td>Answers q.5a</td>
<td></td>
</tr>
<tr>
<td>0:35:50</td>
<td></td>
<td>0:35:51</td>
<td>0:35:51</td>
<td>0:35:51</td>
<td>0:35:51</td>
<td>0:35:51</td>
<td>0:35:50</td>
<td>Answers q.7</td>
<td></td>
</tr>
<tr>
<td>0:36:40</td>
<td></td>
<td>0:36:41</td>
<td>0:36:41</td>
<td>0:36:41</td>
<td>0:36:41</td>
<td>0:36:41</td>
<td>0:36:40</td>
<td>Turns questionnaire over</td>
<td></td>
</tr>
<tr>
<td>0:36:16</td>
<td></td>
<td>0:36:17</td>
<td>0:36:17</td>
<td>0:36:17</td>
<td>0:36:17</td>
<td>0:36:17</td>
<td>0:36:16</td>
<td>Continues answering q.6</td>
<td></td>
</tr>
<tr>
<td>0:39:26</td>
<td>1</td>
<td>0:39:27</td>
<td>0:39:27</td>
<td>0:39:27</td>
<td>0:39:27</td>
<td>0:39:27</td>
<td>0:39:26</td>
<td>Authenticate Student (Final)</td>
<td></td>
</tr>
<tr>
<td>0:40:27</td>
<td>1</td>
<td>0:40:28</td>
<td>0:40:28</td>
<td>0:40:28</td>
<td>0:40:28</td>
<td>0:40:28</td>
<td>0:40:27</td>
<td>Rewind to Pseudocode for 1.2</td>
<td></td>
</tr>
<tr>
<td>0:41:42</td>
<td></td>
<td></td>
<td>0:41:42</td>
<td>0:41:42</td>
<td>0:41:42</td>
<td>0:41:42</td>
<td>0:41:42</td>
<td>Answers q.7</td>
<td></td>
</tr>
<tr>
<td>0:43:32</td>
<td></td>
<td>0:43:33</td>
<td>0:43:33</td>
<td>0:43:33</td>
<td>0:43:33</td>
<td>0:43:33</td>
<td>0:43:32</td>
<td>End of clip</td>
<td></td>
</tr>
<tr>
<td>0:43:33</td>
<td>1</td>
<td></td>
<td>0:43:33</td>
<td>0:43:33</td>
<td>0:43:33</td>
<td>0:43:33</td>
<td>0:43:33</td>
<td>Finish</td>
<td></td>
</tr>
</tbody>
</table>
### Interaction Profile - Student 10  Serialist

#### Features Used (Chronological)

<table>
<thead>
<tr>
<th>Pause</th>
<th>Rewind (B)</th>
<th>Forward (B)</th>
<th>Rewind (DM)</th>
<th>Forward (DM)</th>
<th>Chapter</th>
<th>URL</th>
<th>TC</th>
<th>Task</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>0:47:25</td>
<td>0:48:21</td>
<td>0:48:40</td>
<td>0:48:45 Just a little (4 clicks)</td>
<td>0:49:09</td>
<td>0:50:00</td>
<td>0:50:05</td>
<td>0:50:07 Back to Linking different levels of DFI Button didn't work so used DM instead</td>
<td>0:50:17 Back to DFD decomposition (1)</td>
<td>Answers q.1</td>
</tr>
<tr>
<td>0:51:09</td>
<td>0:51:43</td>
<td>0:52:00</td>
<td>0:52:31 Looks at the 2nd side of the questionnaire</td>
<td>0:52:42 Turns questionnaire over to 2nd side</td>
<td>Answers q.2</td>
<td>Answers q.3</td>
<td>Answers q.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0:53:26 Just a couple of clicks again</td>
<td>0:53:34 Back to Pseudocode for 1.2 (5) But uses chapter headings for nav point</td>
<td>0:53:35</td>
<td>0:53:53 Answers q.6</td>
<td>Answers q.6a</td>
<td>Answers q.5 (1st line)</td>
<td>Answers q.5a</td>
<td>Answers q.6a</td>
<td>0:55:00 Continues answering q.6a</td>
<td></td>
</tr>
<tr>
<td>0:55:50</td>
<td>0:56:20 Back to around beginning of System state vs. process (7)</td>
<td>0:56:22 Continues answering q.6a</td>
<td>0:57:22 Answers q.7</td>
<td>0:57:51</td>
<td>0:58:05 End of clip</td>
<td>0:58:15 Data Dictionary - &quot;ID and Password&quot; Correction</td>
<td>0:58:21 Choose Course DFD</td>
<td>0:58:29 Data Dictionary - &quot;ID and Password&quot; Correction</td>
<td>0:58:34 Authenticate Student - Process 2 added</td>
</tr>
<tr>
<td>0:58:37 Authenticate Student - Forms Database</td>
<td>0:58:38 Authenticate Student (Final)</td>
<td>0:58:44 Correct q.6a (direction of dataflow)</td>
<td>0:58:59 Continues answering q.7 (2nd line)</td>
<td>0:59:15 Back to around Dealing with duplicate form submissions</td>
<td>0:59:41 Finish answering q.7 (&quot;where to put the expiry&quot;)</td>
<td>0:59:55 Finish</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Interaction Profile - Student 11

**Serialist**

#### Features Used (Chronological)

<table>
<thead>
<tr>
<th>Event</th>
<th>Time (01:04:55)</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pause</td>
<td>1:03:16</td>
<td>Back to beginning of clip</td>
</tr>
<tr>
<td>Rewind (B)</td>
<td>1:05:32</td>
<td>Answers q.1</td>
</tr>
<tr>
<td>Forward (B)</td>
<td>1:07:01</td>
<td>Back to Linking different levels of DF</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:07:29</td>
<td>Had a look at different chapter titles</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:07:34</td>
<td>Answers q.2</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:07:36</td>
<td>Answers q.3</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:08:16</td>
<td>Back to Physical vs. Logical DFD</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:08:46</td>
<td>Answers q.4</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:08:47</td>
<td>Answers q.4a</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:09:06</td>
<td>Answers q.5</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:09:22</td>
<td>Forward to around Pseudocode for 1 (Mistake?)</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:09:24</td>
<td>A few clicks then gives up</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:09:29</td>
<td>Back to around Linking different levels of DF</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:09:41</td>
<td>Back to around Linking different levels of DF</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:10:03</td>
<td>Back to around Linking different levels of DF</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:10:10</td>
<td>Back to end of Physical vs. Logical DFD</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:10:34</td>
<td>Ammend answer to q.5 (crossed out 1st line, then wrote 2nd line)</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:11:07</td>
<td>Looks at the 2nd side of questionnaire</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:11:16</td>
<td>Back to around Physical vs. Logical DFD</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:11:46</td>
<td>Crosses out answer to q.5 and writes 3rd line.</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:11:59</td>
<td>Back to around Physical vs. Logical DFD</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:12:04</td>
<td>Back to around Physical vs. Logical DFD (earlier)</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:12:13</td>
<td>Answers q.5a</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:12:29</td>
<td>Turns questionnaire over</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:12:40</td>
<td>Answers q.6</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:12:52</td>
<td>Held down rewind button but stays within the same chapter</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:13:04</td>
<td>Play</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>01:13:06</td>
<td>Move more to beginning of Linking different levels of DF</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:13:16</td>
<td>Move more to beginning of Linking different levels of DF</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:13:45</td>
<td>Authenticate Student - Process 2 added</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:13:49</td>
<td>Authenticate Student - Forms Database</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:13:53</td>
<td>Data Dictionary</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:14:03</td>
<td>Choose Course DFD</td>
</tr>
<tr>
<td>Forward (DM)</td>
<td>1:14:10</td>
<td>Authenticate Student (Final)</td>
</tr>
<tr>
<td>Time</td>
<td>Event Description</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>1:14:24</td>
<td>Choose Course DFD</td>
<td></td>
</tr>
<tr>
<td>1:14:28</td>
<td>Authenticate Student (Final)</td>
<td></td>
</tr>
<tr>
<td>1:15:07</td>
<td>Answers q.6a</td>
<td></td>
</tr>
<tr>
<td>1:16:34</td>
<td>Data Dictionary - &quot;ID and Password&quot; Correction</td>
<td></td>
</tr>
<tr>
<td>1:16:54</td>
<td>Authenticate Student - Forms Database</td>
<td></td>
</tr>
<tr>
<td>1:17:15</td>
<td>Authenticate Student - Process 2 added</td>
<td></td>
</tr>
<tr>
<td>01:17.16</td>
<td>Authenticate Student - Forms Database</td>
<td></td>
</tr>
<tr>
<td>1:17:21</td>
<td>Authenticate Student (Final)</td>
<td></td>
</tr>
<tr>
<td>1:17:25</td>
<td>Continue answering q.6a while looking at Authenticate Student (Initial)</td>
<td></td>
</tr>
<tr>
<td>1:18:27</td>
<td>Top Level (Final)</td>
<td></td>
</tr>
<tr>
<td>1:19:35</td>
<td>Back to Dealing with duplicate form submission</td>
<td></td>
</tr>
<tr>
<td>1:19:40</td>
<td>Play</td>
<td></td>
</tr>
<tr>
<td>1:20:30</td>
<td>Answers q.7</td>
<td></td>
</tr>
<tr>
<td>1:20:50</td>
<td>Continue answering q.7</td>
<td></td>
</tr>
<tr>
<td>1:22:19</td>
<td>End of Clip</td>
<td></td>
</tr>
<tr>
<td>1:22:25</td>
<td>Finish</td>
<td></td>
</tr>
</tbody>
</table>
Appendix H: UCL Case Study Phase 2

Transcript of Interviews

In this section, the interviewer's words are represented by bold text, while the students' words are represented by normal text.

Time Synchronised

Student 1

Duration of Interaction: 18 minutes 30 seconds
Time Code: Start .00.10 End 0.18.40

I just need to find out whether you think there are enough materials in there for you to answer the questions that you've got?

Not really. Sometimes it's a little hard to understand what is going on. When I see the pages that she's brought up the DFD. What actually is it that you're discussing? So you can fully follow, if the camera would have gone directly, you know, for like in a film or something you'd see what the people there see, it would have been easier. But still if you're very focused you can. The information is there, I think, most of it.

Right. Have you answered all the questions then?

Yeah one, I haven't answered them because I couldn't really find...

Which one was that?

Which one?

Which did you say you couldn't find...

This one I said don't know.

Question 4.

They had some although she had some physical, but the physical DFDs there was some problems... I heard in the second time. It depends whether you listen to it once or if you listen to it a couple of times like I had to do. If you're only there to do it once, it's not very clear. If you sit down and take each and every part and listen to it again, then it's more clear.

That's good. You've mentioned one improvement already like if you had the camera goes in and you can see what's going on. Do you mean like hand movements or just closer up?
Appendix H: UCL Case Study Phase 2 – Transcript of Interviews

Yeah, sort of closer up so that you can see exactly what it is that you’re doing. It’s not very clear how she has her DFDs from the first page to last page. What it consists of and how she is thinking.

Yes.

That’s not very clear but I don’t know if this is how tutorials look like.

There is another version of this and [at this point the subject is shown the material set with manual mode of navigating through props]. I was asking whether it would have been better for you if you had the options of actually controlling...

[The material then appears on the screen] That’s what I was supposed to say because sometimes it was hard. I wanted to see. When I was hearing about the dialogue and I wanted to see go to different places and see the top level and then so that I could change and go to the top level and then see and go to the pseudocode and look at the different things in her work, so that I wasn’t controlled by the camera that [shows] you know what is already there. So that I could sort off ... go ... yes, yes, this is much better.

So you would prefer to work out what’s being looked at yourself?

Yeah, yeah. I think so. Is it possible to hear both the dialogue and then to …? That would have been good.

What do you mean that?

Like to see the dialogue between the two of you and to listen to it and at the same time as you were able to go and see the work that she the student has done. So here are the DFD and you can go to different parts of her work and at the same time you could if you want to go and listen to the dialogue.

So you want it separate?

Yes, Sort of two separate windows.

That’s great. Thank you.

[End of Interview]

Student 3

Duration of Interaction: 19 minutes 20 seconds
Time Code: Start 0.24.50 End 0.44.10

Did you have any problems using that?

It was easy to use. And this, trying to keep this on while I’m still trying to look at that.

Trying to keep what on? This bit [prop view]
Only because it changes. It's kind of distracting.

**What if you had the option of ... if you have a video here, let's say ... and it's not synchronized like the one you use but you have to choose yourself, what you have to look at. Would you've preferred that one?**

I don't know, actually, no. Because at least with that [time-sync], you know which bit they're talking about. It's not clear when you say it which bit she's talking about but it is if you've got it next to it. But it's ok because you can pause it anyway, so, I did manage to get it back without too much trouble. Maybe if here [chapter navigation], it had the process with the name there as well. You know here you can search for which bit you want to look at. Well, if that had next to it, which picture it corresponded to, then I could choose the one related to the picture, I supposed. You see what I mean?

**Is there anything you want to improve on this? What would it be?**

On what?

**On this material. Apart from the one you've already said about linking this more with this. Or are you quite happy with that?**

I think it's quite clear how it is already. I think.

You don't have to worry about hurting my feelings.

No. I think if it's more clear which picture goes with which bit of the film.

**Which chapter?**

Yeah, I think that's what I would do.

**How would you do that?**

Just have the word next to it. But then, if this was titled then I can have that corresponding to it, then I would know which one is which. But that's more specific to the actual thing rather this in general isn't it?

**So let's say. [Screen shows 1st instance of Data Dictionary in prop] How would you do that [syncing prop and video] differently?**

I don't know really. It's only when I was searching for it [prop changes] I found difficulty finding it.

**Searching for this?**

Yeah, No. Well, yeah, I was trying to search through this [chapter navigation] to find this [prop changes].

So this [chapter navigation] should be a bit more detailed?
Just to show which picture goes with which bit. Then when I was looking for that [the
prop changes] and not that [video chapter], I can find which bit it was.

So this should correspond more with the images here.

Maybe yeah.

Ok. No that, can be done. Well, I think that’s it...

[End of Interview]

**Student 5**

*Duration of Interaction:* 22 minutes 50 seconds  
*Time Code:* Start 0.49.10 End 1.11.40

Did you have any problems then?

Yeah.

Tell me.

Ok, when I was moving, like just moving along using that bar [chapter facility], I found
that the pictures didn’t always match with what was being said immediately. Like it
would eventually come up. And other thing is, when using the thing like in the DVD
chapters, it’s not really like a DVD in that if you get it up you have to select it straight
away, you can’t leave it up and then select one. Which is a bit annoying.

You can click on it and

And then, you see what I mean? Some other things.

Did you know that you can slide this along like that? [direct manipulation
interface]

Using the mouse?

Yeah.

Yeah. Yeah, I did that a couple of times but the thing is the pictures don’t match with
this thing, so I didn’t really do that, but I think other than that it’s quite good. Easy to
use.

What do you think about being able to see another student’s tutorial?

Do you mean before you’ve done the coursework yourself?

Before or after, just the general idea.
Oh right. I think it’s... I don’t really ... it’s hard to say because I think it’s helpful in a way because then you can just sort of see the sort of things that will be said in a tutorial. But in a sense it might not be very nice for the student if they don’t want their tutorial shown to everyone else. I don’t know, it’s hard to say really. I’m not sure.

Well, this student, according to the law you can’t just film someone you have to have their consent. And this student gave her consent for her tutorial to be filmed and shown for the experiment.

Oh right?

So,... and we have other students who consented as well. So in terms of, let’s say in terms of having access to the material, you said you thought it was quite useful.

It could be useful.

It could be useful?

If you might be having the same sort of problems, doing just in general doing DFDs or something. But then I do think it depends if you’ve done the coursework yourself. Because if you’re assigned the same coursework as the student whose, you know, the thing is being broadcasted on the web or whatever, it’s like, you could get ideas from theirs which you may not have yourself which then gives you a bit an advantage they’ve sort of done the thinking, just pick it up, you know because they’ve had the tutorial, but there could be useful things that you could get from it as well.

But what if you haven’t got the same coursework but you’ve got to do DFDs?

Then it could definitely be helpful yeah. Because like

More helpful than...?

Yeah. I think so.

Why’s that?

Because like when I was just looking at that now, because I’m doing a coursework with DFDs I think that is like that’s helped me see what could might be wrong with mine, you know, because I have never done DFDs before so it’s like. I know it now that you have to think of everything from, not like I didn’t know this before the tutorial, but it’s sort of given me an example to see how like you can’t have sort of “input details” you have to have ... you don’t even need that because it’s not a system process, so you know, things like that. So I think even though I’m not doing exactly the same thing as that, it’s still helpful to see the sort of comments that you can make on her project. You know you can sort of apply them to your own, which is quite helpful I think.

So wait a sec, you think it’s more useful when you don’t have the same coursework?
No, I think it can be useful if you don’t have the same coursework. But I think, no, it’s definitely more useful if you are doing the same coursework but I don’t think it’s fair necessarily. That’s what I’m saying.

No, OK. Alright. OK. You’ve mentioned that you’ve got sometimes the... when you say picture do you mean the bit on the right on the left?

Yeah, the right.

What if instead of what you had to use, you had something like this where the video is separate from the actual DFDs they’re being shown? Where you can just choose...

Yeah I know what you mean. I think actually.

Would you think it’s better or worse?

In this sense, I think it would be better to have it like that [manual] because the ... having them both together, it wasn’t fast enough, but if it was, if the chapters sort of, if it was quicker to flick onto this picture, then definitely having them together is easier because you can just move along and it changes together.

So if the timing was better, the other one was better.

But in this instance, I would prefer to have this [manual] because I was getting a bit annoyed that the pictures didn’t match the stuff that was said. Yeah.

So apart from the comments you’ve made already, is there any other improvements you think might be worth it? [silence] You don’t have to give any really.

No I can’t really think of any to be honest, no. I think it was quite easy to use.

Ok. Thank you.

[End of Interview]
Manual Navigation Subjects

Student 2: Manual

Duration of Interaction: 29 minutes 40 seconds
Time Code: Start 0.00.00 End 0.29.40

Did you have any problems with that?
Yeah well I was a bit confused sometimes but I think I managed to...

When were you confused?
Well, someone ... they were asking for process 1 and 2. And it was ... process one once and I could find it. And I think in the final question we had to... That last question.

“What’s wrong with DFD 1”?
It says in the discussion, that means between the student and the ... but they don’t really talk about the top level and that. They start talking directly from ... the first process. So I was looking for that but they start talking about the ... errors ... the physical and logical errors. Apart from that...

Did you have any problems using it?
Using that?
Yeah.

No I was ok.

Yeah? What if you’ve been given something like this instead? [Shown time synchronised material] If this here [cursor pointed at the prop view] was synchronised with this [cursor pointed at the video clip view]. Would you have found that useful?
Yeah basically. Because if it is on the topic then I can compare it and listen at the same time and see what’s wrong.

You prefer not to have to...
Like he is explaining what’s going on here and you can like see what you’re saying according to what is [on the table]

So you think that this one here is better...
Than the other one. Yeah.
Is there any other improvements you think the first one should have? Anything you might suggest?

The one given here?

No the first one. Doesn’t have to be any.

No I think it’s fine. Well. Maybe you should put it a bit bigger here [the top level DFD]

The diagram here?

It’s a bit difficult to see what’s going on.

Well that’s it...

[End of Interview]

Student 4

Duration of Interaction: 21 minutes 30 seconds
Time Code: Start 0.33.40 End 0.55.30
Did you have any problems with that?

Using this? No it was OK. Except for when you ask [for] one point two to process one and two. It was difficult to find in the beginning.

How would it be easier to find?

Maybe if you did for example top-level then. 1.1 1.2 1.3.

Related to the actual process then?

Yes.

Is there anything else?

It was a bit messy. It was hand written. Maybe it might be confusing if it’s correction and final all the time. Top-level Final, does that mean corrected?

Top-level Final. Yeah. So it’s more to do with the labels at the side there?

Yes. They’re easier to see on the right hand side here.

So if it had been a computer diagram drawn

That’ll be easier.

This is all very useful. I’m just going to ask you this one here what we’ve got actually is a time-synchronised version with exactly the same one and when it
comes up... I just want ask you whether you prefer something like this to what you have before?

This links to that? [meaning video links to prop]

**When the diagram comes up...**

Maybe. But how far do they go? [How far does the screen go on the right?]

**Bigger screen here?**

Because then you would have to do the mouse. [Student moves mouse to show that scrolling is necessary]

**Or a smaller diagram.**

On a smaller diagram it’s ok.

**But this is the bigger one. So would you prefer this or the one you had before?**

I like the one before because I can go in different diagrams.

**So you prefer this one?** [Showing subject the one that she interacted with in the experiment] You prefer having that?

Yeap. I prefer that.

**If you had to improve that what else apart from the ones suggested so far, is there any other suggestions you’d want to make?**

About how to do the experiment to make it easier or something?

**About how to make the material better from your point of view. You don't have to give a suggestion.**

Maybe less diagrams you have to go through.

**What so, that would make ..**

The Top Level Final. See in other colours the corrections she’s made. Because you have three data dictionaries and three not two top levels. It’s maybe too much.

Yes, so you want to highlight the changes.

Yes.

**Would you like to see the actually movements when it’s being made – the corrections – or would that make any difference?**

What do mean by movements.
Appendix H: UCL Case Study Phase 2 – Transcript of Interviews

Well, you know when the corrections come on, instead of just having still pictures you have actually the corrections being made.

Yeah. I prefer movements.

Why do you prefer that?

It shows. It attracts the eyes quicker, I think.

OK. So it just draws you to the ...

Yeap.

Well, I think that’s it.

[End of Interview]

Student 6

Duration of Interaction: 19 minutes 20 seconds
Time Code: Start 1.01.40 End 1.21.00

<Subject started making comment before being asked the prompt question – “Did you have any problems with using that?”>

For the first question, can I see the thing again, maybe change the wording a bit or add a line for comment I just added a comment in. because I didn’t understand this “in general” exactly what that meant.

Oh Ok.

You need to specify exactly what it means because you say that you can only answer specific questions but you gave like feedback on certain things so I don’t know. There wasn’t like all these faults.

Did you have any problems with actually using it? [the material]

It was easy to figure out. You had everything labelled well I thought. Could move around. Figure things out.

You managed to follow what’s going on ok.

Yeap.

Oh that’s not too bad. No complaints or anything.

No complaints.

Are you sure?
Appendix H: UCL Case Study Phase 2 – Transcript of Interviews

Just I don’t like Macs. No.

You don’t like Macs. Oh ok, I’ll get the PC in next time. When you say you don’t like Macs, how is it different?

Oh, I just say that because I don’t use them. Probably if I use them I’ll like them. I’m just used to using IBM computers.

What did you think about the ability to see another student’s tutorial? Do you think that it will actually be useful for you as a B160 student?

Hmm. It gives you ideas of what like how you want to prepare yourself when going into a tutorial session because in the beginning she was flipping around and didn’t know where to start. So it makes you realize you should be prepare for it and know what you’re talking about. So I think it would be. It’s a good idea.

So, if this was actually available for real, would you actually use it?

It depends, if I was meeting with my tutor, I would. Yeap.

And if you won’t? Let’s say you were doing your coursework at some point?

Like seeing another guy to see for some help or something?

Something like that?

Yeap. Because you’re going into these assignments not knowing, or expecting, like how much effort and how your work is going to turn out. So, it’ll boost your confidence and kind of help you out while going through the process I would say.

If there is anything you want to change on that, that you think is an improvement. What would it be?

On what? The whole test or what?

Yeah just the whole material itself to make your life easier or just to make the material better from your point of view.

Material for the test or for this assignment?

For this experiment.

I don’t know. For example, if you had students in the class who signed up to do this, who might not have participated that much in the big group project we did the first one, I know some people in my group didn’t do anything at all. They wouldn’t have been able to fill out this whole thing and answer some questions. Stuff like that. So maybe I don’t know telling people in advance a little bit, like may be a sentence what it’s about. So you make sure that you would have the capability of answer questions.
And how about the material itself? Instead of the whole experiment. Would you do it any differently?

I don't know. I can't. I don't know right now.

That's fine.

It might come to me later. What was good how these were on the same page [meaning the link to changes and the prop] so you don't have to like these bits?

Yeah, they're on the same thing so you don't have to switch screens back and forth. That's good.

These bits here?

Yeah.

What about the actual video clip?

Well, it had the sound so you didn't always need to see.

Ok.

Like once you've found out where on the tape you want to be, you can look at everything at once and you can hear. That's good. I thought it was setup fine.

You said you didn't need to see the video that much.

Umm, not the whole time. Like when I first started I was unaware of what was going on so I needed to watch it.

So if it wasn't there at all would that make a difference? If it was just the sound. Because you said you needed to watch it at the beginning.

Well, visual always helps out because you know when she's rustling through the papers and I don't know it always helps to see something.

Ok, that's about it.

[End of Interview]
So, any problems? Doesn’t have to be any problems.

No. Some parts, the last bits were unclear.

What do you mean by that?

As to what the corrections being made are.

Right.

They’re talking about process going from there to there, but you don’t know which one is going from where to where.

What do you mean? Can you just ...

[Subject shows final stage of Top Level DFD – last 20 seconds of material] That’s where I was talking about.

OK.

As for the rest of it, can’t think of any.

Remember you can criticise anything. Let’s think about another things for the moment. What do you think about having materials like this in the first place like being able to see another student’s tutorial?

That’s good.

Why is it good?

Cause it’s not so much about seeing another person’s tutorial, it’s being able to see the mistakes that other people make from their work

Right.

and how it gets corrected and what the corrections are.

Why would that be good for you?

Cause, having handed in my coursework, I know I’ve made some of those mistakes so...
So, if this was, because this was an experiment, it wasn't deployed en masse, would it have been useful if this was available to everyone when the coursework was set.

Yes, I think so. There are some ambiguity as to what pseudo-code looks like at the end of it.

Right.

And that obviously explains it. Break down of processes as well. And flows, dataflows.

Right. So, if, for example, you were involved with this would you actually mind other people seeing your tutorial?

No.

You won't mind them seeing your mistakes?

Nope.

Ok. Why ever not? Yeah, for example, your group coursework, so you won't mind other people seeing the comments that were made.

No.

Ok, No that's good, that's good. Because one of the important things about creating this kind of material is actually to get student's consent, obviously. To create this, not only do I need consent from that student to record it but I also needed her consent to show it as well. So if people aren't happy with that, they can opt out of course.

Yeah.

OK, what if you've been given this kind of material? Did you use this much? This bit here? [Manual navigation]

Not much no.

So you just used this [direct manipulation] to move around?

Yeah.

What if you didn’t have, you know the way this thing is updated automatically, what if that wasn’t there?

These [Manual Navigation] will have to be a bit clearer.

These bits.

Yeah, to show you which is which.
What if we take away the video?
And just have audio?
Yeah.
Yeah, it’ll be interesting.

It’ll be interesting. [laugh] Well, I guess you can’t say, if you haven’t tried it.

You might have a blank piece of paper [the questionnaire].

You might have a blank piece of paper?
Yeah.

So you think the video is quite crucial?
Yes, I do.

Well, the only thing left to ask you, is really if you can suggest any improvements on the material you’ve used?

Change the title of the sheets, goes on forever.

These ones here [manual navigation]?

Oh ok.

Maybe fit the whole DFD in one screen.

Without the scrolling, ok.

Improve sound.

What do you mean by that?

Clearer. A bit [too] quiet at some points. That’s it.

Did you read all this ok? [prop]

Most of it. With exception of a few numbers. 1.1 1.2. If it was computer [drawn] that’ll be easier to see the changes. Maybe use different colours for the corrections.

Different colours for the corrections?
Yeah.
Good idea. Ok. Thank you.

[End of Interview]

**Student 8**

**Duration of Interaction:** 18 minutes 40 seconds  
**Time Code:** Start 0.24.50 End 0.43.30

Did you have any problems using the material?

No.

No? You managed to find everything you want from there?

Yeah.

If there were going to be any improvements which you could suggest, what would they be? If any?

No thought it was alright generally.

What do you think about actually being able to see other people’s tutorial?

I thought it was a good idea because you can see like where...

You don’t have to say it’s a good idea.

But you can see like what they’re doing, what’s going on.

Would you use it if it was actually made available for real on the course?

What? Seeing other people’s tutorials?

Well, if this material was made available a couple of weeks ago, would you have used it?

Yeah, I think I would have because I would have helped us with like our DFDs and stuff?

How exactly?

Because you know we have to do the coursework. Yeah, it might have come in handy for that to see where they make their mistakes so that we don’t make the same ones.

What about if it was you? You say that you’d like to see other people’s tutorial would you mind other people seeing your tutorial?

No I don’t think I want to be recorded.
Appendix H: UCL Case Study Phase 2 – Transcript of Interviews

Why not?
I don’t know. Just...

Is it because you don’t want other people to see your mistakes or you just don’t like being recorded?
A mixture of the two. Really.

What if there’s no cameras but ... and it’s totally anonymous, would you mind other people seeing your work? Let’s say it was just the voice.
Yeah, that’s not too bad because then they won’t be able to recognise you.

Right. But then if this material here hasn’t got the video, do you think it will be worse or it doesn’t matter?
Well, I think it helps to see them doing the work.

Why does it help?
Because you can like just see them, how they interact with each other and stuff. Where if it was just the voice, it will be a bit boring because you don’t know what they’re doing.

Right. Well, I think that’s it. Thanks for your time.

[End of Interview]

Student 9
Duration of Interaction: Invalid – did not realise that she can stop at any time.

Did you have any problems using it?
No.

No? So you managed to ...

No I did actually. Because when I was trying to answer the question about decomposition to authenticate student, like the screen kept on changing to data dictionary while I was actually listening to this bit, authenticate student, and I didn’t really know what was wrong with it and I kept clicking the authenticate student button to get this diagram and then it kept on changing to data dictionary. That was it really.

So how did you solve that problem? You just keep on clicking on it?
Yeah, I just kept on clicking on it and then it sort of worked. Started working again and then it didn’t.
Right ok. Well, what do you think about being able to see another student’s work, another student’s tutorial? Do you think it will be useful for your coursework?

Yeah, definitely.

Why?

Because you can.... because normally you can’t really see how... because you are not really allowed to discuss, I mean, you are allowed to discuss it with your friends and stuff but you can’t exactly go and have a look at their coursework and see how they’re doing and everything. But whereas if you have the chance to look at how other people, I mean how other students are doing and what kind of questions they ask in the tutorial. Definitely helpful I think.

Yeah? Now you say it’s definitely helpful to see other people’s work, how do you feel about other people seeing your work? Seeing your tutorial, if you have a one-to-one tutorial like that?

I mean if they’re doing, if the coursework topic’s different to the topic that I’m doing, I wouldn’t mind at all because I mean if they can learn something out of the tutorial that we have that will be quite good, because I would like to like see their tutorials as well. But if they’re doing the same topic and if they had the chance to look at my tutorial, I don’t think I would ... no.

You won’t like that?

No.

Ok.

But I mean if it’s a different topic, a different coursework title I wouldn’t mind at all.

You won’t mind if you have lots of mistakes to correct and stuff?

No. I wouldn’t mind at all.

Doesn’t matter?

No.

Ok.

Because you can look at what mistakes they’ve made and maybe it’s something that I didn’t really think about. So, it’s another chance for me to learn about other people’s mistakes so that I don’t really make the same mistakes again. And... yeah.

Any suggestions for improvements on this?

The top level diagram looks very sort of complicated.
Appendix H: UCL Case Study Phase 2 – Transcript of Interviews

Right.

Yeah. Sort of... she could have done it a bit. She could’ve got rid of some of the datastores and could’ve made it a bit simpler I think. But... yeah.

Ok, I think that’s it.

[End of Interview]

Student 10

Duration of Interaction: 12 minutes 30 seconds
Time Code: Start0.47.30 End 1.00.00

Did you have any problems using that then?

I couldn’t get this screening in for a while. I thought this screen would come up on one of those things, but it didn’t come up. I wanted that screen to come up.

Which screen?

The one just before this.

That one before that

There the [process] rejected the student.

Which one is that?

It’s not anyone of these, it’s when they’re talking it comes up

This one?

No. After this.

After.

Because they take it off don’t they and they make another one go ...

That one?

The one after that.

After that?

Yeah. There’s one which went. Just went another way.

I think this is the final one they did.
Wasn’t there one that was going like... one going backwards and one going forwards? It was like ....

This one?

No.

No?

It might not have been that one. Probably was the course one I think. Must be the course one.

The course one? Yeap.

Because I thought they’d changed that to “reject course” going up, but it was “course choice” not “reject course”. I can see that

So you couldn’t find...

Which one it was. Yeah.

Alright. Did you find that you can move around, apart from that.

Apart from yeah. It was kind of hard to get to the right place you want it too.

Why was it hard to...?

Because it went too far ahead. I want it to go a little forward a bit or right a bit, and it went too far.

Oh ok.

But you can’t do anything about that.

Yes, you can say anything. This was created for the experiment, so it won’t reflect on my ego if you say ..., so you don’t have to worry about that. So what do you think about being able to see another student’s tutorial? Would that be...

I think it helps.

Help what?

Because you can see like things like the actual word and how they came about like changing things. It helps I think. It helps you when doing your thing, you own like DFD diagrams.

So, if this was available for real and not part of the experiment, how would you actually use it?
Like for one if you didn’t know things like data dictionary and how to set it up, we can check how the tutor tells you to do it. And also like, do you know how you were saying like, how to going about like two processes, she was saying that you can’t get two outcomes. And you said yes you can when you do something. That kind of thing helps because you don’t know that either. And then if they say you can, then you’ll know.

Right. So, the mistakes

You pick … on the mistakes.

So you find the mistakes helpful?

I do yeah.

So compared with let’s say, if I’d given an ideal version versus this, how useful would this be and how useful would the ideal version be?

I think the ideal will be good as well, but with this, I think you learn from the mistakes, what not to do. The good thing about this is it tells you what not to do and then tell us how to do it. Whereas if you just tell us how to do it, then we’ll just copy that and not learning issues in other things.

Ok. Any suggestions for improvement on this?

Maybe just have like. What you’re saying with subtitles because sometimes you don’t really hear what they’re saying as well (as other times). With subtitle, maybe I thought. See what you’re saying as well as listening to it.

So the sound quality can be better?

Yeah.

If it was better, would you still want it subtitled?

No, I think it… I don’t think it’ll be needed, but like. Yeah, it’ll be alright I think, if it was better.

So it’s the sound quality you want improved.

Yeah.

Anything else?

No, No. I don’t think so. It’s fine.

OK. Thank you.

[End of Interview]
Appendix H: UCL Case Study Phase 2 — Transcript of Interviews

**Student 11**

*Duration of Interaction:* 17 minutes 30 seconds  
*Time Code:* Start 1.05.00 End 1.22.30

**What I really want to know is whether you have any problems using it?**

Well, yes. Which is that keeps on changing.

**Which bit? This one? [prop view]**

Yeah. When I was trying actually, it just kept on changing when I was actually listening to something and look at a picture, it maybe didn’t want me to look at it or something.

**Sorry, can you say that again?**

Say if I wanted to look at the “Forms” database and they were actually talking about data dictionary, well, or that just starts to display data dictionary, it won’t allow me to look at the thing I wanted to because it keeps on changing.

Yeah.

So, it was kind of irritating. I have to pause the tape and then look at it. Whereas, some how if you... In a way it’s good because it follows it through but it does that by taking control of what I’m looking at. Are you talking about the actual video or just the whole... ?

**Everything.**

Well, yeah. The display... It’s like rewinding stuff is a bit of a hassle as well. It won’t go to specific point. The good things were though that that thing where it just allowed me to go to different bit.

**This bit? [chapter navigation]**

Yeah.

**O ok.**

That’s quite good. And so was that because it splits...

**Which bit? Use the mouse.**

Sorry yeah. These things were quite good [pointing at manual navigation]

**O ok, so you prefer to manually go through...**

Yeah, because it like so you can see. When you’re answering questions that are asking specific points, you don’t want to look at stuff you don’t need. So you want to go to specific points, so that kind of details kind of help. The actual thing [video clip] was
quite clear what you were going through. The diagrams were a little ... because of all the squiggly lines and crossings out, it was quite hard to see sometimes what was going on in the diagrams but the dialogues and stuff explained it.

Yeap.

So that was fine.

OK.

Yeah everything else was fine.

**What do you think about the ability to actually see another student’s tutorial?**

I thought it was quite helpful actually, because ...

**Quite helpful?**

Yeah.

**Well, why is that?**

Because it made me realise how other people approach the same piece of work. And also how say how the lecturer or tutor would ... how he helps certain problems. Say if you have this common problem with that [student] you may not actually realise it or something but then realise just then that oh I’ve actually done the same thing as her or him. So it helps.

**So if this was available for real, instead of just through an experiment, would you actually use it?**

Yeah. Definitely.

**Definitely?**

Yeah, because it would actually help me a lot with the work. Because I’m getting help to see where you’re [I’m] going wrong as well.

**Yes. But are you talking in terms of general curriculum or the course or specifically with the coursework?**

No just the curriculum of the course. Because everyone always have common problems with the work, right, just little things in the tutorial that you’re supposed to straighten out. Some times in your tutorial, it might not get straighten out and or it might, it depends on things so. If you can have the best of both where you can actually see what they went over, you can’t always attend all those tutorials obviously so you can actually see what other people...

**Well, you said it’s useful, but how would you feel about other people seeing your tutorial?**
I'll probably be, it depends... It would probably be quite embarrassing because I'll say
dumb things and people would laugh or whatever. But I mean, for example, say if it
was ... I don't know. It'll probably be a bit embarrassing but I mean if it was like come
in and look at that where you just don't know who it is then I think it'll probably be
fine. Well, you don't actually have to see the girl's face in this and it would still be the
same thing

But then you say people see your mistake but they also see that you've managed to
do it correctly by the end.

Hmm. I suppose.

So it's not just seeing mistake and just leaving it at there but you also show that
you are competent by the end of it. Does that make any difference?

It probably would but I mean to you it would but to them they would just see, o they
make like ... Say if you make a really silly mistake like if you completely miss you
miss a process out, an obvious process out, I mean sure you correct it at the end, but it's
just silly for missing the obvious process out in the first place. Which would be...I
don't know. It'll probably be a bit off putting but I'll probably still would do it. I won't
mind.

In the end...

In the end I'll probably would weigh it up and then say yeah I won't mind being... if I
had to film myself.

If every other students...

Yeah was doing it as well, then I would still do it.

Ok. Any improvements? I think you've already mentioned some but...

Yeah. No, all the ones, I've mentioned.

Great, thank you for your time.

[End of Interview]
Appendix I
Published Paper (E-Learn 2002)

Appendix I: Published Paper (E-Learn 2002)

Computer Support for Vicarious Learning

Rachada Monthienvichienchai
M. Angela Sasse

Department of Computer Science, University College London, Gower Street, London, WC1E, UK
+44 (0) 20 7679 3039
P.Monthien@cs.ucl.ac.uk and A.Sasse@cs.ucl.ac.uk

Abstract: This paper investigates how computer support for vicarious learning can be implemented by taking a principled approach to selecting and combining different media to capture educational dialogues. The main goal is to create vicarious learning materials of appropriate pedagogic content and production quality, and at the same time minimise the financial cost and effort to produce such materials. We propose that multimedia and television production principles can be harnessed for this purpose. We report the results of 2 case studies on collaborative learning of television production in communication arts and diagram construction in computer science and analyse the problems encountered in the production and use of the vicarious learning materials created. We conclude that, if vicarious learning is to be implemented, the problems that educationalists face in creating appropriate materials needs urgent attention.

Keywords: courseware authoring, vicarious learning, collaborative learning, digital video, higher education.

Introduction

What is Vicarious Learning?

Vicarious learning (VL) is learning that takes place when one learner observes an educational dialogue between a tutor/lecturer and another learner (Mayes & Fowler 1999). In previous studies of vicarious learning, the evaluation criteria were entirely pedagogical, such as assessing the effectiveness of VL materials (Lee et al. 1999; McKendree et al. 1998; Stenning et al. 1999) and whether VL promotes learning (Lee et al. 1998). The research reported in this paper builds on these studies, and extends them to consider how best to implement computer support for vicarious learning (CSVL). The main goal of our research is to create tool support for VL materials that contain the appropriate pedagogic and production quality, and can be delivered with the skills, resources and equipment available to most educators.

What makes CSVL different from a video?

The main advantages of supporting the production and access of vicarious learning material via computers as digital video (DV) over conventional video are:

1. the ability to integrate this resource with other online learning materials – DV can contain URLs to online lecture notes or relevant online formative/summative assessment modules and
2. the possibility of personalising the learning material.
3. DV can be divided into chapters that are much easier to navigate through than conventional analogue video.

As real life interactions will be recorded, students will be able to relate directly to problems that they and their colleagues are having during that academic year. In the simplest form, CSVL allows students to revisit their collaborative attempts at tackling a problem. Such revisits strengthen their understanding of the topic by promoting the use of episodic memory (Tulving 1983). Episodic memory is a person's personal memory encoded with respect to specific time and place, i.e., remembering the lecturer explaining what episodic memory is on a hot summer afternoon in his/her office. Such memory is more resistant to forgetting. Additionally, students will also be able to view other groups' attempts at tackling the same or similar problems by either accessing materials from the current or previous academic years.

Producing VL Materials

The main aim of our research is to produce a design specification for a cost-effective CSVL system that can be easily implemented by individual or small groups of educators and is flexible enough to accommodate the specific needs of their teaching topics and student cohorts. The system also needs to be
Appendix I: Published Paper (E-Learn 2002)

flexible enough to support installation in small rooms (individual tutorial) and medium-size rooms (group tutorials).

Why focus on these implementations of CSVL? VL has been shown to be effective in professional productions, e.g., Open University education programs containing brainstorming and debates between lecturers and students and public debates often discussing issues concerning current affairs. However, a lecturer who wants to use such programs can face several obstacles. Firstly, the content of the program may not suit the need of the students/courses that the lecturer is teaching. Secondly, the materials are not grounded in the students' own experience and therefore do benefit from the effects of episodic memory. Professional productions are also costly and require large amount of time and effort from a lecturer who wants to produce similar material. For this reason, our research is asking whether computer support can bring the benefits of VL to individual lecturers. If so, how can it be done? If not, what are the main obstacles?

Pedagogic Design

VL can form parts of various pedagogic designs. Since the main aim of our research is to investigate the various aspects of technology used for implementing VL, the Laurillard's model of learning (Laurillard 2002) was adopted and maintained through out for consistency. In this case, VL forms part of the ongoing negotiation of meaning between the lecturer and the students. A simplified diagram of this model is given below.

![Figure 1: Simplified diagram of Laurillard's Model of Learning (Pennis 1996)](image)

Another model of learning which may also be applicable is Wenger's Learning Architecture Model (Wenger & Snyder 2000), where students are working towards being part of a community of practice, in this particular case, the community of systems analysts and IT developers.

Perceived quality of production matters – a pilot study

Most video-based VL systems consist of video recordings of the interactions between lecturers and students, accompanied by notes on the topic under discussions, and perhaps the page of the lecture notes on the topic. Two such examples are The Dissemination System¹ used at Heriot-Watt University and a similar one at University of Edinburgh². Both systems are used for teaching Human-Computer Interaction (HCI) courses. On the other end of the spectrum, the Classroom2000 project³ at Georgia Institute of Technology demonstrates what high-quality recording and dissemination technology can deliver. By combining video/audio recording with time-stamped slides and annotation, the Classroom2000 project has managed to put the essence of a lecture online. However, this emphasis of putting lectures online means that Classroom2000 does not focus on student actions and feedback, which is essential for VL. Additionally, the system, requiring expensive equipment, is not cost-effective to implement in individual lecturer's or small tutorial rooms.

A pilot study was conducted to see how a simple production of a single-camera recording a tutorial session be perceived. Computer science students were shown some samples of videos containing vicarious learning resources and were asked to make general comments about them. In each video, a lecturer and a student have a staged dialogue on general HCI topics while seated around a table. At various points, either the lecturer or the student would refer to materials on pieces of paper or the whiteboard. The video was produced using a single static-angle video camera and, after encoding into RealMedia streaming format, shown on a 1-inch in diagonal window supported by mono sound. Some of the most prominent comments from the students concerning such a production were:

1. Poor sound quality made it very difficult to understand what each person was saying.
2. The video was so small and blurry that there was "little point in it being there".
3. It was impossible to see what was written on the whiteboard or the pieces of paper on the tabletop.

¹ http://www.hcrc.ed.ac.uk/Vicar/TT/
² http://www.cogsci.ed.ac.uk/school/study/ug/hc1h/
³ http://www.cc.gatech.edu/fce/eclabs/index.html
Appendix I: Published Paper (E-Learn 2002)

4. The content was perceived as “deadly dull.”
5. It was hard work going through each video and picking out what the main message was.
6. Students said they would be reluctant to refer to such material, they would prefer to use lecture notes and books.

The pilot study revealed that the perceived quality of the material not only affects comprehension of the content being offered, but also its perceived practicality, i.e., whether such resource will be used or not. A previous study of real-time multimedia in a distance education context (Watson & Sasse 2000) found that perceived quality of materials can be affected by unsatisfactory audio quality resulting from incorrect setup of end-system audio hardware and equipment setup, rather than by network effects such as packet loss and jitter. Comments from students in this pilot study showed that perceived quality of recorded material can be similarly affected by insufficient end-system video hardware and incorrect equipment setup.

How to make a difference?

So what affects the perceived quality of video-based vicarious learning materials? This case study looks at the student’s perception of the quality of materials in comparison with other materials such as lecture handouts, books and self-made notes. Audio/visual production variables play a crucial role in the perceived quality of the final material. We wanted to determine which variables affect students’ perception of the quality of recorded instructional material, and to what extent.

Multimedia Production Principles

Reeves and Nass (1996) identified a number of factors that can influence the perception of multimedia material. In our view, the following are particularly relevant to authoring video-based multimedia:

1. **Image size:** larger images are evaluated more positively than smaller ones and better capture the viewer’s attention. Additionally, content on larger images are better remembered than those on smaller ones.

2. **Fidelity:** sound quality was found to have more impact on the viewer’s perception of the quality of the material being shown. More importantly, audio fidelity was found to affect attention to media and the viewer’s memory for audio information.

3. **Synchrony:** viewers of videos containing audio-video asynchrony commented that people in the video were “less interesting, less pleasant, less influential, more agitated, and less successful in their delivery” than those in synchronized video. This is very significant, as educational materials should not have any of the attributes that have just been mentioned.

4. **Scene Changes:** scene changes can be used to provide structural cues to direct the viewer’s attention as well as serving as markers in the viewer’s memory. In order to create appropriate cuts and scene changes without using cameramen, it will be necessary to use more than one camera to capture the discussion.

Television Production Principles

Guidelines from the area of communication arts (or media studies) suggest that the number of camera angles also affect the viewer’s perception of the quality of the production. The two main factors that have not already been mentioned are:

1. **Shot Selection:** Multimedia principles already point out that, if the production will be viewed in small windows, the camera should close in on the speakers to create the sensation of larger size. Television production principles add to this several points concerning the placement of cameras and how speakers should appear on screen (shot selection). These ranges from wide-angle shots used for orientation of the viewer to over-shoulder shots for suggesting relationship between speakers. Overall there are around seven main shots that can be used during an interview each with specific purpose (Armer 1990). Specifically in the context of this case study, it is also important to make sure that the camera shots that are used allow a clear view of any artifacts – such as models or drawings.

2. **Number of Cameras:** As well as shot selection, the number of cameras also influences the quality and style of production (Watts 1997). Single camera productions require a camera operator that can skillfully move around the set in order to film each speaker as he/she speaks without any obvious interruptions. In a two-camera production, camera movements are greatly reduced by “cross-shooting” (the field of vision of each camera appear to cross). Additionally, the camera operator can zoom in or out to get extra “over-the-shoulder” shots. However, if a third camera is introduced, the job of the camera operator becomes minimal or nonexistent. That is, it is possible to create all the necessary shots
Appendix I: Published Paper (E-Learn 2002)

with three cameras for an interview situation. If no camera operators are required, materials can be created without the camera crew associated with traditional video productions.

Post-production Issues
In addition to multimedia and television production variables, there are some post-production design issues that may also affect the student's perception of quality. Compared with text, video and audio are slow media for transmitting information — reading a book yourself is much quicker than having it read to you. It is therefore necessary to provide navigational support to allow students to quickly access certain part of the material, without having to go through the entire content of the material.

Too Many Cameras?

Case Study 1 - TV Production Course, St. John's University, Bangkok, Thailand

According to television production principles, increasing the number of cameras will increase quality of production. But is there a point of diminishing return? In terms of return on investment, is the amount of information captured that much better when using three cameras than one?

An experiment was conducted to investigate how increasing the number of camera angles in video productions affects the students' perception of the quality of the production. Three cameras were used to capture 3rd year undergraduate communication arts students producing their first television program. Lecturers in this discipline usually introduce students to the theories of producing a "show" in the classroom, but it is difficult to teach students how things actually work or relate to each other in the studio. The aim of the video was to show fellow students the dynamics and the dialogues that go on within the control room — problems that other students encounter, how they solved them and how they make decisions within the group to accept certain takes. The point of the video is to minimize the amount of time students spend inside the studio learning how to produce a show rather than actually producing one. As studio time is rare and expensive, this will allow students to make better use of their studio time.

Experimental Setup
The production session takes place in two adjacent rooms - the control room and the studio. The producer, director, soundman, switcher and computer graphics supervisor work in the control room while actors, cameramen and stage manager work in the studio. It is the action in the control room that are of direct pedagogic relevance for this production, but the actions in the studio are also relevant in the wider pedagogic context. Three cameras were setup to capture the student's production session. The aim is to create for the experiment three productions that differ only in the number of camera angles that are used. Consequently, it was necessary to produce the three productions from just a single take to ensure that the content of the productions are identical. Each camera was positioned as follows:

Camera 1: Wide angle shot inside the control room with each person and control equipments visible. Each person has his/her back towards the camera as they are working on the equipments within the room. Additionally, a small portion of the studio room was also visible.

Camera 2: Wide angle shot inside the studio itself. This camera captures the actors, cameramen and stage manager.

Camera 3: Close up shot of each person inside the control room. Each person face, in contrast to camera 1's angle, is now visible.

Figure 2: Screenshots showing the three camera angles used in the experiment (including PIP insert)

In addition to these three camera angles, it was possible to add another angle, which was drawn from the actual production that the students were creating - i.e., the show that they were making - this was presented as a picture-in-picture (PIP) insert. This is similar to being able to see what people are writing while they have a discussion around a whiteboard. From these three cameras and the PIP insert from the student's production, the following productions were created:
Appendix I: Published Paper (E-Learn 2002)

<table>
<thead>
<tr>
<th>Production</th>
<th>Camera 1</th>
<th>Camera 2</th>
<th>Camera 3</th>
<th>PIP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

The productions are ordered according to the amount of effort it would take a lecturer to edit each production, where production 1 requires the least amount of effort. Once all the necessary productions have been created, twenty-one students were grouped into three focus groups. Each group viewed the following productions:

<table>
<thead>
<tr>
<th>Focus Group</th>
<th>Prod.1</th>
<th>Prod.2</th>
<th>Prod.3</th>
<th>Prod.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Students were not directly prompted to comment about the quality of the video but instead were first asked whether there were any differences between the two video productions.

Summary of Results
The transcripts of each focus group were analysed in terms of comments that the students made specifically about the quality of each production. There were significant differences in terms of perceived quality between production 1 and production 2, and between production 2 and 3. In both cases, increasing the number of camera angles resulted in the students thinking that the quality of the production had been improved. However, there were no perceived improvements in quality when moving from production 3 to production 4. As a matter of fact, focus group 3 actually said that production 4 was 'more boring than production 3'. This indicates that while increasing the number of cameras does not always increase the perceived quality of the production, the number of cameras used does affect the viewer's perception of production quality. The result suggests that the optimum setup for this particular case would be to use two cameras to capture the dialogue and one PIP insert to keep track of what the students are doing with props.

Analysis of Results
Why did the addition of another camera in production 4 not increase the perceived quality of the production? When breaking down the content of the video in terms of the Laurillard’s model of learning, a pattern has emerged. If the content of each production is categorised in terms of the stages of interactions in the model, each additional camera angle in successive productions adds another stage of interaction of the model to the production — all except in the case of production 4. Production 2 adds the result of the student action, production 3 adds the actual action of the students in the studio, but production 4, while adding another camera angle, does not add a stage of interaction that has not already been covered by previous productions. Consequently, in order to determine how many cameras will be needed to effectively capture a situation for use as vicarious learning material, it is necessary to first identify what actions correspond to which part of Laurillard’s model, and then implement the necessary technology to capture those actions. For example, a 1-camera setup will be as pedagogically effective as a 2-camera setup when capturing a student and a lecturer talking about a concept, but a 2-camera setup will be more pedagogically effective should any written materials be introduced into the discussion.

Capturing Dialogues in the Real World
Vicarious Learning and Computer Science Education
Diagram construction is a major part in the syllabus of computer science and information technology students. Each year, students find it difficult to learn how to construct system models such as entity-relationship or UML diagrams. To help the students, many lecturers show common mistakes in diagrams constructed by students in previous years. But since the process of constructing such a diagram involves more than the finished product can communicate, most students acquire the ability to construct such diagrams only after several attempts of their own, with feedback from the lecturer. This type of feedback — delivered 1-to-1 or in small groups — is very demanding on lecturers’ time. To get more learning revenue from this time-consuming process, the tutorial sessions were captured as digital videos, and integrated into course notes and online computer-aided assessment (CAA) system. In effect, students who are not present in
the tutorial can vicariously learn the same material and more through this setup. Students can also acquire necessary skills by observing one of their colleagues constructing a diagram or, more often, by collaboratively constructing the diagram as a group. Additionally, if dialogues between the student(s) and the tutor/lecturer can be captured during an attempt at constructing a diagram, students who were not present will not only see the resulting mistakes but also how and why the mistake came about in the first place and of course, the reasoning behind constructing the final correct diagram as well! Hence, this particular case study looks at how best to produce Digital Video-based (DV-based) vicarious learning materials for teaching diagram construction in the field of computer science and what kind of problems lecturers face when producing video-based for such a course.

Case Study 2 – Systems Analysis and Design Course, University College London, UK
What kind of problems do lecturers really encounter when creating their own video-based materials? In order to investigate this issue, a case study was conducted. Rather than start from scratch, the system used was based on current knowledge of what is required to produce good quality video-based materials. A lecturer’s room has been setup with the following equipments so that tutorials can be captured:

1. 3 digital video cameras
2. 1 MIMIO (see reference) electronic whiteboard
3. 1 Intel-based and 1 PowerPC-based PCs configured for DV-editing and whiteboard content capture
4. 1 Intel-based PC configured as a streaming video server
5. 1 high quality omni-directional microphone
6. 1 document scanner.

So far, the total cost of the system is under $10,000. While it has less functionality than Classroom2000, it is only one tenth of the cost.

Problems with Capturing Real Educational Dialogues
Capturing real (as opposed to scripted) educational dialogues presents significant problems in terms of the pedagogic content of the captured material and the task of video-editing.

Pedagogic content
In a small-group discussion (1 lecturer and 2 students), the written materials referred to are often on paper, not on whiteboard as in the materials in the Dissemination System (see reference). Students bring their work on paper, and discussions and amendments centre around the pieces of paper on the desktop. Desktop and surrounding cameras did not get a good angle on the content of paper – even at close range both physically and through zooming. It was very difficult or impossible to make out what is being written on the pieces of paper in sufficient detail. Why is the whiteboard not used in this instance? The ReLaTe project (see reference) found that the use of the whiteboard is in the “tutor’s domain”. Students are reluctant to “expose” their work on the whiteboard and prefer the familiarity of their own paper (Hughes & Sasse 1997). For students, writing on the whiteboard means publishing their work, which they must be prepared to defend. Additionally, unscripted real world dialogues take time to get going – there are often periods of silence when discussion materials or off-topic chats.

Video editing
In order to produce good quality material, captured tutorial sessions need to be edited. Off-line editing of captured dialogue is the most time consuming task in the process of creating CSVL. It was necessary to first listen to a 5 or 6 second segment of a clip to determine which camera angle to use, then repeat this process until the end of the clip is reached. This “stop-go” approach is very time-consuming and
not practical for a lecturer to do. TV studios do real time (live) editing where the producer or director makes the decision to “switch” cameras while the production continues to roll. This “studio” style of creating the final production would be much easier and less time-consuming for the lecturer. However, an individual educator cannot afford dedicated staff to support each captured session.

**Implication for Design**

This section presents the conclusions derived from the pilot study and the two case studies in terms of what educational users need and what tools are required to provide sufficient support for producing video-based educational materials.

So, what constitute the “ideal” video-based vicarious learning material? Together with the previous findings from the literature and the case studies conducted, the following attributes have be derived:

1. The size of the video should be at least 360x288 pixels (1/2 DV) in a 1024x768 screen resolution.
2. The audio should be captured at 16-bits stereo audio, sampled at 48kHz.

However, these attributes are often dictated by the bandwidth that is available while viewing the material online and therefore will be more of a design constraint rather than a design feature. In contrast, the following features can be incorporated irrespective of bandwidth size:

4. Cuts and scene changes can be controlled and incorporated by design into productions.
5. Cuts or scene changes should be used to create structure within the production as well as keeping the viewer’s attention at the appropriate level – more than one camera will be required and each camera will need to be placed in the appropriate position to obtain the best possible angle
6. The video must incorporate camera angles that give the viewer sufficient access to props.
7. Allow the viewer to navigate through the video with respect to a clear pedagogic framework.

**Derived system requirements**

A system that efficiently supports production of video-based educational multimedia must enable the author to create materials with the greatest degree of quality while minimizing the amount of time and effort required to create those materials, i.e., it must be practical to use.

A survey of the current range of video-editing suites reveals that there are no packages that efficiently support, in terms of time and effort required, the task of authoring in-house video-based educational multimedia. Apple’s iMovie is very easy to use but does not support the ability to have more than one synchronized camera angle to choose from at any one moment.

While Adobe Premiere and Apple’s Final Cut Pro support multiple camera angles, they do not allow the author to choose camera angles “studio” style in post-production. Both packages force the user to use the “stop-go” approach to video editing. A system is required that can:

1. simultaneously capture DV footage from more than one camera
2. play each captured camera angle (video file) at the same time (once they’ve all been downloaded and synchronized) so that the author can see exactly what each camera has captured
3. allow the author to choose which camera to use in real-time without having to stop the videos being played (as if the production is being made live in a studio). This task should be as simple as clicking on the camera angle that is wanted at that time to switch to that camera in the final production.

This will critically improve the usability of video-editing systems in three major ways:

1. The pre-editing time will be cut substantially if footages from different cameras can be downloaded in parallel.
2. The editing time will be cut substantially compared with the “stop-go” approach.
3. The editing task and user-interface will be simplified to just picking which camera is “live” or active at certain time.

**Conclusions**

It is possible to bring the benefits of vicarious learning to individual educators but there are some significant problems and issues that still need to be addressed in order to implement the most effective support for such method of learning and teaching. Producing video-based educational multimedia is more than just pointing a video camera and shooting. Empirical works reported in this paper support the notion that perceived quality of production is significantly affected by the number of camera angles that are used in
the production. While the current range of video-editing software packages have the features to produce video-based educational multimedia material of sufficient quality, the tasks in which they demand the user to go through in order to produce such materials are not compatible with the way the lecturer actually needs to work. To make video-editing packages usable in the educational context, the editing task needs to be both quicker and easier. As the number of camera angles in production affects the perceived quality of that production, packages need to support the use of multiple camera angles in productions without forcing the user into a “stop-go” style of interaction to edit videos – this is currently a significant usability bottleneck for users of these packages.

There is currently no large-scale empirical data on how students interact with vicarious learning materials. More importantly, there are no data on how the interaction pattern is affected when there are pedagogic shortfalls resulting from production problems, e.g., missing out vital contents through using insufficient camera angles. These variables are independent from the usual variables investigated in video technology, such as bandwidth, resolution and synchronization. This needs to be thoroughly investigated as pedagogic effectiveness is at stake.

References


Wenger E and Snyder, WM. (2000), *Communities of Practice: The Organizational Frontier*. Harvard Business Review, Jan-Feb, pp 139-145

**Classroom2000 Project** at http://www.cc.gatech.edu/fee/eclass/index.html Georgia Institute of Technology

**The Dissemination System** at http://www.hcrc.ed.ac.uk/Vicar/TT/ at Heriot-Watt University, UK

The Computers in Teaching and Learning course was a module of an MSc in Human Computer Interaction

**Human Communications** 1h: at http://www.cogsci.ed.ac.uk/school/study/ug/hc1h/

A first year undergraduate course taught at HCRC (University of Edinburgh).

**MIMIO Whiteboard** at http://www.mimio.com/

**ReLaTe** at http://www.ex.ac.uk/pallas/relate/

ReLaTe is developing and testing video conferencing software for use in language teaching. It is a joint project between the University of Exeter and University College London (UCL).
Appendix J
Published Paper (LTSN-ICS)

4th Annual Conference of the LTSN Subject Centre for Information and Computer Sciences
National University of Ireland, Galway, 26th-28th August 2003
Learning from Others’ Mistakes Through Computer Supported Vicarious Learning

Rachada Monthienvichienchai
Department of Computer Science
University College London
Gower Street, London WC1E 6BT
P.Monthien@cs.ucl.ac.uk

M. Angela Sasse
Department of Computer Science
University College London
Gower Street, London WC1E 6BT
A.Sasse@cs.ucl.ac.uk

Abstract
This paper presents the results of a study into how first year undergraduate students approach using tertiary courseware in order to complete a learning task. The aim of the study is to investigate how educational dialogue should be presented to students as vicarious learning material. The study reveals that students use such courseware in either the serialist or holist fashion and adopt different navigational strategies, irrespective of how the material is implemented. Consequently, students experience usability problems when courseware design does not offer functions in support of their chosen navigational strategy. The findings of the study help to inform developers of what materials make effective tertiary courseware and what functions are required to efficiently access it.

Keywords
Tertiary Courseware Development; Computer Supported Vicarious Learning.

Introduction
Computer-Aided Learning has produced a multitude of primary and secondary courseware, such as online lectures and simulations. However, there are many instances where such courseware fails to meet some needs of the students [1]. When students have misconceptions following their interaction with primary courseware, it is difficult for them to effectively apply what they have learnt when using secondary courseware. Often such misconceptions are only realised with the support of their tutors. However, such support places heavy demand on the time and effort of the tutor and, consequently, misconceptions are often realised only after the students have received summative feedback for an assessed piece of work.

Tertiary courseware based on Vicarious Learning (VL) [2] aims to fill this need by giving students access to feedback-rich educational dialogues, allowing the students to vicariously learn from educational experiences of other students. Examples of such dialogues are logged discussions in a text-based CMC (computer-mediated communication) environment, audio recording of a group debate and a video recording of a 1-to-1 tutorial between a student and a tutor.

1.1 Background on Creating Tertiary Courseware
Previous research on VL has shown it to be an effective pedagogic tool for learning [3, 4]. However, creating effective tertiary courseware requires much effort and skills. Educational practitioners who want to implement computer support for vicarious learning (CSVL) as part of their teaching strategy not only need to have a certain degree of proficiency in authoring multimedia material, but also be aware of factors that affect the pedagogic effectiveness and efficiency of the material being produced. A learning dialogue has both discursive (e.g. the spoken dialogue) and interactive (e.g. activities under discussion) processes [5] and all of these processes need to be captured effectively to create tertiary material of appropriate pedagogic and production quality. Previous research [6] shows that, when creating VL material, the learning activity must be captured using a sufficient number of camera angles to effectively capture the learning activity at both the discursive and interactive level. Failure to do so results in the quality of the material being perceived more negatively by the students.

1.2 Towards Creating Effective Courseware
From a technical point of view, it is easier to capture the discursive process than the interactive process of a dialogue. For example, to capture the discursive process of a discussion between a tutor and a student, it is often sufficient to use just one camera angle. However, when the two participants...
start referring to a 'prop' (for example, a written coursework by the student) or interacting with the prop, the use of just one camera angle to capture the dialogue is no longer enough, especially when the video quality is degraded when streaming over a network. In order to effectively capture this part of the dialogue, it is often necessary to either use another camera or another method of capturing the activity.

The main issue addressed by this paper is how the interactive process of the dialogue should be captured. More specifically, it looks at how the interactive process should be presented to efficiently support how students would use the material – this dictates how the process should be captured in the first place. The empirical work reported in this paper is a phenomenography-based study [7] of how students on an Information Systems Analysis and Design course at University College London (UCL) approach VL materials. The findings of the study help to inform developers of what materials make effective tertiary courseware and what functions are required to efficiently access it.

CASE STUDY

This study investigates how materials should be presented to the students by looking at the usability issues concerning the nature of the association of prop access with the relevant video clips. The study is conducted within the context of two systems.

The first one of these is the Dissemination System [8], where the video clips are disassociated from related materials, in this case either the whiteboard or pieces of paper on the table. That is, video clips of the tutorials are shown in one window while the materials under the discussion in those tutorials are shown in a separate browser windows. Consequently, students using this system have to manually navigate through the materials (or props) to search for the relevant sections that are under discussion.

The second system, eClass (formerly Classroom2000) [9], implements a fully synchronised association between video clips and their related materials, in this case the electronic whiteboard. Students using this system can see the amendments made to the electronic whiteboard as it happens in the video clips, i.e., they do not have to manually search through different images of the whiteboard and work out which one is relevant for certain sections of the video clips.

1.3 Goals of Study

The main goal of this study is to investigate whether full synchronisation between material and video clip, as implemented by eClass, is necessary for students using VL material. It looks at whether manual navigation of props causes any usability problems for the students and then progressively adds degrees of synchronisation and navigation features to the material while looking at how the usability of the materials are affected.

1.3.1 Data Collection

Data concerning two areas of investigation is collected. This reflects the need for a thorough documentation of how students interact with VL material and also what the students themselves perceive to be problematic when interacting with the material.

Firstly, quantitative data about how the student's interaction with VL materials are affected by the following production variables are collected:

1. Manual access to props only
2. Video-synchronised access to props only
3. Both mode of accessing props

This data allows differences in interaction patterns from each mode to be analysed.

In addition to quantitative data of the student's interactions, the study is also be used to elicit qualitative data concerning the following issues:

1. Did the student experience or perceive to have experienced technical or pedagogic problems when using the material?

This question is used to highlight what problems students have with materials of different production variables. Additionally, it is also used to indicate whether students experience more problems with certain types of materials than others.

2. What is the student's assessment of the usefulness of the material?

This question is designed to probe how students will feel about using or being part of the CSVL environment, if it is implemented widely.

3. What improvements does the student feel should be implemented?

This question allows students themselves to suggest how the material can be improved (and therefore be more efficient and effective from their point of view).

1.4 Case Study Setup

12 volunteers from the course interacted with one of three sets of materials while completing a questionnaire that tests the students on the following topics:

1. DFD decomposition
2. Physical vs. Logical dataflow diagrams (DFDs)
3. Linking different levels of DFDs
4. Dealing with error conditions in DFD
5. Deriving pseudocode for a process
6. Dealing with missing functionality in the design
7. System state vs. System process

296
The three sets of materials are created from the following components:

- **A QuickTime video clip** containing the discursive process of a tutorial. The tutorial covers all seven topics listed above. These topics are explicitly shown in the video clip by the implementation of 'Video Chapters'. Figure 1 is a screenshot of a video clip showing this feature.

- **Manual prop access** giving access to student's works that are discussed in the video clip in the form of hyperlinks that student can click on to navigate different stages of the changes in the prop during the tutorial (interactive process of the dialogue).

- **Time-Synchronised prop access** giving the same access, in terms of content, for the student as the manual access, with the addition that each stages of the interactive process are now time-synchronised to the video clip, i.e., when the tutor/student makes a change to the prop, that change is automatically reflected in the prop access frame of the browser. This feature is implemented as 'Web-links' in the QuickTime video clip using Adobe Premiere.

From these components, three sets of materials were created as follows:

<table>
<thead>
<tr>
<th>Set</th>
<th>Video Clip</th>
<th>Manual Prop Access</th>
<th>Time-Synchronised Prop Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Figure 2 and 3 show the screenshots for material set 1 and 3:

1.5 Data Collection & Analysis

To record the students' interaction with the materials, their on and off-screen activities are captured using two digital video cameras. The two video streams are then overlaid on top of one another with the on-screen activities video-stream transparency setting set to 60% to allow both video-stream to be seen simultaneously. To allow both video-streams to be as large as possible, the decision was taken to overlay them (as opposed to setting them side by side). This enables the student's answers on the questionnaire to be legible and any mouse action on the screen to be clearly visible (see Figure 4). With this setup, the student's on-screen activities (e.g. searching for something) can be analysed with respect to his/her off-screen activities (e.g. answering a question on the questionnaire).
Each student’s session is then coded in terms of what navigational features he/she used and what off-screen activities preceded or followed the use of those features. Each of these activities is time-stamped allowing all activities to be tabulated chronologically. To enhance legibility, each activity is then colour-coded to aid identification of different interaction patterns of the student. Figure 5 shows a colour-coded activity log representing an orderly progression through the video clip with three instances when the rewind feature was used.

To collect data on the students’ perception of tertiary courseware, students are given a post-session interview when only their voice is recorded. The student at this point still has access to the material so that they can illustrate any problems they had during the interaction session. Any on-screen illustration given by the student at this point is recorded as a video-stream and synchronised with the interview audio-stream.

Overall, over 15 hours of video data and 5 hours of interview data were gathered.

### RESULTS

#### 1.6 Students’ Approach to using the Material

Students use material in different ways, irrespective of which set of material they interact with. The approaches are linked to each student and not to the material set. The way in which a student would use the material depends on how he/she tackles the questionnaire given.

There are two main approaches that have been observed in this student population: the **serialist** and **holist** (in line with Pask’s learning strategies). The students, who adopt the holist approach, first watch the whole video clip and then review smaller sections of the clip. These students answer the questionnaire by first answering any questions that they can while they are watching the clip, often missing out questions that requires deeper reflection on the topic. These questions are answered when they review the material.

On the other hand, students adopting the serialist approach begin by watching the video clip but, as soon as they have identified a relevant part of the clip, they either pause the clip and answer the related question on the questionnaire or immediately rewind the clip to review that section. Students in this group move through the video clip in a more orderly fashion and answer each question on the questionnaire in chronological order.

It is worth noting that none of the students treated the material as a linear resource. Navigational facilities were extensively used in all cases.

#### 1.7 Interaction Patterns

Students adopt one of two strategies to move around the clip.

1. Students who navigate through the video clip by means of the direct-manipulation interface. These students use the chapter titles as indication of their current location within the clip.

2. Students who extensively access prop changes manually. These students first identify which stage of the prop changes they want to see then try to locate the appropriate part of the video clip. This indicates that these students rely on each iteration of the prop change to provide them with the structure of the video clip. This group of students has the most problem associated with the lack of synchronisation between the video clip and the prop changes.

#### 1.8 Students’ Perception of Tertiary Courseware

Without exception, every student in this study perceived access to tertiary courseware as being useful for his or her learning tasks.
As all students extensively use this facility, we recommend that such a facility is implemented in future video-based VL courseware.

CONCLUSIONS

This paper has reported on a case study looking at how first year undergraduate students approach using tertiary courseware in order to complete a learning task. Through a phenomenographic study, it has discovered that students use such courseware in either the serialist or holist fashion. Serialists and holists adopt different navigational strategies, irrespective of how the material is implemented. Unsurprisingly, students experience problems when the system does not offer functions in support of their chosen navigational strategy. Design of CSVL systems therefore should provide functions to support both navigational strategies.

REFERENCES


1.10 Prop Synchronisation

The result of the study reveals that students experience navigational problems at all level of prop synchronisation. This is due to the student's individual preference for navigating through the material. Even in the material set in which the prop changes are fully synchronised with the video clip, there are some students who prefer to be able to manually go through each stage of the prop changes themselves. However, overall there were fewer problems experienced by the students who used fully synchronised material. Consequently, the best balance in terms of implementing synchronisation is to implement full synchronisation between the video clip and the prop, but also to provide navigational support to allow students to manually navigate through the changes in the prop.

1.11 Additional Navigational Support

The study also reveals that students in all groups made at least implicit use of the Video Chapter facility. Some students use them as an indicator as to where they are in the clip as they navigate through the clip using the direct manipulation interface. Other students explicitly accessed different parts of the clip through the chapter facility.