Designing online learning for scientific writing:
Collaborations, creations and transformations

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A thesis submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy

Sydney School of Education and Social work
Faculty of Arts and Social Sciences

The University of Sydney

2019
Declaration

This is to certify that, to the best of my knowledge, the content of this thesis is my own work. This thesis has not been submitted for any degree or other purposes.

I certify that the intellectual content of this thesis is the product of my own work and that all the assistance received in preparing this thesis and sources have been acknowledged.

Helen Drury

June 2019
ABSTRACT

This thesis is a multilayered approach to understanding the complex processes involved in designing, developing, implementing and evaluating online learning environments for academic writing in discipline contexts. The study is broadly situated in the field of educational design research (EDR). It brings together theories of pedagogical design, including those of multimodality and educational linguistics, with the practical implementation and evaluation of designs in context. From an applied perspective, the research addresses the problem of providing support for students to improve their academic writing, in particular the writing of the laboratory report genre, a key genre in science and engineering disciplines. For teachers and others involved in the design of online teaching and learning, the aim is to provide design principles to support the process of creating effective resources to teach academic writing online. These principles cover all stages of the process from design to evaluation.

The thesis comprises three main stages which focus on the processes involved in the development of an online program for supporting students writing a report in Physiology, the Flexible Electronic Report-writing Tool (FLERT). The first focuses on the collaborations of the design team in creating the online learning resources within a ‘communities of practice’ framework. I use discourse analysis, based on the theory of systemic functional linguistics (SFL), to identify knowledge and relationship building among participants. The second draws on both multimodal social semiotics and SFL to examine how network and screen designs created for laboratory report writing programs in science and engineering have evolved over time. The third uses a multi- and mixed methods approach, together with SFL, to examine two cycles of implementation and evaluation of FLERT to assess how students have transformed
their learning through their interactions with the program.

The relationships among the outcomes from these three stages provides insights into:

- the practice of design for learning;
- the meaning making characteristics of the products of design for teaching and learning purposes;
- the interactions of student users with the designed products and the influence of design features on student learning;
- design principles, both general principles for online learning program design and those, at a more local level, for teaching academic writing online.
ACKNOWLEDGMENTS

If you have the words, there’s always a chance you’ll find the way
Seamus Heaney, Stepping Stones: Interviews with Seamus Heaney, 1996.

This thesis has been a long journey and over the years there have been side roads taken and many roundabouts; so finding “the way” and “the words” has been an ongoing challenge. There are many people who I would like to acknowledge for their help along this journey and without whose support I would not have reached the end.

I am deeply grateful to my supervisor, Professor Peter Goodyear for his unfailing support and encouragement over the years and his belief that my research would make a PhD thesis. I have appreciated greatly his scholarship and feedback and attention to detail in the many iterations of this thesis. My colleague and friend and fellow systemicist, Dr Janet Jones, has played a pivotal role as my co-supervisor in providing advice and insightful comments on the Systemic Functional Linguistic and multimodal aspects of this thesis.

My colleagues past and present in the Learning Centre have always been there to listen and offer their support and act as sounding boards for my ideas. In particular, I would like to acknowledge Dr Janet Jones and Dr Bronwyn James, as Heads of the Learning Centre, for their understanding of the need for me to balance my work demands and PhD research. I owe a special debt of gratitude to Dr Lorraine Ryan who has carried out the end noting of the literature in this thesis. Thank you Lorraine, this thesis would not have been completed without your help.

I would like to thank my FLERT team colleagues in Physiology, Dr Meloni Muir, Dr Miriam Frommer and Dr Irene Schneider for deepening my understanding of the language and discourses of their discipline. I would also like to acknowledge the elearning team members, Dr Helen Wozniak and Gosia Mendrela for their creative work on the FLERT website. I am especially grateful to Dr Meloni Muir, the project leader, for her friendship and encouragement during the years when I have been transforming the FLERT project into my thesis. My work with the project team has
been a highlight of my University career and the warmth and enjoyment we experienced in our team meetings has, I’m sure, led to the success of the project. At the same time, I would like to acknowledge Dr Natassia Goode who carried out the statistical analysis for the evaluation of FLERT. I am also grateful to the many students who took part in the project and gave such valuable feedback on the program design.

I have been tremendously blessed to have experienced inspirational teachers whose work has influenced this thesis. It has been a privilege to have known Professor Michael Halliday and Professor Gunther Kress. This thesis also owes much to Professor Jim Martin who first introduced me to the power of Systemic Functional Linguistics.

I want to acknowledge the kindness and support of Dr Jim Donohue and Professor Sheena Gardner in the final stages of completing this thesis journey in London and Coventry.

My family and friends near and far have been with me on this journey, and have tried not to keep asking ‘are we there yet?’ I am grateful for their patience and constant encouragement and their belief that I could do it. Special thanks to my husband, Thomas, and my daughter, Marianna, both of whom are creative in their own different ways and have understood and supported my determination to create this body of work, my thesis.
DEDICATION

This thesis is dedicated to my parents, Mary Kate Lynch and James Drury
who believed in education for a better world

“There is no separating one’s personal history from the academic paths
one pursues, nor any way of detaching cause from effect in explaining
one’s chosen approach to a field of study”

M. A. K. Halliday

Introduction: A personal perspective. In On Grammar: Volume 1
M. A. K. Halliday and Jonathan Webster, 2002, p. 2
Included publications and attribution

This thesis contains three Chapters based on publications. Chapters 5 and 6, although based on the published works, differ from the publications. Chapter 7, a joint publication, comprises the published work. Although these Chapters are stand-alone scholarly contributions, they have been woven together to form a coherent thesis.

Chapter 5
I am solely responsible for the scholarly work in this Chapter.

Chapter 6
I am the sole contributor to the research reported in this Chapter.

Chapter 7

*My contribution*
I designed and developed the online learning materials that are reported in this paper in collaboration with discipline academics, elearning specialists and an ALL colleague, Dr Janet Jones. As part of this process, I adapted the genre pedagogy teaching and learning cycle to the online context and drafted the learning materials for student writing in collaborative work with Dr Jones. I was responsible for the design of the project evaluation reported here. I created and implemented the evaluation instruments.
I directed the data analysis which was carried out by Natassia Goode. Data
interpretation was conducted jointly by myself and Dr Meloni Muir. As lead author, I wrote the first draft of this paper and created the graphic elements. Editing of the final version was shared with Dr Meloni Muir.

Author Signatures:

Helen Drury

June 19, 2019

Meloni Muir

June 21, 2019
# TABLE OF CONTENTS

**CHAPTER 1 Introduction** .............................................................. 1

1.1 Introduction and background ....................................................... 1

1.2 Rationale and motivation for this study ......................................... 5

1.3 Theoretical and research perspectives ........................................... 8

1.4 The research problem .................................................................. 9

1.4.1 The aim and research questions ............................................. 10

1.5 Significance of the research .......................................................... 12

1.6 Outline of the thesis ................................................................... 13

1.7 Terminology used in this thesis ..................................................... 17

Chapter references ........................................................................... 18

**CHAPTER 2 Theoretical perspectives** ................................................ 23

2.1 Introduction .............................................................................. 23

2.2 A social semiotic theory of multimodality ..................................... 25

2.2.1 Modes and multimodality ....................................................... 29

2.2.2 Modal ensembles ................................................................. 31

2.2.3 Changing modes: transformation and transduction .................... 33

2.3 Multimodal semiotics and teaching and learning ........................ 37

2.4 Systemic functional linguistics ..................................................... 38

2.4.1 SFL and context of use ........................................................ 40

2.4.2 SFL and levels of language systems ....................................... 43

2.4.3 The descriptive power of SFL .............................................. 44

2.4.4 Genre analysis .................................................................... 46

2.5 Sociocultural theory and learning ............................................... 49

2.6 Summary .................................................................................. 51

Chapter references ........................................................................... 51

**CHAPTER 3 Literature review** .......................................................... 57

3.1 Introduction .............................................................................. 57

3.2 Educational design research ....................................................... 60
CHAPTER 4 Methodology and methods ........................................ 109

4.1 Introduction ........................................................................... 109

4.2 Research aims and methodology ............................................ 110

4.3 Methodology and methods ..................................................... 112
   4.3.1 Ethical approval and considerations ........................................... 114
   4.3.2 Researcher reflexivity ................................................................. 115

4.4 Context and stages of the research: the FLERT program .............. 117

4.5 Stage 1 Design and development ............................................ 119
   4.5.1 Research focus ........................................................................ 119
   4.5.2 Research methods for design and development of Help with report writing module .................................................. 121

4.6 Stage 2 Implementation and evaluation: formative .................... 124
   4.6.1 Data: Quantitative and qualitative data: Instruments and procedures .... 127
   4.6.2 Data: Quantitative data: Instruments and procedures .......................... 128
   4.6.3 Data: Qualitative data: Instruments and procedures ................................ 130

4.7 Stage 3 Implementation and evaluation: summative .................. 132
   4.7.1 Data: Quantitative and qualitative data: Instruments and procedures .......... 133
   4.7.2 Data: Quantitative data: Instruments and procedures .......................... 134
4.8 Context and data analysis for evolving program designs for writing laboratory reports ................................................................. 134

4.9 Data analysis techniques: Project stage 1 ........................................... 136
4.9.1 Analysis of team interactions: audio and video recordings ................. 136

4.10 Data analysis techniques: Project stages 2 and 3 ................................ 139
4.10.1 Quantitative data ........................................................................ 139
4.10.2 Qualitative data ......................................................................... 139
4.10.3 SFL techniques for analysis of qualitative questionnaire data .......... 141

4.11 Data analysis of evolution of online programs for writing laboratory reports .................................................................................. 146

4.12 Summary ......................................................................................... 149

Chapter references .................................................................................. 150

CHAPTER 5 Design process ......................................................................... 152

5.1 Introduction to Chapter 5 .................................................................. 152

5.2 Publication ......................................................................................... 153

5.3 Knowledge building: How interdisciplinary understandings are realized in team negotiations ............................................................... 153

5.4 Introduction and background ............................................................. 154

5.5 Broad theoretical framework .............................................................. 156

5.6 Analysis of talk in institutional meetings ............................................ 162
5.6.1 Data and participants ................................................................... 167

5.7 Analysis ............................................................................................ 168
5.7.1 Negotiating knowledge ................................................................. 169
5.7.2 Disputing knowledge .................................................................. 174
5.7.3 Explaining knowledge .................................................................. 178

5.8 Towards a meeting genre ................................................................. 183
5.8.1 Formal meeting: opening exchanges ............................................. 183
5.8.2 Informal meeting: opening exchanges .......................................... 185

5.9 Discussion and conclusion ................................................................ 190

5.10 Concluding comments to Chapter 5 ............................................... 193

Chapter references .................................................................................. 193
<table>
<thead>
<tr>
<th>Chapter 6</th>
<th>Design products</th>
<th>198</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>Introduction to Chapter 6</td>
<td>198</td>
</tr>
<tr>
<td>6.2</td>
<td>Publication</td>
<td>198</td>
</tr>
<tr>
<td>6.3</td>
<td>Moving online to teach academic writing in science and engineering: theory and practice</td>
<td>199</td>
</tr>
<tr>
<td>6.4</td>
<td>Introduction</td>
<td>199</td>
</tr>
<tr>
<td>6.5</td>
<td>The context of design</td>
<td>202</td>
</tr>
<tr>
<td>6.5.1</td>
<td>A design team and the cycle of design</td>
<td>202</td>
</tr>
<tr>
<td>6.6</td>
<td>Design principles</td>
<td>204</td>
</tr>
<tr>
<td>6.6.1</td>
<td>Re-presenting content</td>
<td>205</td>
</tr>
<tr>
<td>6.6.2</td>
<td>Organizing content</td>
<td>213</td>
</tr>
<tr>
<td>6.6.3</td>
<td>Creating social relations</td>
<td>215</td>
</tr>
<tr>
<td>6.7</td>
<td>User practice and evaluation: Impact on design</td>
<td>217</td>
</tr>
<tr>
<td>6.7.1</td>
<td>Cycles of design, use and evaluation</td>
<td>217</td>
</tr>
<tr>
<td>6.7.2</td>
<td>Learner engagement and learner pathways</td>
<td>219</td>
</tr>
<tr>
<td>6.7.3</td>
<td>Perceptions of learning from design</td>
<td>222</td>
</tr>
<tr>
<td>6.8</td>
<td>Conclusion</td>
<td>224</td>
</tr>
<tr>
<td>6.9</td>
<td>Concluding comments to Chapter 6</td>
<td>225</td>
</tr>
</tbody>
</table>

Chapter references | 225 |

<table>
<thead>
<tr>
<th>Chapter 7</th>
<th>FLERT Implementation and evaluation</th>
<th>227</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.1</td>
<td>Introduction to Chapter 7</td>
<td>227</td>
</tr>
<tr>
<td>7.2</td>
<td>Publication</td>
<td>227</td>
</tr>
<tr>
<td>7.3</td>
<td>Using an e-learning environment for developing science students’ written communication: the case of writing laboratory reports in Physiology</td>
<td>227</td>
</tr>
<tr>
<td>7.4</td>
<td>Introduction</td>
<td>228</td>
</tr>
<tr>
<td>7.5</td>
<td>Teaching writing in the sciences: theory and practice</td>
<td>229</td>
</tr>
<tr>
<td>7.6</td>
<td>The design approach</td>
<td>231</td>
</tr>
<tr>
<td>7.6.1</td>
<td>The FLERT program</td>
<td>232</td>
</tr>
<tr>
<td>7.6.2</td>
<td>Developing the Help with report writing module</td>
<td>233</td>
</tr>
<tr>
<td>7.6.3</td>
<td>Developing the Help with understanding content module</td>
<td>236</td>
</tr>
</tbody>
</table>
7.7 Methods for trialling and evaluation of FLERT
7.7.1 Participants
7.7.2 Trial and implementation of FLERT
7.7.3 Instruments
7.7.4 Data analysis

7.8 Outcomes and discussion
7.8.1 Student demographics and writing experience
7.8.2 Students’ perceptions of their areas of difficulty in report writing
7.8.3 The characteristics of student users versus non-users
7.8.4 The performance of student users versus non-users
7.8.5 User evaluations and perceptions of FLERT on learning

7.9 Conclusions

Chapter references

CHAPTER 8 Learning from users: qualitative data
8.1 Introduction
8.2 Methodology and methods
8.3 Qualitative data from questionnaires
8.3.1 Analysis of student comments: focus on learning materials
8.3.2 Analysis of student comments: focus on pedagogy
8.3.3 Analysis of student comments: focus on learning experience
8.4 Qualitative data from student interactions with FLERT
8.5 Qualitative data from reflective recounts
8.6 Summary: bringing together quantitative and qualitative analysis

Chapter references

CHAPTER 9 Summary and Conclusions
9.1 Introduction
9.2 Discussion of key outcomes
9.2.1 Team interactions
9.2.2 The evolution of designed products
9.2.3 Student online learning from a report writing program for Physiology, FLERT
9.3 Design principles ........................................................................................................ 293
  9.3.1 General principles for teaching and learning online ........................................ 293
  9.3.2 Design principles for teaching academic writing online ............................. 294

9.4 Overall conclusion .................................................................................................... 296

Chapter references ........................................................................................................... 297

APPENDIX 1 Questionnaires ......................................................................................... 298
APPENDIX 2 Pre-post-test activity ............................................................................... 309
APPENDIX 3 Focus group protocol example ............................................................. 313
APPENDIX 4 Ethics committee documents ................................................................. 314
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABET</td>
<td>Accreditation Board for Engineering and Technology</td>
</tr>
<tr>
<td>ACAD</td>
<td>Activity-centred analysis and design</td>
</tr>
<tr>
<td>ACLITS</td>
<td>Academic literacies</td>
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<td>ADDIE</td>
<td>Analysis, Design, Development, Implementation and Evaluation</td>
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<td>AISC</td>
<td>Australian Industry and Skills Committee</td>
</tr>
<tr>
<td>ALL</td>
<td>Academic language and learning</td>
</tr>
<tr>
<td>ALTC</td>
<td>Australian Learning and Teaching Council</td>
</tr>
<tr>
<td>ASCILITE</td>
<td>Australasian Society for Computers in Learning in Tertiary Education</td>
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<td>AUTC</td>
<td>Australian Universities Teaching Council</td>
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<td>BCA</td>
<td>Business Council of Australia</td>
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<td>CAL</td>
<td>Computer assisted learning</td>
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<td>D1</td>
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<td>Physiology discipline academic 3</td>
</tr>
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<td>DEEWR</td>
<td>Australian Government Department of Education, Employment and Workplace Relations</td>
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<td>DBR</td>
<td>Design based research</td>
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<td>E</td>
<td>Elearning computer programmer and graphic designer</td>
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<td>EAL</td>
<td>English as an additional language</td>
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<td>EAP</td>
<td>English for Academic purposes</td>
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<tr>
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<td>Educational design research</td>
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<td>English as a second language</td>
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<tr>
<td>ESP</td>
<td>English for Specific Purposes</td>
</tr>
<tr>
<td>FLERT</td>
<td>Flexible Electronic Report-writing Tool</td>
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<tr>
<td>IMRaD</td>
<td>Introduction, methods, results and discussion</td>
</tr>
<tr>
<td>ISE</td>
<td>Institute of Student Employers</td>
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<td>IT</td>
<td>Information technology</td>
</tr>
<tr>
<td>L1</td>
<td>Language and learning academic 1</td>
</tr>
<tr>
<td>L2</td>
<td>Language and learning academic 2</td>
</tr>
<tr>
<td>LC</td>
<td>University of Sydney’s Learning Centre</td>
</tr>
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<td>LCT</td>
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<td>LD</td>
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<tr>
<td>LD-F</td>
<td>Learning Design Framework</td>
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<td>LD-P</td>
<td>Learning Design Practice</td>
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<td>LMS</td>
<td>Learning management system</td>
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<td>OECD</td>
<td>Organization for Economic Co-operation and Development</td>
</tr>
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<td>QILT</td>
<td>Quality indicators for learning and teaching</td>
</tr>
<tr>
<td>QS</td>
<td>Quacquarelli Symonds</td>
</tr>
<tr>
<td>SFL</td>
<td>Systemic functional linguistics</td>
</tr>
<tr>
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<td>Statistical Package for the Social Sciences</td>
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<td>TEL</td>
<td>Technology-enhanced learning</td>
</tr>
<tr>
<td>TLC</td>
<td>Teaching/Learning Cycle</td>
</tr>
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<td>VLE</td>
<td>Virtual learning environment</td>
</tr>
<tr>
<td>WAC</td>
<td>Writing across the curriculum</td>
</tr>
<tr>
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</tr>
<tr>
<td>WRiSE</td>
<td>Write reports in Science and Engineering</td>
</tr>
<tr>
<td>ZPD</td>
<td>Zone of proximal development</td>
</tr>
</tbody>
</table>
CHAPTER 1
INTRODUCTION

1.1 Introduction and background

Proficiency in communication is a key attribute that both employers and government expect of university graduates and universities have consistently included this in their descriptions of graduate qualities or outcomes that they aim to engender in their students (Australian Industry and Skills Committee (AISC), 2018; Donleavy, 2012; Graduate Careers Australia, 2016; Oliver & Jorre de St Jorre, 2018; Organization for Economic Co-operation and Development (OECD), 2019; White, 2018). However, despite overall improvements in employer satisfaction with graduates (Quality indicators for learning and teaching (QILT), 2019), both government and employers identify communication, (essentially oral and written communication) as one of the areas where graduates tend to fall short of their expectations (Bloomberg Next, 2018; Clarke, 2018; Clokie & Fourie, 2016; Moore & Morton, 2017; Oliver & Jorre de St Jorre, 2018; Quacquarelli Symonds (QS) & The Institute of Student Employers (ISE), 2018; Shah, Grebennikov, & Nair, 2015; Suleman, 2016). At the same time, with the massification of higher education and a widening participation agenda, universities are expected to educate a larger and more diverse student population. This has meant that universities are increasingly under pressure to meet the needs of students entering with a range of educational experiences and abilities, not least in the area of academic communication (Baik, Naylor, & Arkoudis, 2015; Devlin, Kift, Nelson, Smith, & Mackay, 2012; Kift, 2008; Nelson, Kift, & Clarke, 2008; O'Shea, May, Stone, & Delahunty, 2017; Rolls & Northedge, 2018).

Universities have tended to assume that students enter with the communication abilities necessary for university study and have been unprepared for situations where
students struggle with meeting the communication demands of their chosen disciplines (Northedge, 2003; Rolls & Northedge, 2018; Taylor et al., 1988). Although the communication difficulties of students with English as an additional language (EAL) are well recognised and strategies to address this issue have been proposed (see for example, Arkoudis, Baik, & Richardson, 2012; Dunworth, Drury, Kralik, Moore, & Mulligan, 2013; Murray, 2015), universities struggle to implement these in any systematic way. Additionally, the communication challenges that all students experience when faced with the literacy demands of a new area of study also remain largely unaddressed. Thus, universities, with their focus on the development of students’ disciplinary knowledge, have been underprepared to support students to develop disciplinary communication practices. Faculty and discipline structures have developed with a focus on teaching core disciplinary content and skills, with little or no explicit teaching of communication of content, despite communication forming a key aspect of assessment practices.

However, since graduate communication continues to be an ongoing concern, Australian universities have developed a variety of strategies to address this issue. These have tended to be ad hoc and each university has developed its own independent approach. Despite this, some common strategies and practices, both face-to-face and online, have developed, although they are combined and deployed differently across the sector. (For a summary, see Briguglio, 2014.) These strategies typically involve specialists in academic language and learning (ALL), either centrally or faculty based. Their approaches fall into five main areas

- generic, voluntary, face to face communication workshops either offered by academic language and learning (ALL) centrally based units or faculty-based units
• individual consultations with students offered by ALL specialists, largely focussing on the development of students’ written communication within the context of specific assignments or theses
• discipline specific communication strategies integrated or embedded into discipline content curricula based on collaborations between ALL specialists and discipline staff
• communication courses for credit within faculties, typically offered by ALL specialists
• online or blended courses - either generic or discipline specific - developed through collaborations among ALL specialists, elearning specialists and discipline staff.

The consensus in terms of best practice is that communication practices are discipline based and should be integrated into discipline curricula and, if at all possible, ideally taught by discipline lecturers familiar with the structure and language of the genres of their discipline (Briguglio, 2014; Harris, 2016; Hoadley & Hunter, 2018; Mort & Drury, 2012; Wingate, 2006, 2018). However, although discipline lecturers are experts in the communication genres of their discipline community and can assess these, few can explicitly discuss the structures and language features that result in effective communication. In other words, many discipline lecturers lack a language to talk about language, in particular those in the area of the sciences and engineering (Etherington, 2014; Fischer, 2015; Goldsmith & Willey, 2016; Howard, Khosronejad, & Calvo, 2017; Lea & Street, 1998; Wingate, 2015). As a result, collaborative approaches among discipline lecturers and ALL specialists have developed to integrate communication into discipline units of study (Briguglio, 2014; Harris & Ashton, 2011; Kift, Nelson, & Clarke, 2010). Integration or embedding
occurs in a range of ways but rarely involves complete integration where discipline lecturers teach both content and the communication of that content in discipline genres. More commonly, ALL specialists either team teach with discipline lecturers in sessions that address communication or they provide adjunct sessions on communication within, or in addition to, unit of study curricula. These interventions usually address the communication genres involved in assessment tasks. Much research in this area attests to the effectiveness of these various integrated approaches, especially where they address the curriculum as a whole. (See for example, Chanock & Burley, 1995; Hoadley & Hunter, 2018; Thies, 2012; Wingate, 2011; Wingate, Andon, & Cogo, 2011.) However, a whole of institution approach to discipline-based development of students’ academic and professional communication is rare (Hoadley & Hunter, 2018).

In the sciences and engineering, students’ communication has been identified as a critical area of need. This is exacerbated by student and sometimes even staff perceptions that communication is of lesser importance in these disciplines than competence in mathematics and other areas of skill such as laboratory technique. However, pressure from employers and accrediting bodies continues to demand that universities address this issue (Accreditation Board for Engineering and Technology [ABET], 2017; Prinsley & Baranyai, 2015; Sarkar, Overton, Thompson, & Rayner, 2016). A key genre for developing written communication in these disciplines is the laboratory report, typically set in the early undergraduate years as a building block towards students developing competence in writing a research paper in later years or as preparation for the demands of writing an honours research thesis. The laboratory report genre is often viewed as formulaic, with a common structure of introduction, methods, results and discussion (IMRaD). However, this macro structure varies across
disciplines and across the undergraduate years and even more so within each stage where the aim of the experiment and the content under investigation demand a sophisticated use of structure and language. (See for example, Nesi & Gardner, 2012.) Mastering the communication of scientific research in the laboratory report genre, as well as understanding the rigorous conceptual framework underpinning the genre structure, can provide students with a basis for the development of other ways of communicating scientific and technical information. Supporting students in this endeavour is an urgent task as effective communication of scientific knowledge and research outcomes at all levels in society is necessary to address and counter misinformation (Iyengar & Massey, 2019).

1.2 Rationale and motivation for this study

The motivation for the research reported in this thesis is based on my professional role as an academic language and learning (ALL) lecturer in the University of Sydney’s Learning Centre (LC). The Learning Centre provides academic language and learning support for all students enrolled in the University of Sydney, a large and diverse learning community with over 50,000 students, 6 faculties and 3 schools. Students come from more than 130 countries, including urban and regional Australia and speak more than 80 languages. The LC lies outside the faculty and school structure and is located within the Education Portfolio, an academic and administrative unit of the University. Since its inception in 1991, the LC has offered support to students from varied language and educational backgrounds, coming from different discipline areas and levels of study. The Centre’s courses comprise both generic and faculty-based programs, an individual learning program and a suite of online resources, underpinned by a rich theory of language in education, namely, systemic functional linguistics (SFL).

My research and teaching interests in my professional role in the Centre have
focussed on the discipline specific written genres of science and engineering. This has led to research and teaching collaborations with discipline staff to integrate writing into curricula. These collaborations have resulted in a number of successful pedagogical interventions, both face-to-face and online (Drury, 2013; Drury, Airey, & O'Carroll, 2010; Drury & Jones, 2009, 2010; Drury & Mort, 2012, 2015; Drury, O'Carroll, & Langrish, 2006; Taylor & Drury, 2007). The learning resources have been developed within the framework of SFL and an approach to teaching writing based on genre pedagogy in the SFL tradition (Drury, 2016; Drury & Mort, 2015; Drury & Muir, 2014; Jones, 2004; Mort & Drury, 2012). These interventions to some extent have brought about a cultural change in some discipline areas where there is now an understanding that discipline content and associated communication are learned through writing and other modes of communication and that communication practices are intertwined with discipline knowledge building: one cannot occur without the other. However, this cultural change has not happened across all science and engineering disciplines and in those where it has occurred, it has been eroded by staff turnover and the increase in student numbers and diversity without a concomitant increase in staffing. As a consequence, the opportunities for students to develop their communication skills in the curriculum have decreased to a point where often the only assessed written assignment within a unit of study is a single laboratory report. This means that students have fewer opportunities to practice writing and receive feedback which will feedforward to their next assignment. (See for example, Carless, 2018; Sadler, 2010.) Inevitably, in this situation, many students continue to struggle to improve their report writing skills within science and engineering disciplines.

At the same time as university cohorts have increased and diversified, the introduction of a semester modular system has meant that discipline content has been
constrained into smaller time frames, leaving little room to address communication issues within face-to-face teaching in curricula, despite the interdependency of both content and communication for student success.

For these reasons, and also for a more sustainable approach, given the issue of staff turnover, most LC resources to support student writing in science and engineering have been redesigned from face-to-face teaching and learning materials and approaches into an online format (Drury, 1997, 2001). In particular, these resources have focussed on supporting students to write the genre of the laboratory report, a key genre in these disciplines. Early online interventions have been largely successful in terms of their perceived contribution to improved student performance in laboratory report writing assessments (Drury, 2001; Drury et al., 2006). However, the focus on the evaluation of student performance means that broad questions remain about the design and development process for the online resources; students’ learning experiences from interacting with these resources; and, if learning has taken place, how the resources and their design have contributed to this outcome.

With this in mind, when a new project for supporting students to write a laboratory report assessment in second year Physiology gained internal University of Sydney funding, this provided the opportunity and motivation to explore these issues. The project, the creation of a Flexible Electronic Report-writing Tool (FLERT), was conceived in a way that allowed for incremental design, development, implementation and evaluation. This approach enabled research into collaboration among team members in the process of creating and developing their online learning designs as well as analysis of the designed product, the program itself. In addition, a cycle of implementation and student and staff evaluation facilitated a mix of methods to more fully explore student experiences and learning from FLERT. These characteristics of
the project align with an educational design research (EDR) process (to be described below) and provide the basis for the research reported in this thesis.

1.3 Theoretical and research perspectives

The broad framework for this research is that of a sociocultural theory of education where teaching and learning take place in communicative interactions with teachers and peers. These interactions are influenced by the meanings embodied in the learning materials accompanying interactions and those of the physical, social and cultural components of the context (Vygotsky, 1978). Interactions are multimodal; they take place through a variety of ways or modes, such as spoken and written language, visual materials and actions, computer hardware and software and the multiplicity of other ways of communicating meanings in educational contexts (Kress, Jewitt, Ogborn, & Tsatsarelis, 2001). Semiotics is the theoretical basis for research into how modes or ‘signs’ combine an outward material form with a meaning that is socially and culturally shaped. These ‘signs’ are the semiotic resources, the multiple modes and their arrangements and combinations which teachers and educational designers can choose to create their learning resources and approaches. The theoretical approach of multimodal social semiotics can be used to research how modes are chosen to make meaning and how learning takes place through the deployment of these semiotic meaning making resources in an educational environment (Kress, 2010). Thus, this thesis takes a multimodal social semiotic approach to the communication and learning practices it is investigating.

Multimodal social semiotic theory and research draws extensively on SFL and applies its descriptive power and analysis of how meanings are made in language to other semiotic resources (for example, the application of SFL to visual modes, Kress & van Leeuwen, 1996). In this thesis, SFL, in particular the SFL approach to genre analysis and pedagogy, is used to complement the multimodal social semiotic analysis
of the modes chosen for the learning resources of report writing programs in science and engineering, the products of the design process. The rigorous analytical tools of SFL are also deployed to research the language of negotiation and knowledge building in the collaborative team meetings where FLERT was designed and developed, in other words, the design process. Further, SFL analysis of students’ evaluative qualitative data is used to enhance the more typical mixed methods theme-based approach.

The research process followed in this thesis is that of educational design research (EDR) (McKenney & Reeves, 2012) where a real world educational problem is addressed through practitioner/teacher and researcher collaborations on the design and development of theoretically informed learning resources. These in turn are evaluated iteratively by both students and teachers so that their feedback can inform both design and learning theory. This thesis uses the overarching framework of the EDR process to research the collaborations of the design process, the characteristics of designed products and in turn the students’ learning experiences in interactions with the FLERT product. In general, the methodology can be described as multi- and mixed methods encompassing not only the more traditional approaches to analysis of quantitative and qualitative data (Tashakkori & Teddlie, 2003; Teddlie & Tashakkori, 2009) but also social semiotic multimodal and SFL analysis.

1.4 The research problem

The practical focus of this thesis is how to address the ongoing issue of supporting students to improve their written communication in the sciences, in particular their writing of the laboratory report genre. This encompasses both how students learn the complexities of writing from both a process and product perspective, as well as how teachers create learning materials and approaches to bring about effective learning. Although these issues are not new, what is new is the expansion of
modes, particularly screen-based online modes, available to teachers to create learning designs. These designs, which comprise combinations of teaching materials and methods and their presentation, need to build on both educational theory and research on teaching writing as well as theory and research relevant to these new contexts of learning. In an iterative cycle, research based on the ways students engage and learn from these new learning environments can build and inform theory and contribute to principles for an online learning design for teaching writing.

1.4.1 The aim and research questions

The overarching aim of this research is illustrated in the cyclical diagram in Figure 1.1.

Firstly, this thesis investigates the collaborative design work of the team comprising discipline and ALL teachers and educational or elearning designers (glossed as Teacher/designers in Figure 1.1). In the design process, they engage in knowledge sharing and building to create the learning resources of the program. These resources, the designed program, embody the potential for bringing about student learning, the central component of the diagram. Learning can only take place through students’ varied interactions with these resources.

Secondly, the products of the design process, iterations of program design for laboratory report writing are analysed through the lens of multimodal social semiotics and SFL with a focus on how these online resources contain the learning potential associated with genre pedagogy in the face-to-face context.

Thirdly, the experience of student users as they interact with the FLERT program are explored as it is users’ activities that bring about the potential for their learning. Finally, student performance and their perceptions of their learning from interactions with the program are analysed to provide evidence that the program design has indeed contained the learning potential that the design team has built into their
design. These aims are captured in the three research questions below Figure 1.1.

Figure 1.1 The different facets of the research and their interrelationships

1. How does the design team (teacher-designers and elearning designers) negotiate the process of learning design?

   How is knowledge and experience shared among team members?
   What spoken interactions and use of artefacts facilitate this process?
   Do patterns/genres of team practices and knowledge building emerge in design meetings?
   How are the outcomes of knowledge building embodied in learning resources?

2. How does the design of a program for teaching and learning writing online evolve?

   How is writing pedagogy, specifically genre pedagogy in the SFL tradition,
adapted to an online context?
What multimodal elements are chosen to create the online writing pedagogy and how are these combined and arranged?
How have these elements evolved in different iterations of laboratory report writing programs?

3. **How do users learn from the online learning environment for writing a laboratory report in Physiology (FLERT)?**

How does the performance of users change after interacting with the program?
How do users interact with the program and perceive their learning from the program?
What elements of program design do learners perceive support their learning?

1.5 **Significance of the research**

The research reported in this thesis contributes in four main areas. Firstly, the diverse investigations carried out in this thesis support the development of theoretically informed principles for online design and pedagogy and particularly for teaching academic writing online. Secondly, the SFL analysis of team collaborations offers a new perspective on the EDR design process. Thirdly, social semiotic multimodal research illustrates how online learning programs for laboratory report writing, the designed products, have evolved over time shaped by the semiotic resources available through developments in technology and educational software. Lastly, a wide-ranging multi- and mixed methods approach, including SFL analysis, provides insights into student practices and learning in the online learning environment and how aspects of a program’s design can influence their learning.

From a theoretical perspective, multimodal social semiotics and SFL provide a
comprehensive and rigorous framework for the analysis of the complexity of the learning design both as process and product. These are relatively novel methodological approaches in educational design research. Additionally, this study extends these theoretical perspectives to the analysis of student user experience and learning.

1.6 Outline of the thesis

This thesis is compiled as a thesis including publications. Chapters 5 and 6 are largely based on publications that have already been issued. Chapter 7 comprises the publication itself, a joint publication. The remaining six chapters follow a traditional thesis format. These are the current chapter, Chapter 1, which provides an introduction and justification for the research; Chapter 2, an overview of the theoretical framework; Chapter 3, a literature review; and Chapter 4, the methodology and methods. Chapter 8 presents the analysis of qualitative data and is in the process of preparation for publication. Chapter 9 brings the thesis to a close with a summary and conclusion. Figure 1.2 provides an overview of the whole thesis.

Each of the chapters comprising publications (5, 6 and 7) has an introductory and, where necessary, a concluding section to carry the thesis narrative forward and integrate the work into the thesis. These chapters also have their own literature review, methodology and reference list. Inevitably, there is some overlap with Chapters 1, 2, 3 and 4.

Chapter 2 provides the theoretical framework for the thesis. A multimodal social semiotic theory of education is presented which can be used to inform the choice of language and other meaning making modes to be used in teaching and learning, especially in online contexts. This chapter also introduces the language theory of SFL, which has strongly influenced theoretical aspects of multimodal social semiotics. The analytical resources of SFL relevant for research into spoken discourse in this thesis are also discussed. Genre analysis in the SFL tradition is summarised, as it is the basis
for genre pedagogy for teaching academic writing. These different theoretical perspectives are included in the overarching framework of a sociocultural theory of learning.

Chapter 3 is essentially a literature review, which situates the research in the field of educational design research (EDR) to address the problem of student writing in the sciences. Within this broad field, models of designs for learning, particularly relevant to online learning, and associated learning theories are evaluated. The review proposes that approaches to designs for learning tend to ignore the theoretical perspectives of multimodal social semiotics and the role of language in education.

Chapter 4 introduces the methodology and associated methods. A varied and wide ranging multi- and mixed methods approach is used to address a rich primary data set of both quantitative and qualitative data. Quantitative data comprise students’ performance data linked to their use or non-use of FLERT, pre- and post-test data, as well as tracking data and user ratings of aspects of FLERT. Statistical analyses are used to interrogate this data. Qualitative data include team members’ interactive dialogues in the design process as well as visual and hypertext data of screen-based design products. SFL and multimodal analyses are used to investigate this data. Additional qualitative data comprise students’ open-ended comments, recordings of their interactions with the FLERT program and their reflective recounts while using the program to write an assessed laboratory report. A theme-based analysis together with SFL is used to research this data.

Chapter 5 begins the narrative journey of the thesis with the SFL analysis of the interactions of the team in the design process. An SFL approach to analysis of this kind of data has rarely been used in EDR. This chapter presents an analysis of the spoken interactions of team members as they engaged in the design process, with the
aim of identifying typical patterns of negotiation and the meeting genres which facilitate this process.

Chapter 6 moves the focus to the designed product itself with a multimodal analysis of the genre pedagogy of online programs used to support students’ report writing in the sciences and engineering. An investigation of a number of design iterations is presented as well as insights into student users’ reported experiences of learning from the design of the programs.

Chapters 7 and 8 report on the detailed evaluation of the FLERT program. Chapter 7 reports on quantitative data while the focus of Chapter 8 is qualitative data. Chapter 9 presents the overall conclusions, summarises the contributions of the thesis to knowledge in the area and provides suggestions for future research. Design principles based on the research are proposed and reflections on the work are shared.
There is a need for research into the design of online learning environments for academic writing in the sciences and how students experience and learn from these environments.

A multimodal social semiotic approach to the design of online learning environments. SFL theory of language in education. Genre analysis. Sociocultural theory of learning.


A multi- and mixed methods approach. SFL and multimodal analysis. Quantitative and qualitative data analysis.

Knowledge building: How interdisciplinary understandings are realised in team negotiation

Moving Online to Teach Academic Writing in Science and Engineering: Theory and Practice

Using an e-learning environment for developing science students' written communication: the case of writing laboratory reports in Physiology

Learning from users: qualitative data

*Figure 1.2 Overview of the different chapters of the thesis and their purposes*
1.7 Terminology used in this thesis

A number of terms are used to describe online teaching and learning environments. As technology has changed so have the terms ranging from computer assisted learning (CAL) to elearning (or e-learning) to virtual and digital learning. This thesis uses the global term ‘online learning’ for all learning that takes place through the medium of a computer screen. In addition, a more recent term used in the literature, ‘technologically-enhanced learning’ (TEL), is used in the review in Chapter 3. When the term elearning is used in this thesis, it is written without a hyphen except for its use in the publication in Chapter 7 where it is written as ‘e-learning’.

There are also a number of terms used to describe the professional staff who are engaged in collaborative online teaching and learning design work with discipline and ALL staff. These professionals have expertise in information technology, elearning and graphic design. This thesis uses the term educational designer or elearning specialist or designer to describe these practitioners. The publication in Chapter 7, also uses the term IT pedagogical designer, essentially with the same meaning as educational designer or e-learning specialist/designer.

ALL academic staff are also referred to as language and learning specialists in parts of this thesis.

The design work in this thesis was undertaken by discipline and ALL teachers and educational designers or elearning specialists. In this thesis all of these participants are considered designers as they are all involved in the process of design. I use the term ‘teacher-designers’ to emphasise that the role of the teacher is also to design teaching and learning materials and activities. This reflects Kress’s use of the term “rhetor” (Kress, 2010, p. 26) to describe the work of the teacher as always involving design.
Chapter references


Drury, H., Airey, D., & O’Carroll, P. (2010). Improving report writing for undergraduate students in engineering through an online learning environment:


Hoadley, S., & Hunter, K. (2018). Whole of institution academic language and


Oliver, B., & Jorre de St Jorre, T. (2018). Graduate attributes for 2020 and beyond:


CHAPTER 2
THEORETICAL PERSPECTIVES

2.1 Introduction

Chapter 1 provided the context for this research by highlighting the need for teaching academic communication in the sciences and the challenges associated with integrating this into a content driven curriculum. An online approach aligned with the curriculum was proposed as a way to meet students’ diverse needs in the area of written communication and the object of the research was introduced, namely the FLERT program for teaching the laboratory report genre in Physiology. This chapter will provide a theoretical framework for this multifaceted research on the design, development, implementation and evaluation of the online learning and teaching resources that comprise the FLERT program.

My research is primarily informed by a social semiotic theory of education with an emphasis on the role of language and other ways or modes of meaning making in teaching and learning (Bezemer & Kress, 2016; Hodge & Kress, 1988; Kress, 2010; Kress, Jewitt, Ogborn, & Tsatsarelis, 2001; Kress & van Leeuwen, 1996, 2001; van Leeuwen, 2005). Social semiotic theory incorporates the concept of how meanings are made through choices among the multiple modes available in a particular sociocultural context (for example, writing, sound, gesture etc.). Analysis and description of these modal choices or multimodal analysis and the semiotic resources they offer can highlight the ways in which communication and representation of meanings can be organised for particular social purposes. Social semiotic theory and research, especially into multimodal aspects of education, has been strongly influenced by Michael Halliday’s theory of Systemic Functional Linguistics (SFL) and the work of other scholars in this tradition (Eggins, 1994; Halliday, 1973, 1978, 1985; Halliday &
Hasan, 1985; Halliday & Matthiessen, 2004; Martin, 1992; Martin & Rose, 2007, 2008). Halliday conceived of “language as a social semiotic” (Halliday, 1978, p. 2), a way of making meaning in a social system or culture. He acknowledged other modes of meaning making or semiotic systems such as painting, sculpture, dance, and defined a culture as “a set of semiotic systems, a set of systems of meaning, all of which interrelate” (Halliday & Hasan, 1985, p. 4). Thus, the theoretical framework of SFL and its analytical tools have been applied to other semiotic modes to describe their meaning making properties and interrelationships with language and other modes (for example, the application of SFL to visual modes (Kress & van Leeuwen, 1996)).

I use a social semiotic theory of multimodality together with SFL in the two main areas of my research. The first area investigates the FLERT program as both a design process and a designed product. It is both an outcome of a knowledge building process of dialogic interaction among teacher-designers and elearning specialists as well as the result of the evolution of a multimodal social semiotic approach to learning design. The second area focuses on student use and learning from the FLERT program embedded in the wider curriculum. Students’ activities and learning are traced through a multi- and mixed methods approach complemented by an SFL analysis of the language used in student surveys, in interactions with the program and in reflective recounts while writing. Therefore, meaning making through language and other semiotic resources is at the centre of this research. More broadly, social semiotic theory and SFL can be seen to align with a sociocultural perspective in education as both see language and other meaning making ‘tools’ as mediating learning (Wells, 1994, 1999). This Chapter presents an overview of these key theories and their relevance to this research.
2.2 A Social semiotic theory of multimodality

Social semiotics is the study of how meanings are made and communicated through a variety of means in our interactions with our sociocultural and material world.

...a theory that deals with meaning in all its appearances, in all social occasions and in all cultural sites. That theory is Social Semiotics. (Kress, 2010, p. 2)

Social semiotics sees meaning as a social and cultural creation.

Social semiotics is primarily concerned with human semiosis as an inherently social phenomenon in its sources, functions, context and effects. It is also concerned with the social meanings constructed through the full range of semiotic forms, through semiotic texts and semiotic practices, in all kinds of human society at all periods of human history. (Hodge & Kress, 1988, p. 261)

From semiotics, the core concept of the sign, a combination of an outward material form and a meaning, is redefined in social semiotics as the motivated sign where signs are chosen, reshaped and made according to the interests of the maker.

In signs, sign-makers mediate their own social history, their present social position, their sense of their social environment in the process of communication; and this becomes tangible in the reshaping of the cultural resources used in representation and communication. (Kress, 2010, p. 69)
Sign-makers, for example, teacher-designers and educational designers, draw on the culturally and socially available semiotic resources as a means for making meanings. These resources can be physical, such as gesture or conceptual, such as genre. The theoretical perspective of a “meaning making resource” is based on Halliday’s conception of language as a semiotic “resource” for “meaning potential”, where language is seen as a system of choices for making meaning and carrying out social functions.

*Semiotic resources are the actions, materials and artifacts we use for communicative purposes, whether produced physiologically – for example, with our vocal apparatus, the muscles we use to make facial expressions and gestures – or technologically – for example, with pen and ink, or computer hardware and software – together with the ways in which these resources can be organized. Semiotic resources have a meaning potential, based on their past uses, and a set of affordances based on their possible uses, and these will be actualized in concrete social contexts where their use is subject to some form of semiotic regime.* (van Leeuwen, 2005, p. 285)

Many researchers in social semiotics have described the meaning making functions of semiotic resources in terms of Halliday’s metafunctional theory of language; how language choices simultaneously embody meanings of three kinds to achieve their social purpose. These are the ideational, concerned with experiential and reflective meanings, interpersonal, concerned with interactional meanings and textual, concerned with the organisation of these into coherent text. An early influential work in this area, Kress and van Leeuwen’s *Reading Images: the Grammar of Visual Design*
(1996) extended the metafunctional concept to meaning making in images and combinations of image and writing. This has been summarised by Unsworth (2007, p. 332; 2008, p. 3) as follows:

- **Representational/ideational structures** verbally and visually construct the nature of events, the objects and participants involved and the circumstances in which they occur.
- **Interactive/interpersonal verbal and visual resources** construct the nature of relationships among speakers/listeners, writers/readers and viewers and what is viewed.
- **Compositional/textual meanings** are concerned with the distribution of the information value or relative emphasis among elements of the text and image.

This metafunctional approach has provided a unifying theoretical base for exploring the role of semiotic resources in meaning making in a number of contexts, (for an overview, see Adami, 2017; Jewitt, 2009, 2014; Jewitt, Bezemer, & O'Halloran, 2016; Martinec, 2005; O'Halloran, 2004; O'Halloran & Smith, 2011; Painter, Martin, & Unsworth, 2013; Unsworth, 2008), including education. (See for example, Archer & Newfield, 2014; Bezemer & Kress, 2016; de Silva Joyce & Feez, 2019; Jewitt, 2006; Macken-Horarik, Love, Sandiford, & Unsworth, 2018; Martin & Rose, 2008; McCabe, O’Donnell, & Whittaker, 2007; Unsworth, 2008.) In the context of my research, the metafunctions can, for example, illuminate the still image in Figure 2.1, from a video of a FLERT team meeting, an image that accompanies the monologue in Chapter 5, Extracts 6, 7 and 8.
Ideational or representational meanings comprise the participants, their posture and facial expressions (‘body language’), spatial positioning, their interactions with other objects, notably the paper-based diagram representing the structure of the introduction module of the FLERT program. Interpersonal or interactive meanings are embodied in the role of the speaker as she uses gaze and gesture to guide listeners through the content of the diagram and they in turn show their attention to the diagram through hand and body posture. The textual or compositional meanings portray a meeting genre, participants gathered around a table with papers, computers and other objects indicating the context of a meeting. Although this image is not included in Chapter 5, where the focus is the analysis of spoken discourse, it serves to highlight the importance of the visual in meaning making and the semiotic resources that are brought together by the participants, both consciously and unconsciously to communicate and in this way facilitate the purpose of the meeting.

In social semiotic research, semiotic resources are typically discussed in terms of modes or the varied means of communication and representation available to people
to carry out functions in a sociocultural context. Thus social semiotic research has incorporated the theoretical framework of multimodality to describe and analyse the ways in which modes make meaning separately and in combinations with other modes, in other words, “a social semiotic theory of multimodality” (Kress, 2010, p. 5):

*Multimodal Social Semiotics theorizes meaning from three ‘perspectives’. The overarching perspective is that of semiosis – making meaning: its categories apply to all representation, to all communication and to all the media of communication. From the perspective of multimodality, the theory deals with issues common to all modes and to the relations between modes. ... In the third perspective, of dealing with a specific mode, the theory has categories that describe forms and meanings which are appropriate to the specificities of a given mode – its material affordances, its histories of social shaping and the cultural origins/provenance of elements of that mode.* (Kress, 2010, p. 61)

### 2.2.1 Modes and Multimodality

In any given situation, meanings are created through choices from the semiotic resources available, in other words, the choice of both conceptually available resources such as genre and material resources or modes. The choice of the term mode, originally based on Halliday’s description of the distinction between the channels of communication of speech versus writing, has been extended in social semiotics to cover a range of meaning making resources.

*Mode is a socially shaped and culturally given semiotic resource for making meaning. Image, writing, layout, music, gesture, speech, moving image, soundtrack and 3D objects are examples of modes used in representation and communication.* (Kress, 2010, p. 871)
Communication and representation always involve the combination of a multiple selection of modes, in other words, multimodality (Kress & van Leeuwen, 1996), and consequently a multiplicity of modes are involved in teaching and learning (Kress et al., 2001). Each mode, for example, colour, offers different options or potentials for making meaning termed affordances; “the potentials and constraints for making meaning” (Bezemer & Kress, 2016, p. 23). (The term ‘affordance’ is used in social semiotics with a different sense, and a different set of theoretical commitments, to those found in the original work of Gibson (1966)). Colour offers the affordances of the choices of materials for creating the colour as well as the social and cultural meanings attached to a colour choice. A particular colour affordance will be used for a given communicative or representational purpose (Kress & Van Leeuwen, 2002). In other words, the choice of the mode will be “apt” for the communicative or representational function for the given situation; “aptness means that the form has the requisite features to be the carrier of the meaning” (Kress, 2010, p. 55).

Just as cultures and societies vary in their choice of modes for particular purposes, so do disciplines. Physiology, for example, as the study of chemical and physical mechanisms in living systems, can be said to draw equally on both writing and image (and specific kinds of image) in the ways it engages with both research and teaching. It uses a range of other modes in the teaching and learning environment of the laboratory, classroom and lecture theatre as well as the online learning environment, where animation and simulation, as affordances for images are “apt” to illustrate living system mechanisms (for example, in programs developed for educational purposes by ADINSTRUMENTS


Although there is still ongoing discussion among researchers about what
constitutes a mode, I follow Kress in adopting Halliday’s metafunctions as the basis for describing the semiotic principles that constitute a mode.

...each mode expresses meanings about states, relations, actions and events in the world [ideational]; ... meanings about the social relations of those who interact in communication [interpersonal]; and that it has the capacity for forming semiotic entities which cohere internally and with their environment [textual]. (Kress, 2010, p. 104)

**2.2.2 Modal ensembles**

Modes are found in combinations or multimodal ensembles where they contribute to meaning both individually and in their interactions with other modes. In an educational context, different learning environments offer different modal choices. A digital environment offers modal choices for the medium of the screen providing both opportunities and constraints, “gains and losses” (Kress, 2005). In this study, multimodal learning resources are brought together online to help students write a discipline-based laboratory report. An example from Chapter 6 is the choice of modes for the banner of a screen for the discussion module of a report writing program in biochemistry, Figure 2.2.

*Figure 2.2 Screenshot of banner for early report writing program in biochemistry*

In this modal ensemble, layout, colour, image and typographical resources are brought together to create the meaning of a banner. This comprises a series of headings
and sub-headings located at the top of a screen indicating in a succinct way the content of the screen. Each mode has its own meaning making properties which contribute to the overall meaning. The main semiotic meanings are carried by writing (incorporating the mode of typography) and layout “the arrangement of elements on a site of appearance” (Kress, 2010, p. 91). Writing specifies the discipline and content focus of the program, the topic or ideational meaning. Changing size and capitalisation in typography, moving from left to right on screen, provides cohesion (textual meaning), a part/whole structure; comprising on the left, the title of the report program; followed by a module in the program and within this module, the specific topic. Colour choices combine with typography to distinguish between the program and its parts. The layout of the program with the title on the left of the screen is the space for signalling what users already know, the ‘given’ information, (they are still within a website about report writing for biochemistry), whereas moving to the right indicates the ‘new’ information that will be presented and interacted with, creating interpersonal meanings. Layout is complemented by the framing of the title with the background image, taken from Leonardo da Vinci’s notebook, giving the title unity and separating it from the rest of the banner where the framing of white space and coloured font provide unity for the program parts.

In creating modal ensembles, Bezemer and Kress (2008, 2016) provide guiding semiotic principles for teacher-designers and educational designers, namely selection of modes, their framing, arrangement, and their foregrounding. The modal ensemble will then create social relations between speaker and listener, writer and reader, website designer and user. For the modes that comprise the banner (Figure 2.2), the designer has chosen typography and colour to complement the written mode as well as using framing and layout. This selection of modes taken together with a left to right
linear, sequenced arrangement represent the composition of the program. The title of
the program is foregrounded through the choice of a larger font with a background
image. The left to right layout creates the ‘reading pathway’ establishing social
relations with the users with the expectation that they will interact with the content of
the module.

2.2.3 Changing modes: transformation and transduction

When modes and modal ensembles are changed to meet new social and cultural
needs accompanied by changes in media, two processes are involved termed
transformation and transduction (Bezemer & Kress, 2008; Kress, 2010). Transformation is when the characteristics of a mode or modal ensemble change
within the same mode or modal ensemble: “Intra-modal changes we call
transformation. They refer to and describe changes in the arrangement of the
elements (of some entity) within one mode” (Bezemer & Kress, 2016, p. 53).

A comparison between Figure 2.2 and 2.3, from Chapter 6 of this research, is
used here as an example to explain the concept of transformation.

![Writing a Short Scientific Paper in Molecular Biology](Screenshot of banner for later report writing program in molecular biology)

The selection of modes has remained the same (writing, typography, layout,
colour, image) but the main changes have occurred in the framing, arrangement and
foregrounding of modes with consequences for social relations. Colour is used to
frame the layout of both the image and the written content so that the left to right
potential reading pathway moves from the image to the title of the report writing
program. The composition of the program is presented through the vertical layout of
the program parts in contrast to horizontal layout in Figure 2.2. Colour (both in terms of typography and background) and typography combine with layout to complement the compositional meanings. The positioning of the title of the program at the top of the screen is what students are aiming for, the ‘ideal’ and the structure of the discussion below is the content that will help them achieve this goal, the ‘real’. In this later design (Figure 2.3), image, colour and layout are foregrounded, although writing is necessary to convey the topic of the program and its composition. Framing in terms of both layout and colour complement the meanings made in the written text in a more effective way than in Figure 2.2 and in this way present a more cohesive banner.

Transduction is when the changes involved are across modes: “Inter-modal changes we call transduction. They refer to and describe changes from one mode to another – from speech, say, to drawing” (Bezemer & Kress, 2016, p. 53). When moving online, the face-to-face spoken language of the classroom, is “recontextualised” using different modal ensembles: “recontextualization involves the re-presentation of the meaning-materials in a mode apt for the new context, in the light of the available modal resources” (Bezemer & Kress, 2016, p. 75). The practice of scaffolding is most at risk in moving from the classroom to the screen. Scaffolding in the classroom takes place in real time through the spoken mode accompanied by gesture, facial expression etc., in interactions between teacher and students and among students and supplemented by illustrations, for example, notes on paper or whiteboard. On screen, the complexity of meanings brought together in the classroom learning situation are impossible to replicate. However, the modal ensemble illustrated in Figure 2.4, discussed in more detail in Chapter 6, aims to provide scaffolding on screen for students to understand the staging of a discussion in a laboratory report.
One example of staging the Discussion is shown here based on an extract from a student report on the purification and analysis of plasmid DNA containing an insert of unknown size and orientation. When you have played the animation, click on the stages in the diagram to see which questions are answered in each stage and an example of that stage. Note the movement from general to specific and back to general.

Figure 2.4 Screenshot of the stages (schematic structure) in a discussion section of a laboratory report on the purification and analysis of plasmid DNA containing an insert of unknown size and orientation

Scaffolding is first provided by the instructional written text located in Figure 2.4 above the diagram. However, when students first enter this screen, the diagram is not visible. They can choose to click on a button (see left) to reveal and animate the diagram. The unfolding of the diagram from top to bottom gradually reveals the stages of the discussion within the lab report genre, each framed in a coloured semi-rectangle. At the same time the overall ‘hourglass’ frame which arranges the stages is revealed as well as the vertical arrow on the left-hand side of the diagram, accompanied by stage numbering. Both show the linear
development of the text, through the discussion stages from general to specific to general linked by the same colour. This colour saturates the hourglass frame as it unfolds and is used in the labels from general to specific accompanying the unfolding of the left-hand arrow and both of these fade when the animation stops. Finally, the curved arrows appear, disappear and reappear as they illustrate the possibility of the repetition of stages shown by the extra rectangles gradually appearing behind these stages. (A link to the screen to view the animation is provided: http://learningcentre.usyd.edu.au/wrise/biochemistry3/discussion/disc_structure2.html)

In describing this animation in written text above, I have experienced the challenge of transferring predominantly moving visual meanings into the mode of written text: the process of transduction. Clearly, the written mode cannot convey the meanings as well as the visual animation. However, the question is whether this animated modal ensemble can adequately scaffold students’ understanding of how to structure their discussion compared to the modal ensemble of a classroom where speech is dominant.

The animated image presents students with an abstract diagram of the stages in the genre of a discussion in a laboratory report, foregrounded in the central space of the diagram. The stages are labels in the written mode presented in differently coloured, solid frames, indicating their separate and different functions. At the same time, they are grouped together within the ‘hourglass’ frame to show their relationship to each other and to the whole discussion. The unfolding animation and the use of the visual meanings associated with graphic arrows mimic for students the real time, linear, dynamic development of their text while simultaneously, indicating the possible recursive nature of writing some of the stages in the discussion. The written mode, although minimal, is essential for providing the ideational meanings, the naming of the
stages. Colour and layout are foregrounded in the diagram, complementing the ideational meanings of the stages and their arrangement as well as providing coherence to the diagram or the textual meanings. Overall, the use of animation, although optional, is not simply decorative; it embodies the meaning of a real-life dynamic unfolding text and provides coherence to the whole visual display. Clearly more scaffolding is needed and is provided through written examples of each stage which students can reveal progressively or all at once (Chapter 6). So, the predominantly visual introduction to the stages of the discussion is followed by the more detailed written exemplification, an approach that aims to provide on screen scaffolding.

2.3 Multimodal semiotics and teaching and learning

Teaching and learning are interactions involving multimodal communication, exchanges of meaning in multiple modes and in modal ensembles. Teachers as designers of learning or (more accurately) learning potential, select modes and media that are apt for their purpose and audience. Although teachers hope to bring about learning, learning depends on the learner, hence teacher’s designs offer a learning potential.

By potentials for learning we mean the ensemble of semiotic features of a text or of an environment - objects, texts, people – that provides the ground for learning and in that way may shape what learning is and how it may take place. It includes the epistemological as well as the pedagogical significance of representational practice. (Bezemer & Kress, 2008, p. 168).

Learners are also meaning makers who shape their own meanings from the learning resources. A social semiotic multimodal view of meaning and learning is provided by Kress (2010, p. 182):
Learning is the result of the transformative engagement with an aspect of the world which is the focus of attention by an individual, on the basis of principles brought by her or him to that engagement; leading to a transformation of the individual’s semiotic/conceptual resources.

Although teachers have always designed learning environments within the constraints of the curriculum and institution, technology offers new modes and media, each with their own affordances, for creating multimodal learning resources. For learners, the online medium offers the choice of creating their own pathway through the online environment, shaping their own learning. However the new media place demands on students to develop the multiliteracies they need to interact with, read and learn from the array of multimodal resources; discern the overall structure of the website, the function of links and hyperlinks, and select what is relevant and important for the meaning making required for a given task.

There is now a large body of research into academic written and spoken modes, their genres, structures and language. This has formed the basis for developing a pedagogy and metalanguage for teaching. More recently, research and pedagogy has incorporated approaches to describing multimodal texts both in online and offline contexts, in other words developing students’ multiliteracies. A key foundational theory for this research is systemic functional linguistics. This theory is introduced in the following section.

2.4 Systemic functional linguistics (SFL)

Systemic functional linguistics is a rich theory of applied linguistics which enables a detailed description of how language is used to make meanings in context. This theory posits a stratified system of how language builds meanings from the
smallest components in the phonological or sound system of spoken language (or the typography/graphology of written language or gestures in sign language) to the context of the use of language in a specific situation or, at a higher level of abstraction, the role of language in creating and maintaining our sociocultural world. “Language is the principal means through which we create the world in which we live” (Halliday, 1977, p. 48).

The theory emphasizes language as a system of meaningful choices where language choices are made to carry out social functions in their context of use. Importantly, these functions are reflected in the choices made in the structural components of the language system.

This [the form of the language system] consists of a meaning potential, represented as a network of options, which are derived from a particular social function and are realized, in their turn, by structures whose elements relate directly to the meanings that are being expressed. (Halliday, 1973, p. 29)

In terms of the social functions of language, a particularly powerful conception within SFL is that all language use conveys three kinds of generalised functions simultaneously. It reflects our experience of both our outer and inner world (‘ideational function’), it enables our interactions with others (‘interpersonal function’) and it allows us to organise our meanings in ‘texts’ so they make sense in the context of use (‘textual function’). These functions are termed metafunctions (Figure 2.5). They have been described in more detail above in Section 2.2 as foundational principles for multimodality.
2.4.1 SFL and context of use

Since SFL conceives of language in terms of how it is used to make meanings in social contexts, context and its influence on language use is an important part of the theory. SFL describes context at two levels of abstraction, the most abstract is that of the context of the culture, the language practices available within a culture but differentially available to those within the community and the context of situation, the specific situation in which language use occurs.

Language .... is a range of possibilities, an open-ended set of options in behaviour that are available to the individual ...The context of culture is the environment for the total set of these options, while the context of situation is the environment of any particular selection that is made from within them (Halliday, 1973, p. 49).

In this research, the cultural practices of the university can be taken to be the
context of culture, primarily an educational context, and within this context, there are a wide range of acceptable language practices (and other meaning making practices) that participants engage in to achieve their own aims and those of the university. These practices are termed ‘genres’ in SFL and a genre is defined as “a staged, goal-oriented, purposeful activity in which speakers (and writers) engage as members of our culture” (Martin, 1984, p. 25). Genres, often called ‘text types’ in educational contexts, have distinctive and generally, culturally predictable and acceptable stages and language characteristics. These stages, termed schematic structure, are used by speakers and writers to achieve their social purpose. The three genres of interest in this research are:

- those of the interdisciplinary meeting where the content of the FLERT program is being designed (Chapter 5),
- the curriculum genre of the online program (Chapters 6 and 7),
- and the genre of the laboratory report itself, the content of the learning design of the program (Chapter 6).

The context of situation is the specific situation or instance in which language is used - termed a register in SFL - and language use can be predicted to some extent from the context of situation and vice versa. Language choices in register are described in terms of three variables, Field, Tenor and Mode and these relate to the broad functions of language, the metafunctions (Table 2.1).

Table 2.1 Relating contextual variables to metafunctions (Christie & Unsworth, 2000, p. 4).

<table>
<thead>
<tr>
<th>Variable within context of situation</th>
<th>Component of language system (metafunction)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field: social activity, topic</td>
<td>Ideational: to represent experience</td>
</tr>
<tr>
<td>Tenor: social roles and relations</td>
<td>Interpersonal: to enable interaction</td>
</tr>
<tr>
<td>Mode: medium and role of language</td>
<td>Textual: to achieve coherence and connectedness</td>
</tr>
</tbody>
</table>
Field describes those language choices concerning the content, topic or activity unfolding in the written or spoken text, Tenor, the language use that reflects the roles and relationships among those involved and Mode, the influence of the channel or medium of communication on language choices.

*Types of linguistic system differ from one another, broadly speaking, in three respects: first, what is actually taking place [Field]; secondly, who is taking part [Tenor]; and thirdly, what part language is playing [Mode]. These three variables, taken together, determine the range within which meanings are selected and the forms which are used for their expression. In other words they determine the ‘register’* (Halliday, 1978, p. 31).

In the present study, one specific situational context is meetings among discipline lecturers, language and learning academics and elearning specialists to create online learning resources for students to learn the genre of the laboratory report in second year physiology. The Field focus in this setting consists of the discussion of the content of the online learning resources and the procedure for their design and development, Tenor, the meanings that reflect the status, roles and relationships among participants and Mode is the medium of spoken language accompanied by other semiotic modes encompassing gesture, gaze etc. as well as the written texts, visual diagrams, and screen prototype designs on display. The patterning of register variables combines to reflect the schematic structure of a genre in a given situational context. An example from this research is the confluence of Field, Tenor and Mode meanings to characterise the beginning stage, or orientation stage, in a more formal team meeting. In this meeting, the chair (person of highest status in terms of Tenor) begins the
meeting by outlining the agenda (the Field of the meeting) through a spoken monologue consisting of a list of items (Mode). Chapter 5, Extracts 9 and 10 illustrate this further.

**2.4.2 SFL and levels of language systems**

I have already discussed how SFL divides context into two abstract levels of meaning making or strata, the context of culture and the context of situation and the role of genre in the former and register in the latter. I now turn to the descriptions of the strata or levels within language itself which are used to create meanings appropriate for choices within register and genre. Language strata in SFL comprise three levels. The least abstract is that of phonology or graphology or signing and signings: choices among sounds, symbols and gestures. The next level is that of lexicogrammar: choices of vocabulary and grammatical structures at the level of the clause or sentence. At the highest level is the stratum of discourse semantics: choices of language to create combinations of clauses and sentences in a text. The visual representation of these strata and their connection with the strata of context is shown in Figure 2.6
This representation of the stratification of language and context embodies the principle that each level comprises a pattern of patterns from the level below. For example, genres comprise patterns of field, tenor and mode or discourse semantics comprise patterns of lexicogrammar.

2.4.3 The descriptive power of SFL

SFL provides an array of functionally based ways of describing language choices within language strata. These are aligned with the metafunctions and can be used to illuminate language choices in register and genre. For example, where meanings are being negotiated in the interdisciplinary meetings for creating the FLERT design (Table 2.2), the interpersonal choices open to the speakers (L1 and L2) at the level of discourse are described in SFL as speech functions or moves. L2 initiates the move by demanding information, in this example concerning the definition of the hypothesis, which means that L1 is put into the position of responding and can choose to complete or continue the exchange, a stage in this negotiating genre, by agreeing or disagreeing or challenging L2.
Table 2.2 Extract from interaction among speakers (L2, L1) in interdisciplinary meeting showing speech functions where ‘it’=the hypothesis

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Talk</th>
<th>Speech function</th>
</tr>
</thead>
<tbody>
<tr>
<td>L2</td>
<td>do you mean – do you mean that it’s a statement</td>
<td>Demand information</td>
</tr>
<tr>
<td>L1</td>
<td>I mean that</td>
<td>Respond</td>
</tr>
<tr>
<td>L2</td>
<td>formulated as a statement</td>
<td>Respond</td>
</tr>
<tr>
<td>L1</td>
<td>it’s formulated as a statement but …</td>
<td></td>
</tr>
</tbody>
</table>

At the level of the lexicogrammar, these interpersonal meanings are organised through the clause structures of question (interrogative) or statement (declarative). These structures are termed the Mood system in SFL where the difference between question and statement is shown through the choice of and position of the subject (nominal element) and finite (verbal element) (Figure 2.7). In this example, L2 uses both a question and a statement in their opening move.

Figure 2.7 Simplified Mood system based on the exchange in Table 2.2

The Subject and the Finite together ‘carry the argument forward’. The Finite makes the clause ‘negotiable’ and the Subject is responsible for the validity of the information. These interpersonal meanings combine with ideational meanings, namely what is being negotiated, the explanation or definition of the hypothesis. These meanings are structured at the level of the lexicogrammar in terms of the Transitivity
system, the choice of processes (verbs of doing (material), thinking (mental), saying (verbal), being, having (relational)), the participants (nouns of people, places, things) and circumstances (when, where, how etc.) involved in these processes. Here L2 uses a process of cognition ‘do you mean’ (thinking or mental process) to probe L1’s thinking about the explanation for the hypothesis, the thing or participant under negotiation. L2 puts forward the explanation for the hypothesis using an ‘identifying’ (relational (being) process, ‘it’s a ‘statement’, and follows this up with a ‘material’ or action process ‘formulated as a statement’. L1 responds agreeing and repeating L2’s explanation. This small exchange makes sense through the textual metafunction which ties together the interpersonal and ideational meanings mainly through L1’s use of the pronoun ‘it’, referring to the hypothesis, in first position or Theme position in the clause. However, we can see that this exchange, a stage in the negotiation of how the hypothesis is to be explained in the FLERT program, has not reached completion as L1 suggests further negotiation is going to take place with the conjunction ‘but’. Chapter 5 provides a detailed description of the SFL analysis of the series of exchanges needed to reach consensus for the explanation of the hypothesis. These exchanges can be seen as stages in a meeting genre for co-construction of knowledge, where each consists of phases where possible explanations/definitions for the hypothesis are negotiated among team members before the negotiation reaches closure.

2.4.4 Genre analysis

Since the early 1980s, SFL research has focussed on the genres of educational contexts, both spoken and written, as a way to inform pedagogy. (For an overview, see Christie, 2012; Christie & Unsworth, 2005; Cope & Kalantzis, 1993; Martin, 2016; Rose & Martin, 2012; Gardner, 2017.) This SFL research began with the description of elemental (junior primary genres) written and spoken genres (such as observation-
comment, recount, description, explanation, procedure, etc.) initially in the context of curricula in primary school education (for example, Christie, 2012; Christie & Derewianka, 2010; Martin, 2009; Martin & Rose, 2008; Rose & Martin, 2012; Rothery, 1989). Further projects have investigated the written genres of the secondary school, including macrogenres (texts composed of more than one genre) (Martin, 1994), as well as genres of the workplace (for example, Christie & Martin, 1997, 2007; Coffin, 1997, 2006; Feez, Iedema, & White, 2008; Humphrey, 2017; Korner, McInnes, & Rose, 2007; Martin & Rose, 2008; van Leeuwen & Humphrey, 1996; Veel, 1997, 1998, 2006; Wignell, Martin, & Eggins, 1993). At the same time, genre analysis has been carried out at the tertiary level, particularly in the context of the discipline-based assignments students are required to master for assessment purposes. These analyses have revealed the complexity of both macro and embedded genres (for example, Candlin & Plum, 1998; Dreyfus et al., 2016; Drury, 2001; Drury & Webb, 1989; Hao, 2018; Hewings, 2004; Hood, 2010; Nesi & Gardner, 2012; Ravelli, 2004; Szenes, 2017; Woodward-Kron, 2005).

As texts have become more visual, genre analysis has been extended to the description of multimodal texts in education, those that use not only language but also other modes, primarily visual in terms of diagrams, graphs, tables, photographs, pictures, mathematical symbols etc. (for example, Bezemer & Kress, 2008; Jewitt, 2005; Lemke, 1998; Macken-Horarik et al., 2018; Martin & Rose, 2008; O'Halloran, 2007; Unsworth, 2001, 2007, 2008; Zammit, 2007). Also, as all pedagogy is recognised as multimodal, research into the modal interactions in classrooms or other sites of learning has been undertaken (Bezemer & Kress, 2016, 2017; Bourne & Jewitt, 2003; Jewitt, 2005, 2006; Jewitt & Kress, 2003; P. Jones, 2008; Kress et al., 2001). With the development of online pedagogy, including the pedagogy for teaching
academic writing, multimodal genre analysis has been carried out of online learning sites (Archer & Breuer, 2015; Coffin, 2013; Djonov, 2007; Domingo, Jewitt, & Kress, 2015; Jewitt, 2002, 2006, 2014; Jones, 2007; Zammit & Callow, 2000).

Genre analysis and description is typically based on a corpus of texts sharing the same purpose and context. Patterning of the register variables and their realisation in choices at the level of discourse semantics and lexicogrammar are used to identify the schematic structure or the stages of the genre and the phases within each stage. Genre analysis and description can then be used to develop models for educational purposes. For example, Figure 2.4 shows the schematic structure of the discussion stage of the laboratory report on the purification and analysis of plasmid DNA containing an insert of unknown size and orientation. When students click on the first stage, Relate to aim, its purpose is summarised in the prompt questions, shown in the left column of the window in Figure 2.8. Subsequently, a student example taken from a corpus of analysed texts can be revealed (column on the right of the window).

![Figure 2.8 Screenshot of the Relate to aim stage of the Discussion section of the laboratory report on the purification and analysis of plasmid DNA containing an insert of unknown size and orientation](image)

At the level of register, the language choices in this example reflect the field in this stage of the discussion not only through the choice of technical language specific to the experiment but also language indicating the purpose of this stage, namely,
bringing together the aim and the results; ‘The main aim ... to determine’; The fragment … has been identified …in size and is inserted in orientation…’. The tenor of the language is impersonal, for example, the typical use of the passive voice and the statement of the results with certainty. The mode is clearly that of a written monologue, reporting and reflecting on the outcome of the experiment, a lexically dense, abstract text. However, reference to the visual presentation of the results is also necessary to support the results statement. At the level of discourse semantics, the choice of macro-Theme clearly signals the first stage in the discussion section of a report, a conventional, almost formulaic beginning ‘The main aim of this experiment’. Lexicogrammar choices also identify this stage, for example, shifts in the choice of verb tense from simple past ‘was’, to remind the reader of the aim of the experiment, to present perfect ‘has been’ to link the aim to the findings.

This kind of genre analysis and description has formed the basis for genre pedagogy, a design for learning which is discussed in Chapters 3, 6 and 7.

2.5 Sociocultural theory and learning

Sociocultural theory as the name suggests emphasises that the basis of learning is its social and cultural context. Learning takes place in the complexity of interactions among people, the histories and cultures they embody and the ‘tools’ and ‘signs’ accompanying, mediating, constituting and transforming such interactions. ‘Tools’ encompass the physical/material aspects of the situation and their historically and socially constituted semiotic properties and ‘signs’ or ‘psychological tools’, comprise spoken and written language and other semiotic systems such as drawings, art work etc. (Vygotsky, 1978; Wells, 1994). The concept of meaning making ‘tools’ and ‘signs’ orchestrated to achieve certain purposes in their contexts of culture and situation is aligned with multimodal social semiotic and SFL approaches to research and practice in education.
Sociocultural theory owes its origins to the seminal work of Vygotsky and his collaborators, who recognised that all mental phenomena such as memory, reasoning, reflection etc. have their origins in sociocultural activities mediated by tools and signs and involving interactions with others. “All the higher functions originate as actual relations between human individuals” (Vygotsky, 1981, p. 57). Stetsenko, drawing on Vygotskian theory, argues that scholarly theory-building, perhaps the highest form of intellectual activity, relies on real world interactions.

For example, although theory-building might appear, in a superficial observation, as a purely arm-chair activity, detached from mundane practices of life, this activity type can only emerge, exist, and develop as a form of scholars' connection and contribution to the world, a form of collaborative pursuit in the world, that is, as inevitably practical. (2005, p. 15)

In sociocultural, real world interactions, Vygotsky considered spoken language to be the most important ‘sign’ or ‘psychological tool’ in mediating human meaning making activities. Dialogue could then form the basis for intellectual activity, conceptual development and learning.

Experienced first in interaction with others, the functions of speech are gradually internalized and become means for self-directed mental activity. "A sign is always originally a means used for social purposes, a means of influencing others, and only later becomes a means of influencing oneself” (Vygotsky, 1981, p. 157, cited in Wells, 1994, p. 60).
The role of spoken dialogue in supporting learning in social interactions is important in Vygotsky’s concept of learning taking place in the zone of proximal development or ZPD. Learning in the ZPD takes into account students’ current levels of knowledge and understanding and aims to support students to go beyond this through guidance from more experienced adults or peers.

*The zone of proximal development ... is the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers.* (Vygotsky, 1978, p. 86)

Learning is brought about through collaborative activities guided by both spoken language and other meaning making modes (Wells, 1994). This concept underpins the nature of scaffolding provided in both face-to-face and online situations. Although scaffolding can be carried out through spoken dialogue in both contexts, (given the limitations of the screen), multimodal meaning making is especially important in screen-based learning. This means that knowledge of the multimodal affordances of the screen is essential for designing scaffolding in online learning.

2.6 Summary

This chapter has given an overview of the theories guiding this research, namely, multimodal social semiotics, systemic functional linguistics and sociocultural learning theory. It has drawn attention to their relevance to aspects of the research presented in later chapters. This theoretical framing provides a way of understanding the complexities of designing for learning in an online environment both in terms of
the process of design work and the product of the design. Chapter 3 will begin with a
review of Educational Design Research (EDR) which provides further context for this
research and is followed by a discussion of designs for learning. This will lead to a
focus on approaches for teaching academic writing at tertiary level in face-to-face and
online contexts with particular reference to genre pedagogy.

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CHAPTER 3

LITERATURE REVIEW

3.1 Introduction

Chapter 2 located this research in the theoretical context of SFL and multimodal social semiotics within a sociocultural theory of education. This theoretical underpinning of meaning making through semiosis is valuable for research that has the practical outcome of developing resource materials for teaching academic writing online. These resources address the issue of improving student writing in the sciences. Hence the overarching research framework is that of Educational Design Research (EDR) which aims to develop practical solutions for educational problems. EDR is “a genre of inquiry” (McKenney & Reeves, 2012, p. 3) where practice and theory are mutually informing in iterative cycles of educational interventions to address teaching and learning issues.

*Educational design research can be defined as a genre of research in which the iterative development of solutions to practical and complex educational problems also provides the context for empirical investigation, which yields theoretical understanding that can inform the work of others.* (McKenney & Reeves, 2012, p. 7)

This chapter will begin with a review of EDR (Section 3.2), followed by a discussion of designs for learning and their theoretical basis (Sections 3.3, 3.4 and 3.5). This will lead to an overview of approaches for teaching and learning academic writing at tertiary level, with a focus on the genre-based literacy pedagogy behind the online learning program, FLERT (Section 3.6). How approaches have been repurposed for
teaching academic writing online will also be discussed (3.7). The chapter concludes with a summary bringing together EDR, designs for learning and genre pedagogy (3.8).

Figure 3.1 integrates the theoretical framework discussed in Chapter 2 with other relevant theory in an adapted generic model of EDR which will be explored in this chapter.
### Figure 3.1 Process of EDR in this research and associated theoretical frameworks (adapted from Reeves, 2006, p. 59)

<table>
<thead>
<tr>
<th>ANALYSIS OF PRACTICAL PROBLEMS BY RESEARCHERS AND PRACTITIONERS IN COLLABORATION</th>
<th>DEVELOPMENT OF SOLUTIONS INFORMED BY EXISTING DESIGN PRINCIPLES AND TECNOLOGICAL INNOVATIONS</th>
<th>ITERATIVE CYCLES OF TESTING AND REFINEMENT OF SOLUTIONS IN PRACTICE</th>
<th>REFLECTION TO PRODUCE ‘DESIGN PRINCIPLES’ AND ENHANCE SOLUTION IMPLEMENTATION</th>
</tr>
</thead>
</table>
| • Student/staff needs analysis | • Community of practice  
  • Interdisciplinary knowledge building | • Online learning | • Reflection |
| • Ethnographic survey  
  - student and staff surveys/ focus groups  
  - document survey, curriculum documents, assessment guidelines etc. | • Design for learning  
  • Learning theory  
  • Social semiotic theory of multimodality  
  • SFL language in education  
  • SFL genre analysis and pedagogy | • Methodology and methods: approaches to evaluate students’ online learning | • Develop more widely applicable theoretical and practical understandings |
| • SFL genre analysis of corpus of student laboratory reports |  |  |  |
3.2 Educational design research

EDR provides a promising framework for this research as the overall aim is to address the problem of poor student writing in the sciences through the online learning FLERT project. This project involved a collaborative, interdisciplinary design process to develop online learning resources for academic writing aligned with the wider context of curriculum goals and assessment. The EDR process comprises a number of phases (Figure 3.1) and proceeds from analysis of the problem, through design and development to evaluating student use and learning from the resources to complete a feedback cycle to further improve design. A major goal of EDR is to develop both local and, if possible, more widely applicable design principles as a contribution to both theory and practice building. The EDR approach overlaps with other related approaches (Kopcha, Schmidt, & McKenney, 2015; McKenney & Reeves, 2014), primarily with Design Based Research (DBR) in the field of education. Although I am following the generic model of EDR research and practice developed by McKenney and Reeves (2012, p. 77), I will also review relevant research in education that follows a DBR approach. (See for example Barab & Squire, 2004; Design based Research Collective, 2003.) Both approaches draw on the seminal work of Brown (1992), who argued that educational research was too distant from practical, real life educational problems and proposed “design experiments” (p. 141) to bring together researchers and practitioners to devise and “test” effective learning environments to enhance teaching and learning in the classroom.

McKenney and Reeves’ (2012) key publication Conducting Educational Design Research provides a detailed account of how to approach EDR research together with a review of a number of real-life applications. Other reviews have considered the application of EDR and DBR approaches in online, blended and offline contexts in a number of discipline areas and at all educational levels. (See for example
Overall, these studies were able to demonstrate improvements or potential improvements in student learning based on the interventions. Other more recent collections (Dobozy & Cameron, 2018; Kopcha et al., 2015) have focussed on examples of effective interventions in higher education that predominantly involve technology.

However, despite the increase in and successful completion of EDR or educational DBR projects, many researchers acknowledge that these approaches are challenging in a number of ways. The educational problem to be addressed is often complex and many faceted and so may not be adequately described or theoretically informed before the design and development phase (Collins, Joseph, & Bielaczyc, 2004; Easterday, Rees Lewis, & Gerber, 2016; Goodyear & Dimitriadis, 2013). The result can be an intervention that is poorly aligned with implementation and evaluation methods as well as the wider context of curriculum and assessment (McKenney, 2013; Reeves, 2011). The choice of methodology and methods and the multiple sites for data collection often provide an overwhelming amount of data so that triangulation is difficult and the validity of learning outcomes for possible further iterations can be questioned (Collins et al., 2004; Dede, 2004; Easterday et al., 2016; Easterday, Rees Lewis, & Gerber, 2018; Kelly, 2004; Markauskaite & Reimann, 2008; Raffaghelli, Cucchiara, & Persico, 2015; Reimann, 2011). While it is certainly the case that EDR typically draws on multiple theories, methodologies and methods, this can be seen as a positive strategy to address the complexity of the educational issues under investigation. However, these need to be clearly articulated and justified and the connections among them and their use in the phases of EDR made explicit (Kopcha et al., 2015).
Collaborators may not share the same goals and there may be role and power imbalances which impact the implementation of learning designs (McKenney, 2013, 2016). The need for the collaboration to extend over the longer term and over multiple iterations, the ideal case in EDR, is also a challenge, especially for practitioners. Involving practitioners in the research so the project is truly collaborative is another challenge. (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003; Goodyear, Markauskaite, & Kali, 2009). Interventions may also be unsustainable when educational practitioners and contexts change and when the EDR project comes to an end (Goodyear & Dimitriadis, 2013).

Although longer term projects involving a number of iterations are preferred, nevertheless shorter term projects are also feasible even though they may only achieve success at the local level and develop design principles for their particular context of use (Herrington, McKenney, Reeves, & Oliver, 2007; Kopcha et al., 2015; Pool & Laubscher, 2016). Many such studies comprise case studies where design principles remain limited rather than widely applicable (Anderson & Shattuck, 2012; Easterday et al., 2016; Ormel et al., 2012). However, these local interventions may also be more likely to continue the design process beyond the EDR project time line as practitioners use their new knowledge to continue the design and evaluation cycle, if only on a small scale (Dimitriadis & Goodyear, 2013).

McKenney and Reeves provide an overview of the fields of instructional design and curriculum development which have influenced the development of their generic model of EDR. The ADDIE model of instructional design, for example, (Analysis, Design, Development, Implementation and Evaluation) (Branch, 2009) to some extent, mirrors the phases of EDR, although EDR includes a more flexible and iterative design and development process with an emphasis on formative feedback and
the development of design principles. Additionally, curriculum theories range from those that emphasise a more prescriptive and linear approach to those that locate curriculum design and development in a broader sociocultural context which closely involves teachers and learners. EDR aims towards the latter approach with an emphasis on the social context of the educational design.

An EDR approach is explicitly used in this study to provide a framework for an intervention to address the problem of student writing in the sciences at tertiary level. There have been a number of EDR studies at tertiary level. (See for example Bollen, van der Meij, Leemkuil, & McKenney, 2015; Scott Curwood, Tomitsch, Thomson, & Hendry, 2015; Wozniak, 2015.) There have also been EDR studies that have addressed students’ academic writing at primary and secondary levels and in the context of learning English as a foreign language. (See for example the Seeds of Science/Roots of Reading program cited in Humphrey, 2017; McKenney & Reeves, 2012, p. 55; Ozverir, Herrington, & Vanci Osam, 2016.) However, none have addressed online learning of discipline based academic writing at tertiary level. There is indeed a large body of literature on the theory and practice of teaching academic writing at tertiary level which will be reviewed later in this chapter. In contrast to this literature, the current study places the approach to addressing student writing development within an EDR framework. In so doing, it builds on earlier work (Drury, 2001; Drury, O'Carroll, & Langrish, 2006) to address laboratory report writing in the face-to-face context as well as online. In other words, the current study is part of a longer, ongoing process of educational design and development, rather than a “greenfield site” (Goodyear & Dimitriadis, 2013).

Although design for learning, often called learning design in the literature (Ellis & Goodyear, 2010), is the central component of EDR and is where an EDR
approach is seen to succeed or indeed fail, the complexity of designing for learning is rarely discussed in detail in the EDR literature (Goodyear, 2011, 2015). The next Section, 3.3, will discuss what is now considered the field of designing for learning or “Learning design” focussing on aspects of design and the theories underpinning them that are relevant to this research.

3.3 Designing for learning

Teaching has always involved designing for learning or learning potential (Beetham & Sharpe, 2007). However, the development of “Learning Design” (LD) as a field of inquiry has become more prominent with the growth of technology-enhanced learning (TEL). This has required teachers to make more explicit their pedagogy, their theoretical and practical approaches to designing and developing materials and methods for bringing about learning. Goodyear’s (2005) “working definition” of the broader concept of educational design as “the set of practices involved in constructing representations of how to support learning in particular cases” (p. 83) emphasises design as a practical activity while also incorporating theory and real-world experience. The choice of the term “representations” which comprise visual and textual descriptions for designing for learning also has points of contact with a multimodal social semiotic approach to design which will be reviewed later.

Another definition is provided by Conole (2013, pp. 7, 8).

*It is a methodology for enabling teachers/designers to make more informed decisions in how they go about designing learning activities and interventions, which is pedagogically informed and makes effective use of appropriate resources and technologies. This includes the design of resources and individual learning activities right up to curriculum-level design. A key principle is to help make the design process more explicit and shareable.*
Learning design as an area of research and development includes both gathering empirical evidence to understand the design process and the development of a range of learning design resources, tools and activities.

Dobozy’s (2012) definition also acknowledges the need for a knowledge base and incorporates TEL: “a way of making explicit epistemological and technological integration attempts by the designer of a particular learning sequence or series of learning sequences” (p. 45). Dobozy’s (2013) review of LD empirical studies concluded that most did not define LD, although a range of LD definitions from other scholars are summarised (including Conole’s (p. 68)), with a focus on pedagogy rather than technology. Thus LD remains “a popular but still fuzzy concept” (Dobozy & Cameron, 2018, p. i). The overall consensus is that the LD process is complex and challenging for all academics working in a rapidly changing tertiary education system (Dalziel, 2013; Dobozy & Cameron, 2018; Goodyear, 2015).

A number of scholars have worked on frameworks for supporting teaching and learning design with the aim of developing a more systematic approach to design incorporating theory and practice. Another aim is to enable designs to be more easily exchanged, adapted and extended. (See for example, Beetham & Sharpe, 2007, 2013; Dobozy, 2012; Goodyear, 2001; Laurillard, 2012; Lockyer, Bennett, Agostinho, & Harper, 2009.) Three models are of particular relevance to this research, namely Goodyear’s Activity-centred analysis and design (ACAD) (Goodyear, 2000; Goodyear & Carvalho, 2014), the Larnaca model (Dalziel et al., 2016) and Laurillard’s Conversation framework (Laurillard, 2002, 2012).

3.3.1 Activity-centred analysis and design

A key strength of Goodyear’s Activity-centred analysis and design (ACAD) (Goodyear, 2000; Goodyear & Carvalho, 2014) is that it places the student and the
students’ activities (mental and physical) at the centre of design (Biggs, 2012). The learning planned by the teacher, the learning outcomes, is the potential result from student actions (Figure 3.2). “Learning activity is the key: what the learner does is what makes a difference to their learning outcomes” (Ellis & Goodyear, 2010, p. 121).

![Activity-centred design model](image)

**Figure 3.2 Activity-centred design model (Goodyear, 2015, p. 33)**

The teacher’s critical role is the design of tasks with an awareness of their desired learning potential and outcomes. These tasks prompt the students’ activities and learning, although the learning activities and their outcomes may not be those intended by the teacher.

... learning tasks (as set by the teacher) are transformed by the student through their own interpretative and other work such that it is the students’ activity that mediates between the task as set and the educational outcomes achieved. (Ellis & Goodyear, 2010, p. 122)

This emphasis on students as ‘transformers’ of their learning is also a feature of a multimodal social semiotic approach to learning.
The multimodal design of computer applications offers the student a “designed position to knowledge”, “what it means to be a learner”. This is only ever an offer. The student can attempt to usurp, adapt or reject the learner position embedded in the design of the application. (Jewitt, 2006, p. 101)

The approach to the analysis and design of the task within ACAD comprises three dimensions, the knowledge or epistemic elements of the task, the social aspects and the material/physical environment.

*Our approach to analysis ... involves looking at unfolding activities and drawing connections with (epistemic) task design, with structures of place and social structures.* (Goodyear & Carvalho, 2014, p. 60)

However, the ACAD framework does not provide guidance for teachers on learning theories and design methodologies to inform their design of tasks for student activities and learning. A helpful framework for this is Goodyear’s pedagogical framework (Figure 3.3) (Ellis & Goodyear, 2010; Goodyear, 1999, 2005).
The pedagogical framework provides the intellectual resources for ACAD (on the right of the diagram) in terms of the more general and abstract concepts of pedagogical philosophy and high-level pedagogical theories (the upper two layers on the left of the diagram). Philosophy includes, for example, beliefs about how people learn and epistemological positions (such as positivism or constructivism) while high level pedagogy includes educational approaches, such as problem-based learning. Moving to the lower levels of the pedagogical framework, pedagogical strategy and tactics begin to specify the methods involved in the ACAD task(s) at different levels of detail. The framework is summarised by Goodyear as follows:

*The pedagogical framework is a loosely coupled structure in which hierarchical relations can be made between:*

- *pedagogical philosophy* (how we think people learn, what knowledge consists of, how we think people should be treated, etc.),
- *high level pedagogy* (broad approaches such as problem-based learning, cognitive apprenticeship, collaborative knowledge building),
• pedagogical strategy (e.g. the use of an online debate) and

• pedagogical tactics (the detailed methods we use to set tasks for students, encourage their participation, offer guidance and feedback, etc.).

(Goodyear, 2005, p. 86)

Although the layered, hierarchical elements of the framework suggest a top down, deterministic approach to task design, the upper levels of philosophy and theory allow for varied strategies and tactics. It is important to note that specifying tactics may well precede strategies and that the higher levels of theoretical framing can allow designers to combine different theoretical perspectives. While the elements of the framework are “loosely coupled” in this way, clearly there needs to be a logic behind the way they have been chosen to further the task design, in other words, an alignment (Biggs, 1999).

The need for guidance for teachers in the area of task design (the pedagogical strategy and tactics), especially design incorporating TEL, is not disputed and the use of patterns and pattern languages from the field of architecture (Alexander (1979); Alexander et al. (1975), (1977); acknowledged in Goodyear & Retalis (2010)) has provided a systematic and coherent method to approach educational task design.

There is an acute need to find effective ways of sharing design knowledge, particularly if practitioners are to make any headway in building on the success of others in a cumulative manner. Design patterns provide a way of addressing this issue by providing guidance which is abstracted from practice and informed by theory in a way which makes them more easily translated into effective practice. (Mor, Mellar, Warburton, & Winters, 2014, p. 1)
At the most general level, a pattern provides a specification for a problem and its solution and in this way, it adopts a similar approach to a learning design issue as EDR. A problem can be defined at different contextual levels and within each level, stages and their material and experiential properties as well as their conceptual and theoretical properties are described in a systematic and logical way to achieve a solution. These steps can also be considered as patterns and taken together make up a pattern language.

A pattern language can be seen as a set of patterns which are connected by being either contexts or embellishments for each other. A pattern language is a way of gathering together a set of patterns such that a project of worthwhile scale can be tackled. (Goodyear & Retalis, 2010, p. 17)

A pattern language, as the name suggests, is described in language and in some cases, through multimodal representations. Thus a linguistic analysis (SFL) of the multimodal resources, primarily language, used to specify the pattern or sets of patterns can enhance their description (Yang, 2010). In particular, this analysis can reveal the genres and their staging structures that are associated with pattern languages, an approach that aligns with how patterns are presented in a series of steps to achieve a solution. This combined approach of design patterns, SFL analysis and genre analysis has been applied in a key work by Yang to develop genre pedagogy for online teaching and learning of academic literacy (Goodyear & Yang, 2009; Yang, 2008; Yang & Goodyear, 2014a). The genre-based design of the FLERT program, the subject of this research, can also be conceived in terms of the detailed description of the pattern: Genre-based development of academic writing skills (Yang & Goodyear, 2014b, pp. 83-92).
Both the pattern-based approach to learning design and the meaning making theory of SFL as applied in educational contexts emphasise the influence of the social and cultural context on human behavior and communication and the need for development of explicit descriptions and guidance to support learning. Also, the philosophy behind Halliday’s SFL and Alexander’s pattern languages is one of a commitment to ‘making life better’. In Alexander’s terms “good TEL” would be where “learning can be experienced as coherent with what is most deeply valued in the rest of life, as a source of pleasure, growth and transformation” (Goodyear & Retalis, 2010, p. 18). Halliday was committed to an “appliable linguistics” one that could contribute to positive change in the real world, “a socially accountable linguistics, and this in two though related senses: that it put language in its social context, and at the same time it put linguistics in its social context, as a mode of intervention in critical social practices” (Halliday, 1993a, p. 73).

Another point of contact between SFL and pattern languages is the concept of ‘patterns and patterning’. The conception of patterns in LD, descriptions of recurring ways of problem solving and pattern languages, the relationships among patterns in a broader sociocultural context, has synergies with the SFL description of language as a stratified system for meaning making comprising recurrent patterning of language choices across strata (Martin & Rose, 2008). Despite these synergies and with the exception of Yang’s contribution, a language and multimodal based theory is not used to underpin the language and representational choices of meanings incorporated in patterns and pattern languages.

The pattern-based approach has been widely described and disseminated in education, both in terms of publications and professional development. This has resulted in a broad range of exemplar patterns, especially in the TEL area, for teachers
to access and adapt to their own context (Goodyear & Retalis, 2010; Laurillard, 2012; Mor et al., 2014). The higher level pedagogical framework is also seen as necessary for the use of patterns and pattern languages to plan, document and disseminate learning design pedagogical strategies and tactics (Chatteur, Carvalho, & Dong, 2010).

Another descriptive model in the field of LD, which has points of contact with ACAD and the pedagogical framework, is the Learning Design conceptual map (LD-CM) presented in the Larnaca Declaration (Dalziel, 2015; Dalziel et al., 2016). This also aims to bring together theory and practice in LD.

### 3.3.2 The Larnaca declaration

The Larnaca Declaration is the result of collaboration among a group of scholars to capture the complex components and their interrelationships involved in learning design, incorporating both theoretical and practical aspects as well as contextual factors. The Larnaca Declaration, using the analogy of music notation, aims to provide “educational notation for pedagogical theory and practice” (Dalziel et al., 2016, p. 5), and is summarised in a “conceptual map”, LD-CM, (Figure 3.4). The LD-CM “help[s] to explore the relationships among the “moving parts’ of how an educator comes to teach in a particular way at a particular moment”.

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72
Similar to ACAD and the pedagogical framework, the LD-CM provides an overview of key design components at all stages and levels. For example, design components in a unit of study would comprise the assessment tasks and the teaching activities and materials aligned with these as well as the physical and social environment of learning. The LD-CM neither identifies an overarching educational theory or philosophy for design nor a research methodology, while at the same time acknowledging that these, together with the learning environment, will influence design. The overarching aim of this model is to address the challenge of “creating learning experiences aligned to particular pedagogical approaches and learning objectives”. A central motif of the model is teaching as an iterative cycle incorporating learning design, student engagement and professional practice. This is closely interconnected with both theory and context (on the left of the map) and the specific learning activities operating at different levels in the institution (on the right).
The outcome of the model is the core concepts of the learning design with the central concept being the actual description of the teaching and learning practices. This needs to be presented in a way that can then be shared and used or adapted by other teacher-designers, in other words, this is the “educational notation” which can be used either with or without professional support and guidance. The concept of “representation” refers to how to detail the teaching and learning activities and a number of examples from learning design projects are given, for example, the patterns approach. The development and implementation of the design are also specified in terms of tools (both digital and paper-based) and resources (journal articles, handouts, videos etc.). Finally, as with all teaching, whether classroom based or online, evaluation and feedback from learners is crucial for ongoing reflective teaching and design.

The LD-CM attempts to find a balance and bridge between the complexity of educational and learning theories and their application in context. It provides a way of analysing other learning design pedagogical approaches such as Laurillard’s Conversational Framework. While it allows freedom for practitioners to choose theoretical frameworks appropriate to their context, it emphasises the role of the learner in shaping their learning. In other words, it is the learner who is responsible for their learning and who brings about their own learning through their interactions with the “designed” learning environment. In this way it aligns with the ACAD framework with its focus on the learner’s activities shaping their learning. This suggests that the conceptual map is derived from an interpretivist rather than a positivist educational paradigm, the former aligned with a constructivist, student-centred pedagogy rather than a teacher-centred transmission pedagogy as in the latter. However, the authors of the Larnaca Declaration emphasise that these are two poles of a continuum. They
clearly argue for a student-centred approach, but an approach that can include teachers giving direct instruction when appropriate. Teacher direction is in fact necessary at certain phases of the teaching cycle and in certain contexts. This approach emphasises the importance of context, content and purpose in choice of pedagogy as well as a more nuanced approach to educational and learning theories.

The Larnaca conceptual map (LD-CM) can provide an overview for design work. However, the core concepts, the description of the teaching and learning activities, needs to be further specified in the Learning Design Framework (LD-F) “A descriptive language/notational format/visualization for describing teaching and learning activities based on many different pedagogical approaches” (Dalziel et al., 2016, p. 39) and Learning Design Practice (LD-P), “The action of applying Learning Design concepts to the creation and implementation of effective teaching and learning activities, also called ‘designing for learning’ ” (Dalziel et al., 2016, p. 39). (Figure 3.5). These components of the field of Learning Design can be shared and adapted to support academics in improving student learning by disseminating effective teaching strategies for learning design.

![Figure 3.5 Components of the field of learning design](image)

*Figure 3.5 Components of the field of learning design* (Dalziel et al., 2016, p. 37)

Both ACAD and LD-CM are key models in the field of LD and Laurillard’s
Conversational Framework (Laurillard, 2002) can be incorporated in both. However, the Conversational Framework is relevant to this research as it focuses on the role of ‘discourse’ or conversation between teachers and students in the learning design space.

3.3.3 The Conversational framework

The Conversational framework draws on phenomenographic research into student learning in the face-to-face context, (for example, Marton & Booth, 1997), which highlights variations in students’ perceptions and understanding of discipline knowledge and practices. Students commonly develop misconceptions when discipline knowledge contradicts their common sense understanding of phenomena and Laurillard has developed the “conversation” approach to teaching to address these. Starting with these misconceptions, the teacher gradually aligns students’ conceptions with those of the discipline through iterative interactive dialogue and reflection.

a continuing iterative dialogue between teacher and student, which reveals the participants’ conceptions, and the variations between them, and these in turn will determine the focus for the further dialogue. (Laurillard, 2002, p. 71)

Laurillard’s emphasis that student learning is dependent on their understanding of discourse and representational structures of knowledge and that teaching needs to make this explicit can be applied to student learning of the genre structures and language of their disciplines, such as the laboratory report in Physiology, the focus of this research. Further, the gradual development of understanding through interaction can also be understood as scaffolding of knowledge through the Zone of Proximal Development (ZPD) (Vygotsky, 1978), an important aspect of genre pedagogy discussed later in this chapter. In addition, research into threshold concepts in discipline knowledge also suggests that students encounter typical areas of difficulty in
understanding disciplinary knowledge and therefore need guidance through interactions between expert and learner to move through periods of uncertainty (Meyer & Land, 2005).

Similarly, a social semiotic approach to teaching and learning also recognises the importance of “discussions with the learner … to enable the learner to come closer to the necessary understanding” (Bezemer & Kress, 2016) and the responsibility of the teacher to adjust the learning environment while at the same time acknowledging the learner’s agency.

*More importantly, the learner’s principles have not been dismissed out of hand, leaving her/him feeling incompetent, useless or discarded; rather, she/he sees her/his principles taken seriously. The possibility of innovation and creativity is fostered, not squashed. And most significantly of all, the understanding of the issue to which learners have come is theirs.* (Bezemer & Kress, 2016, p. 135)

Although the model is challenging to implement at scale and online, nevertheless, Laurillard provides a useful analysis of media and teaching methods in terms of the framework together with suggestions and online support tools on how to use it to enhance online teaching which can reach larger numbers of students (Laurillard, 2002, 2012; Laurillard et al., 2013).

These models (and others in the TEL area, for example, Lockyer et al. (2009); Conole (2013)) and online repositories of learning design examples and applications/tools, (for example, Australian Universities Teaching Council (AUTC), 2002; Conole & Culver, 2010; Laurillard et al., 2013; Oliver, Harper, Wills, Agostinho, & Hedberg, 2013) have been created for professional development. They
aim to support academics in their approaches to learning design and teaching, predominantly in online contexts. They often form the basis for professional development courses as well as research in professional networks such as the Australasian Society for Computers in Learning in Tertiary Education (ASCILITE).

Recent trends in higher education teaching place academics under pressure to engage in learning design to update or create new courses and incorporate TEL, as well as respond to increasing student numbers and diversity and meet institutional policies and quality frameworks. In this environment, many academics lack the time both to explore learning design models or online design support applications or tools as well as to access professional development to help them choose and learn to use appropriate models or online learning design resources. Without this guidance, the array of models and online applications or tools can be confusing and overwhelming and many academics confine their TEL to the learning designs available in the virtual learning environment (VLE) or learning management system, (LMS) supported and promoted by their institution.

3.3.4 Teaching practices and learning design models

Research into academics’ teaching practices has often been used to inform learning design models and online design support applications/tools (Bennett, Agostinho, & Lockyer, 2015, 2017; Conole, 2013; Laurillard et al., 2013). Academics approach teaching and student learning from three main perspectives, namely:

- their past beliefs and practices about teaching in their discipline,
- their understanding of their students’ backgrounds and how students learn
- and contextual factors, such as interactions with colleagues as well as logistical factors, such as class size, timetabling and higher-level institutional strategies and drivers.
The components of the course they are to teach are the immediate focus of their design, such as course aims and learning outcomes, content and teaching and learning activities and assessments (Bennett, Agostinho, et al., 2017). Design is cyclical and usually begins at a broad level either with a focus on learning outcomes or course content; it is a “messy, creative and iterative process” (Conole, 2013, p. 103). Course redesign as opposed to design of a new course is linked with student feedback and evaluation and often continues with subsequent iterations with reflection on teaching (Bennett, Agostinho, et al., 2017; Conole, 2013). University teachers’ own beliefs and teaching experience are significant influences and reflect learning theories even though these are rarely mentioned; for example, designing for student needs or diversity. Major influences are discipline based peers who provide advice and sharing of materials and methods within the constraints of the institutional framework (Bennett et al., 2015; Laurillard et al., 2013).

Teachers tend not to identify themselves as ‘designers’ although they do use design representations, text or visuals, online or paper-based, to some extent to illuminate the process and product. However, these are rarely shared. Learning design models or online design applications/tools are also little used although there are clearly points of contact between teachers’ design processes and those incorporated in learning design models. (For a conceptual framework illustrating teachers’ design decisions and a model of teachers’ design processes, see Bennett, Agostinho & Lockyer (2015) and (2017) respectively.) Increasingly teachers do attend professional development workshops on teaching in higher education and many of these are now mandated by the institution. They can target learning design especially to support design with TEL, in particular within a VLE/LMS context (Agostinho, Bennett, Lockyer, Jones, & Harper, 2013; Bennett et al., 2015; Bennett, Dawson, Bearman,
Molloy, & Boud, 2017; Walker, Jenkins, & Voce, 2018).

This research highlights the fact that although learning design models and online support applications or tools aim to bridge the gap between pedagogical theory and practice, and support academics in reviewing their approaches to teaching especially with TEL, this may not be happening to any great extent. The institutional implementation of TEL has generally focused on gaining efficiencies and meeting student demands for flexible delivery and access, rather than supporting academics to reflect on their teaching practices (Walker et al., 2018). In this context, TEL has been mainly adopted to present and deliver course content, in other words in a teacher-centric way (Kirkwood & Price, 2013; Nguyen, Rienties, & Toetenel, 2017; Price, Kirkwood, & Richardson, 2016). As the learning design models emphasize, teacher direction is important during certain stages of the teaching learning cycle and in fact models can be used with different theories (Dobozy & Dalziel, 2016). However, awareness of learning theories is a necessary aspect of learning design. Although some models claim to be “pedagogically neutral” (Dalziel et al., 2016, p. 15), they emphasize that design needs to focus on how students learn and what kinds of teaching and learning activities bring about learning. In other words, this is a “learner centred” pedagogy with the proviso that teachers have a critical role to play in designing, developing and implementing pedagogy in their context. This requires a flexible approach to learning theory (Dalziel et al., 2016; Kali, Goodyear, & Markauskaite, 2011).

3.4 Learning theory and designs for learning

The educational and learning sciences literature identifies an array of theories that could potentially be used by elearning designers and teacher-designers for their context and purpose. A number of scholars have provided an overview of these for learning design particularly as it relates to TEL (Conole (2010, 2016); Lowyck (2014);
Hoadley (2016); Markauskaite & Goodyear (2017); and in edited collections, Spector et al. (2014); Maina, Craft & Mor (2015)). A useful summary of psychologically-informed learning theories is provided by Mayes and de Frietas (2004, 2013) who emphasize Biggs’ (1996, 1999) overarching concept of constructive alignment of all components of the learning environment as a starting point for design. Mayes and de Freitas discuss three broad perspectives on learning theory: associationist, cognitive and situative.

The associationist perspective is related to instructional design approaches where learning of content or a body of knowledge comprises learning and linking or ‘associating’ the component parts in a sequence of activity feedback/cycles. This approach is commonly identified with a behaviourist and a teacher-centred view of education. The cognitive perspective emphasises supporting an individual’s interpretation and construction of meaning from interacting with content where the emphasis is on guiding the activities learners engage in to bring about reflection and, hence, learning. This approach is commonly identified with constructivist learning and student-centred problem-solving environments. With the addition of the concept of collaborative learning, this becomes a social constructivist learning theory. The situative approach to learning acknowledges the social and physical context and the community of practice within which learning takes place. Social and contextual factors are claimed to exert stronger influences on learners’ engagement, motivation and identity than the ways in which subject matter is presented. In concluding their discussion of these theories, Mayes and de Freitas suggest that each can be used to inform different ways of designing for learning and that examples of TEL often incorporate features of more than one perspective (Figure 3.6); “learning as behaviour, learning as the construction of knowledge and meaning, and learning as social
practice” (Mayes & de Freitas, 2013, p. 82).

Figure 3.6 Overlapping learning theories (or perspectives) for TEL adapted from Mayes and de Freitas (2013)

These theoretical approaches can also be seen to influence teaching behaviours at different stages of a teaching learning cycle. For example, the beginning stages of the process of apprenticeship into a discipline community would tend to be more teacher-centred and become more student-centred as discipline knowledge and skills develop. In the same way, the provision of TEL within an institution ranges from a standardised, knowledge telling VLE to a more open, interactive, personalised and student shaped learning environment.

Markauskaite and Goodyear (2017) also see a progressive incorporation of teaching/learning theories, moving from the first order to the third in their model of three ‘orders’ of learning, (p. 605) developed with particular relevance for the field of professional education (Figure 3.7).
Figure 3.7 The three orders of learning (Markauskaite, 2018)

The first order corresponds to the associationist or instructional design approach, the second to constructivist or social constructivist approaches and the third involves a partnership approach where the learner shapes the design of their own learning environment in collaboration with the teacher and others. Moving from the first to the third order involves changes in both teaching and teaching design. However, “teaching as co-configuration” can include “teaching as telling” and “teaching as facilitation” and teaching design activities are “best conceived as becoming more comprehensive rather than as mutually exclusive” as they move from first order to third (p. 607).

This necessarily brief overview of learning theories relevant for designing for learning emphasises that teacher-designers can and should draw on a range of theories to support their learning designs so that complex learning goals can be achieved. This approach to learning theory aligns with Goodyear’s concept of epistemic fluency in arguing for a multidisciplinary or “architectural orientation” to educational research and practice (Goodyear & Carvalho, 2014; Goodyear & Ellis, 2007; Goodyear & Markauskaite, 2009; Goodyear & Zenios, 2007; Markauskaite & Goodyear, 2017).
a multidisciplinary practice that engages forms of epistemic fluency
(combining diverse forms of knowledge and ways of knowing) that are rare or
even shunned in many accounts of educational work (Goodyear & Carvalho,
2014, p. 17)

3.5 Meaning making resources and learning theories

What is absent from these theoretical approaches is a theory of learning that explicitly incorporates language and other semiotic resources for meaning making. As Halliday argues “learning … is inherently a semiotic process” and “language is the essential condition of knowing, the process by which experience becomes knowledge” (Halliday, 1993b, p. 94). The role of language and other ways of creating meaning in educational contexts is elided as the focus of institutional learning tends to be on the knowledge embodied in the subject matter or content of the disciplines, although clearly this is structured through choices in semiotic systems of meaning.

... as a part of our broader cultural tradition, and not uniquely as a feature of schooling, a strong belief prevails by which both knowledge and intellectual skills of various kinds are understood to have status in some way independent of the language patterns in which they come into being. (Christie, 1989, p. 152)

The social constructivist and situative learning theories acknowledge the role of language and communication within the broader sociocultural approach to learning. This perspective recognises that social interaction in context brings about learning and this is also influenced by the cultural histories embodied in participants and the environment. Based on the work of Vygotsky, sociocultural theory and specifically the social constructivist view of learning attributes the development of conceptual
knowledge or “higher mental functions” to social interactions with others mediated by ‘tools’ (physical/material aspects of the situation and their semiotic properties) and ‘signs’ (spoken and written language and other semiotic systems such as drawing/art work etc.).

Vygotsky identified a variety of sign-based tools that function in this way - various systems for counting, mnemonic techniques, works of art - but the one that he undoubtedly considered to be of greatest significance - the "tool of tools" - was language. For language not only functions as a mediator of social activity, by enabling participants to plan, coordinate, and review their actions through external speech; in addition, as a medium in which those activities are symbolically represented, it also provides the tool that mediates the associated mental activities in the internal discourse of inner speech (Wells, 1994, p. 46)

In my research, the ‘tools’ comprise the materiality of the screen, keyboard, etc. and the learning space and the ‘signs’ are the learning resources displayed on the screen, text, visuals etc. The interaction with these learning resources as well as with the physical and social environment, peers and teachers, either around the screen or over the networked computer provides the potential to bring about learning. However, learning design needs to have a theory to illuminate the teacher-designers’ choices of modes of representation and communication for the knowledge and tasks they expect students to engage with either in face-to-face or screen-based contexts, in other words a multimodal social semiotic theory as outlined in Chapter 2.

The situative learning theory expands the work of Vygotsky to what has become known as Activity Theory (Daniels, 2008; Engeström, 1987). Activity Theory
has been used in both workplace and educational contexts to investigate the components and interrelationships of human activity systems. The components of a system consist of the subject of the system, for example a teacher-designer who wants to achieve the object of designing a learning task. The design activity is guided by mediating artifacts or resources which are the based on Vygotskian tools and signs. The activity takes place in a community which has its own sociocultural patterns of behaviour or explicit or implicit rules as well as defined roles and practices for participants who bring their own knowledge and resources to designing the task (division of labour). All of these components work together to achieve the desired goal or outcome, student learning (Conole, 2016). In addition, the concept of a community of both knowledge and practice and an ‘apprentice’ or learner’s gradual participation (legitimate peripheral participation) in this community of experts, for example, in a discipline, supports the social and situated dimensions of learning (Lave & Wenger, 1991). Participation and learning occur through activities and communication through language and other meaning making resources: in other words, in social practice.

*Practice* denotes a set of socially defined ways of doing things in a specific domain: a set of common approaches and shared standards that create a basis for action, communication, problem solving, performance and accountability. These communal resources include a variety of knowledge types: cases and stories, theories, rules, frameworks, models, principles, tools, experts, articles, lessons learned, best practices and heuristics. They include both tacit and the explicit aspects of a community’s knowledge. (Wenger, McDermott, & Snyder, 2002, p. 38)
These sociocultural approaches are summarised by Goodyear and Ellis:

An important element of this socio-cultural view of learning is that participation in authentic knowledge-creation activities, coupled with a growing sense of oneself as a legitimate and valued member of a knowledge-building community, are essential to the development of an effective knowledge-worker. (Goodyear & Ellis, 2007, p. 60)

While these learning theories acknowledge the importance of language and social semiotic systems, they do not incorporate descriptions of language or multimodal meaning making into their theoretical approaches (Hasan, 1992).

In this research, which focuses on developing online resources to teach academic writing, a theoretical approach to learning design incorporating language and multimodal social semiotics is necessary, as has been outlined in Chapter 2. This underpins the teaching of academic writing to be reviewed in the next Section and includes the approach used to develop a design for online learning of academic writing, specifically the FLERT program for supporting students to write their Physiology laboratory report.

3.6 Teaching academic writing

There is a long history of teaching academic writing in face-to-face contexts although methods differ across contexts; North America, the United Kingdom and Australia. Currently there are four main approaches; firstly, the Writing across the curriculum (WAC) movement associated with practices in North America; secondly, the Academic literacies (ACLITS) approach associated with practices in the United Kingdom, thirdly, the English for Academic (EAP) or Specific Purposes (ESP) methodology initially developed in the United Kingdom but now more widespread and
lastly, the Systemic Functional Linguistics (SFL) Genre pedagogy developed in Australia but now used more extensively. (For a comparative overview of these approaches at the tertiary level, see Jones (2004).)

3.6.1 Writing across the curriculum

The Writing across the curriculum movement arose as a response to higher education institutions implementing widening participation initiatives in the early 1970s. (For an overview of the history of the WAC movement, see Russell (1991); Myers Zawacki & Rogers (2012); Reynolds, Dolmage, Bizzell, & Herzberg (2012).) There are two strands to the movement, Writing to Learn and Learning to Write in the disciplines. Writing to Learn or writing as a way of learning discipline content generally comprises practice in writing informal genres which are not usually assessed; such as reflective writing or journal writing. Writing is seen as a way of building students’ knowledge and understanding whether within or across disciplines. Students can explore ideas and concepts, and their interlinkages, and make them explicit, and in this way develop both better understanding of current knowledge and also the potential for new ways of understanding and building new knowledge (Britton, Burgess, Martin, MCleod, & Rosen, 1975; Emig, 1977). These writing to learn practices are strongly associated with compulsory first year or freshman composition courses widespread across North American tertiary institutions whose primary aim is to prepare students for writing in their chosen disciplines. While the focus of these more ‘expressive’ writing practices tends to be on learning discipline knowledge, the other strand of the WAC movement supports students in learning the formal, conventional discourse practices of their discipline; the Writing to learn in the disciplines or Writing in the disciplines (WID) approach.

WID has developed alongside research into the rhetorical practices of the disciplines (Bawarshi & Reiff, 2010; Bazerman, 1988; Berkenkotter & Huckin, 1995),
and has adopted a communities of practice pedagogy where students are explicitly scaffolded or apprenticed into the genres of their discipline communities through writing-intensive courses that tend to be offered as stand-alone courses closely integrated into the discipline. The theoretical foundations of this approach are based in the tradition of rhetoric, or New rhetoric, with its emphasis on the social and cultural contexts of genres (Miller, 1994). More recently, genre studies in this tradition aim is to develop an innovative or a more critical and creative approach to genres across disciplines and professions for a culturally diverse, global, networked audience (Bazerman, 2013).

3.6.2 Academic literacies

The academic literacies (ACLITS) approach is based on the recognition that students bring their own knowledge and lived experiences to the university context and that these can and should be incorporated into new ways of writing which may challenge the more accepted genres of the disciplines. (For an overview, see Jones, Turner & Street (1999); Lillis et al. (2015).) The ACLITS approach arose out of dissatisfaction with other models of academic writing, namely the ‘study skills’ view, with its focus on the surface features of student writing as well as the academic socialisation or apprenticeship model of acculturating students into successfully replicating standardised discipline discourses and genres. Although ACLITS encompasses these other models, it recognises that student writing practices are shaped by their experiences and identity as they negotiate the implicit literacies required across discipline boundaries and academic power relations (Lea & Street, 1998). The aim of an ACLITS approach is to engage students and discipline staff in a ‘transformative’ approach to writing and other meaning making communication activities so that conventional institutional genres and the ideology behind them can be extended and challenged.
3.6.3 EAP and ESP

The EAP and ESP approach has been driven by the need to support the language development of international students with English as an additional language (EAL) either prior to or as an adjunct to their degree studies at English medium universities. Initially this approach drew on more general language teaching techniques such as communicative or functional language teaching with a focus on learning language through interaction. (See for example, Widdowson, 2003.) However, students need to be prepared for the language of the disciplines and professions, and this has led to the linguistic analysis of their discourses and genres as the basis for ESP and EAP pedagogy.

Research not only focusses on identifying the rhetorical structure of genres such as those of research articles (for example, Dudley-Evans, 1994, 1997; Hopkins & Dudley-Evans, 1988; Swales, 1981, 1990, 2004) but also a ‘thicker’ ethnographic description of the communication practices of discourse and professional communities (Bhatia, 1993; Flowerdew & Costley, 2017; Hyland, 2000, 2015; Swales, 1990). Examples of teaching approaches based on the outcomes of this kind of research can be found in numerous publications in the Journal of English for Academic Purposes and the Journal of English for Specific Purposes as well as other publications. (See for example, Feak & Swales, 2009; Swales & Feak, 2000, 2012; Weissberg & Buker, 1990.)

3.6.4 Systemic Functional Linguistics and Genre pedagogy

Systemic functional linguistics (SFL) with its focus on language in use and how meanings are made from a system of choices to suit context and purpose is “an appliable form of linguistics, something that can be used to explore other things. …capable of and designed for being applied” (Halliday, cited in Martin (2013b, p. 188). One of the key areas of application has been education and in the Australian
context the development of genre pedagogy for teaching writing. Research into school genres described in Chapter 2 has led to the development of SFL curriculum genre pedagogy, termed ‘genre-based’ literacy pedagogy, and more generally, the Teaching/Learning Cycle (TLC) or Sydney School genre Teaching Learning cycle (Dreyfus, Humphrey, Mahboob, & Martin, 2016, p. 9). Although a number of TLC models have evolved as a response to research and practice in genre pedagogy (Rose & Martin, 2012, pp. 64-66), essentially the TLC model adapted to develop the online FLERT program comprises three main stages: deconstruction, joint construction and independent construction (reproduced here as Figure 3.8 and also described in Chapters 6 and 7).

![Figure 3.8 A genre-based teaching and learning model (Martin (1999, p. 131), after Rothery and Stenglin (1994, p. 8))](image)

The model is based on seminal SFL research into child language development where language is learned in social interactions guided by adults (for example, Halliday, 1975; Painter, 1984, 1998). In addition, sociocultural theories of learning, have influenced the development of the model; in particular Vygotsky’s concept of the Zone of Proximal Development (ZPD), the zone where performance occurs beyond
current levels through the support of expert adults or peers. This means that students are guided and supported through explicit teaching when new genre literacy demands are introduced into the curriculum.

Briefly, the cycle usually begins with building the field and setting the context of the genre. However, in the context of writing a discipline-based laboratory report at tertiary level, students will have carried out their experimental work and will therefore be familiar with the field and the overall purpose of the genre. Despite this, they may not be familiar with how to communicate the outcomes of their experimental work through the sections of a laboratory report, their stages, functions, structure and language and other semiotic features. Thus, the purpose of the deconstruction stage is to model these aspects of the genre, to make the pedagogy “visible” (Bernstein, 1975). In the face-to-face context this is a teacher led activity where the teacher explicitly ‘unpacks’ the genre, its stages, their functions, structure and language, and sets tasks to support students developing understanding of the genre. This stage is also important for developing students’ language to talk about language, their metalanguage.

The joint construction stage allows students, with the teacher’s guidance, to collaboratively write a new example of the genre, typically with the teacher acting as scribe in the face-to-face context. Then, in the final stage, students are ready to write independently, although the teacher and more expert peers are also available for support. At this stage, the student has both control of all aspects of the conventional genre and also the ability to challenge, question, or creatively play with the genre. The cycle is flexible in that different stages can be omitted, repeated and/or revised to meet students’ needs. (For a more detailed description of the TLC and its theoretical foundations, refer to Martin (1999); Rose and Martin (2012); and in the tertiary context, Martin (2013a); Dreyfus et al. (2016).)
Although these approaches to teaching academic writing share a common concern in developing literacy programs and adopt, to some extent, a genre pedagogy model, they differ in the emphasis they place on the text versus the ethnographic context of the genre (Coffin & Donohue, 2012, 2014). It is beyond the scope of this research to provide a detailed discussion and comparison of these different approaches and there have been a number of publications that have done this (Artemeva & Freedman, 2015; Flowerdew, 2015; Gardner, 2017; Hyon, 1996; Johns, 2002; Martin, 2015) as well as those that have drawn on aspects of the different approaches to develop pedagogy (Deane & O'Neill, 2011; Gardner, 2012; Johns, 1997, 2002; Lea, 2004; Motta-Roth & Heberle, 2015; Parkinson, 2017; Wingate, 2012; Wingate & Tribble, 2012). While acknowledging the contribution of other approaches to teaching academic writing, the FLERT program, the subject of this research, has adapted the Sydney School TLC to an online context to teach the genre of the laboratory report in Physiology.

The argument for choosing the Sydney School TLC as the basis for online pedagogy in this research has to some extent been made in Chapter 2 where the SFL theoretical framework has been presented. SFL theory underpins the TLC as it provides the richest description of how language choices make meaning in a particular cultural context and for a specific genre purpose. Choices at the level of the lexicogrammar shape those at the level of discourse which in turn shape those at whole text level so that language is seen as a comprehensive system for making meaning. The purpose and context of a whole text, a genre, can then be traced and made explicit through the choices in language at each level. In this way, the genre can be deconstructed by the teacher with the purpose of both enabling students to master the genre but also to challenge and critique. Thus, the TLC does not ignore the social and
cultural context and aims to develop a critical literacy based on a thorough knowledge of the conventions of established genres and their cultural purpose.

The challenge in moving online to teach academic writing is how to redesign pedagogy from a face-to-face context to that of online teaching and learning; in other words, taking an “Available Design” such as the TLC and designing “The Redesigned” and in this way producing the potential for new meanings and new learning in the online environment (New London Group, 1996).

3.7 Designing for teaching and learning academic writing online

An online approach to teaching academic writing at tertiary level has developed to meet the needs of an increasingly large and diverse student body with varying language abilities and preparedness for writing the genres of university disciplines. In addition, this approach enables students to work flexibly in terms of time and place, but also at their own pace and according to their individual needs. Initial approaches have focussed on providing generic help, often in the form of text-based guidelines, incorporating images and diagrams, but with minimal opportunities for interaction and feedback. Many of these resources are still available, supported by evidence of student use, and they provide just-in-time help or ‘tips’ as well as links to other more detailed and interactive online resources or face-to-face academic support. (See for example, the University of Sydney, Learning Centre, Help Yourself (evidence of student use in 2018: 3,321 hits on the splash page and 149,084 page views. Note this site is no longer available, October 2019) or the University of New South Wales, Learning Centre, Academic Skills.) Online interactive resources for academic writing are both generic and discipline specific in nature and as technology has developed, so has the range of software media and modes for designing these teaching and learning resources (Garcia, 2018; Strobl et al., 2019).
3.7.1 Designing online genre pedagogy for writing in the disciplines

Discipline specific online resources for supporting students in academic writing have the potential to be used either as an adjunct or embedded within a unit of study as a blended learning approach. Overall, discipline-based genre writing resources are more relevant and realistic for students as they include authentic student examples of the assessment genres students are aiming to write. Deconstructing these examples using online media and modes is the first step in moving the TLC online. There are a number of examples of these approaches to teaching discipline genres online and the FLERT program is one example, described in detail in Chapters 6 and 7. (For other examples of deconstruction in Sydney School genre pedagogy traditions, see Woodward-Kron, Thomson & Meek (2000); Clerehan et al. (2003); Ellis (2004); Drury (2004); Yang & Goodyear (2014b); Dreyfus et al. (2016).) (For other genre pedagogy traditions, see Lamm et al. (2007); Strauss, Goodfellow & Puxley (2009); Wingate & Dreiss (2009); Grossenbacher & Matta (2011); Wijeyewardene, Patterson & Collins (2013); Nallaya, & Kehrwald (2013).)

The most challenging aspect of using the Sydney School TLC pedagogy online is the joint construction stage where, in the face-to-face context, the teacher guides and supports students to co-construct the genre through interactive dialogue. This scaffolding or “guidance through interaction in the context of shared experience” (Martin (1999, p. 126); Rose & Martin (2012, p. 58)) comprises an unfolding dialogue among students and the teacher, where genre understandings from the deconstruction stage are mobilised to collaboratively write a new example of the genre. The students’ spoken ideas are explicitly reworded where necessary into a written format. In this way, students are introduced to the process of how to use their understandings of genre as a textual product as the basis for jointly drafting and redrafting their ideas to meet the requirements of a new example of the genre. Rose and Martin (2012) provide
detailed examples of the interactive dialogue in this stage and conclude “Decades of working with teachers has convinced us that successful Joint Construction is the most powerful classroom practice currently available as far as learning written genres is concerned” (p. 73). At the tertiary level, analysis of examples of classroom joint construction have provided more details of the stages of this curriculum genre (Dreyfus, Macnaught, & Humphrey, 2008; Humphrey & Macnaught, 2011).

Although joint construction has been carried out successfully online using a synchronous virtual classroom and Adobe Connect (Dreyfus & Macnaught, 2013), the virtual classroom screen and technical/software issues can have a limiting effect on interaction. Media and software have to both enable visual and verbal interaction for the teacher and students in real time as well as display the unfolding text on a virtual whiteboard. This can be difficult with current technology and these challenges may mean that joint construction online is not a scalable activity for a typical class size of twenty to thirty students (Dreyfus et al., 2016; Martin, 2013a). Although the FLERT program does not include the facility for an online synchronous TLC joint construction stage with a teacher and peers, interactions with the computer are designed to scaffold understanding of the genre as a preparation for writing as described in Chapter 2. Students’ evaluative open-ended comments on genre examples, exercises and feedback (Chapter 8) indicate that the online resources are guiding them towards understanding and writing the genre. This suggests that in this online environment they perceive their interactions with the computer as if it were ‘the teacher’ supporting some of the aspects of a joint construction stage.

The final stage of the TLC is independent construction, when students are ready to write their own text, typically in the tertiary context, an assignment for assessment. This can be part of a draft feedback cycle where students have the
opportunity to use feedback from the teacher and, in some cases, peers to rewrite their text before final submission. Feedback in the context of the TLC focuses firstly on appropriate meanings at the level of the genre before moving to other levels in the text. A framework for giving feedback on academic writing in the TLC is termed the 3x3 toolkit (a later version is the 4x4) and it is based on the SFL metafunctions (Dreyfus et al., 2016; Humphrey, 2015; Humphrey, Martin, Dreyfus, & Mahboob, 2010). This framework can also be used as a rubric and adapted for giving feedback on different genres. It has been used at tertiary level to provide individual online feedback to students on their academic writing (for example, Mahboob & Devrim, 2013).

The FLERT program has also been embedded within an online draft feedback cycle in an eportfolio. Students writing their laboratory report within the portfolio can refer to the FLERT resources. They can also receive feedback on the content and language of their drafts from physiology lecturers where the feedback can refer students to specific FLERT language resources when necessary (Muir, Drury, & Carroll, 2007). Students also write independently alongside FLERT, as revealed by their reflective recounts. (See Chapter 8.)

Online support for students during the process of independent writing now includes software that is to some extent responsive to students’ texts. This has been influenced both by genre analysis in the EAP/ESL tradition (Abel, Kitto, Knight, & Buckingham Shum, 2018; Cotos, 2017; Cotos, Huffman, & Link, 2015) and the SFL tradition (O'Rourke & Calvo, 2009; Villalon, Kearney, Calvo, & Reimann, 2008) as well as cognitive models of the writing process (for example, models developed by Bereiter & Scardamalia, 1987; Deane et al., 2008; Flower & Hayes, 1981).
3.8 Summary: Educational design research and the Sydney School genre
TLC

This chapter has placed this research in the framework of EDR and reviewed theories of learning and designs for learning in the online environment as well as approaches to teaching academic writing in face-to-face contexts and online. EDR has provided a logical and staged approach to the presentation of this multifaceted research: the design, development, implementation and evaluation of online resources to address supporting students to write the laboratory report genre in Physiology. The choice of a design for learning is a key stage in EDR and characteristics of relevant models have been discussed in this chapter. The chosen design, the Sydney School genre TLC, adapted for online design, has a number of synergies with these models. Overall, each model emphasises the importance of designing for context and purpose, key aspects of genre pedagogy. In the ACAD framework, the TLC aligns with a ‘pattern’ approach to design where the task components of each stage in the genre curriculum can be specified. ACAD emphasises that while the task can be designed, it is students’ activities, shaped by the task, that bring about learning. In particular, in the online context, monitoring, observing and gaining insight into these activities is essential for the feedback loop for improving design (Chapters 7 and 8). In the Larnaca model, the TLC can be interpreted as an example of ‘educational notation’, an approach to academic writing pedagogy that has been widely shared and adopted. The Conversational framework highlights the importance of interaction, dialogue and feedback in bringing about learning; key components of the TLC and challenging to implement online.

These models for learning design also recognise that learning theories can be used selectively in terms of context, purpose and student needs. The TLC is clearly underpinned by a theory of language and multimodal semiosis in education as
described in Chapter 2. However, it also references other learning theories, particularly a sociocultural theory of learning. At different stages of the TLC cycle, there is a movement from a teacher-directed pedagogy to a student-centred pedagogy and back, although the overall approach is that of student-centred pedagogy. For example, the deconstruction stage tends to be teacher-directed whereas joint construction tends towards a student-centred approach. Although learning theories acknowledge a role for language and multimodal meaning making in education, without a theoretical basis for incorporating these aspects, they tend to downplay their importance. This theoretical basis is essential for designing for teaching academic writing, whether face-to-face or online.

As the EDR process unfolds, design is followed by development, implementation and evaluation. Chapter 4 will present the methodology used to investigate the design and development process and methods used to evaluate the online learning design.

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CHAPTER 4

METHODOLOGY AND METHODS

4.1 Introduction

Chapter 2 described the theoretical framework for this research and Chapter 3 discussed relevant background literature. These two chapters provide the foundation for the methodology and rich array of methods described in this chapter. The Educational Design Research (EDR) framework, the overarching methodological framework for this thesis, divides the process of developing teaching and learning resources and approaches into four phases: analysis; design and development; implementation and evaluation; and reflection on design principles (Figure 3.1, Chapter 3). Each phase leads to the next and thus, even though each can yield a large amount of data for investigation, inevitably, data and research outcomes in each phase are relevant for the next. Most importantly, all phases contribute to the final phase of each cycle, where the aim is to provide evidence-based principles for future design. Thus, the EDR researcher is faced with the challenge of finding an appropriate methodology and methods to yield a manageable data set for analysis and interpretation. In this context, the overall aims of the research and the questions posed in Chapter 1 of this thesis provide guidance for choices in methodology and methods. Hence, this chapter begins with a summary of the research aims and their place in EDR (4.2), followed by an overview of the chosen methodologies and methods (4.3). This leads to a description of the context of the FLERT program, the stages of researching the program and at each stage, the participants, the materials and instruments, data and data collection procedures (4.4 to 4.7). The next Section, 4.8, focuses on a broader aspect of this research, the evolution of program designs for online teaching of laboratory report writing in science and engineering. This Section summarises the
context of this part of the overall research and the data. Sections 4.9 and 4.10 present the approaches to data analysis from the FLERT project (discussed in Chapters 7 and 8) while 4.11 presents the data analysis for the evolution of report designs (discussed in Chapter 6). Section 4.12 concludes the chapter.

4.2 Research aims and methodology

The focus of this research is threefold: on the work of teacher-designers and elearning specialists in the process of creating an online learning program for academic writing (FLERT); on the analysis of design features of online programs for academic writing and lastly, on students, their interactions with FLERT and their learning from using the program. Although the emphasis in EDR research is primarily on the evaluation of student learning from using the designed teaching and learning resources, learning is intimately connected with the design of these resources. Therefore, investigating the synergy between design and learning can provide evidence for design principles for learning. The aims of this research, although presented in detail in Chapter 1, are summarised here in three overarching research questions and are related to the chapters in this thesis where they are addressed:

**Question 1:** What are the patterns of dialogic interaction among teacher-designers and elearning specialists that comprise the design and development process and result in a designed product, in this case, the online learning materials for FLERT? (Chapter 5)

**Question 2:** What are the components of designed products and how do these evolve over iterations of online learning programs for supporting students in learning the genre of the laboratory report in science and engineering? (Chapter 6)

**Question 3:** How has student performance been influenced by students’ interactions with the FLERT program; how have students used the program and what are their perceptions of learning from their interactions with the designed elements of the program? (Chapters 7 and 8)
The methodological framework afforded by EDR brings together both theory and practice in the development of pedagogy to address challenging issues in education (McKenney & Reeves, 2012). It involves both researchers and practitioners, and, in the case of online pedagogy, elearning specialists, in the research process and its practical outcomes. The process unfolds through temporal phases from design and development through to implementation and evaluation. The outcomes, or interim outcomes as in prototype or pilot phases, build evidence-based knowledge for a cycle of future design and the development of design principles. This EDR approach can be considered within the philosophical perspective of pragmatism which provides a rationale for investigating real world issues involving human behaviour with the ultimate aim of advancing knowledge and practice (Feilzer, 2010; Morgan, 2007; Teddlie & Tashakkori, 2009).

The process of EDR provides a methodological framework which may encompass other methodologies as well as a variety of research methods and procedures in order to develop well-supported, evidence-based descriptions, explanations and interpretations for the relationships between the phases of design, development, implementation and evaluation of a particular pedagogical intervention. In many EDR projects, the research emphasis is on the evaluation of learning more than the process of design and development or the analysis of designed products. Although research into these processes and products is recognised as important, time and stakeholder interests often mean that the primary purpose of the research is to assess whether learning has taken place as a result of the intervention. However, the interactions around design and development result in the creation of learning resources, the designed products, and these constitute the pedagogical potential of the program. As such, these design processes and products warrant investigation. This
study includes these EDR phases in the research process in order to address the research aims in Questions 1 and 2 above. Question 3 concerns student learning and is investigated in the phases of implementation and evaluation in the EDR process. The wide-ranging aims of this study, which encompass the phases of the EDR process, require a more elaborate and diverse approach to both methodologies and methods.

4.3 Methodology and methods

The chosen methodology for this research can be broadly described as both multi- and mixed methods, an approach that can be underpinned by a number of theoretical perspectives (Hesse-Biber & Johnson, 2015). This diversity in both methodology and methods is necessary to investigate both the varied data collected in this study as well as the range of research questions addressing the different phases of the EDR process. From a multi-method perspective, this thesis draws on the theories of multimodal social semiotics and SFL described in Chapter 2 to apply methods of analysis to the data relevant to Questions 1 and 2. SFL discourse analysis is used to analyse the conversations among the participants during the design and development phases of EDR. Multimodal social semiotic analysis is used to investigate the evolution of designed products for supporting students to write the laboratory report genre in science and engineering. Early online programs for writing laboratory reports can be considered as prototypes for the FLERT program (Drury, 2001; Drury, O’Carroll, & Langrish, 2006). Further, SFL analysis is used to extend other methods of investigation of student generated qualitative data in the implementation and evaluation phases of EDR.

The methodology of mixed methods, termed the “third methodological movement” (Tashakkori & Teddlie, 2003, p. ix) is generally understood to incorporate methods for collecting and analysing quantitative as well as qualitative data to address a research question or related questions with the aim of triangulating data not only to
obtain increased validity for results but also to broaden the range of insights from the data (Creswell & Plano Clark, 2011). In this research, the mixed methods design is a multiphase design comprising the sequential collection of quantitative followed by qualitative data over the phases of the project. The sequential design is termed 'explanatory' as the qualitative phase aims to further 'explain' the outcomes of the quantitative phase (Creswell & Plano Clark, 2011, p. 185). A multiphase design is common for evaluating educational interventions within an EDR framework.

The collection of quantitative data in education research is typically quasi-experimental as students cannot usually be randomly assigned to undertake the pedagogical intervention (Gribbons & Herman, 1997). Quantitative data on student learning comprise performance data where students are tested on aspects of the pedagogical intervention. Ideally tests are administered in a pre- and post-intervention test format. When the pedagogical intervention is optional, students who do not use the learning resources form a control group for evaluation purposes. Both of these quantitative methods are in line with a quasi-experimental research design and have been used in this research. Other numeric data can include students’ perceptions of their learning using a rating scale, typically a Likert scale, to provide an assessment based on statements about the learning intervention. In a mixed methods approach, numeric data are complemented by qualitative questionnaire, focus group and /or interview data. Qualitative data are typically analysed based on grounded theoretical approaches where recurring patterns of meanings arising in the data are coded as themes or categories (Gibbs, 2007). These categories initially describe the data but move towards data analysis to inductively develop contextualised theoretical explanations ‘grounded’ in the data. In this study, a suite of both quantitative and qualitative methods has been used to investigate student use of the online learning
4.3.1 Ethical approval and considerations

The appropriate ethics approval for all aspects of this research was gained from the University of Sydney Human Research Ethics Committee. There were two main ethical concerns; firstly, the involvement of physiology lecturers in the research team where the focus was on physiology students’ learning of written communication and secondly, the investigation of team members’ design practices by a team member participant. In addressing the first concern, all research involving students was carried out by academic language and learning specialists, Learning Centre (LC) academics who were seen to be independent from discipline academics. In this way the unequal power relationship between students and staff was removed as LC academics were largely unknown to the student cohort and had no educational involvement or influence over their assessment or progression. Students were reassured in the Participant Information Statement (Appendix 4) that their student identity number would be matched to performance data and other research instruments and then a new number assigned so that their identity would be protected.

A smaller group of students was recruited for more detailed student-user participation. Their involvement was outlined in the general advertisement describing the whole project that was presented to students in an introductory lecture (Appendix 4). Subsequently, a random selection of the student cohort (100 students) was emailed an invitation to take part in this student-user group and the email included the Participant Information Statement for this part of the research and a deadline for responding. Ten students were randomly selected from the responses. Student participants were rewarded for the time they gave to this part of the research project. All student participants in the research were assured of confidentiality and the standard University policy for secure data storage was followed.
The second area of concern was data collection from design team members where the researcher was also a team member. Data collection involved audio or video recording of team meetings. If a team member did not consent to the recording, then arrangements were made for minute taking and minutes to be vetted by the team. If consent was given for recording, this could be suspended at any time as stated in the Participant Information Statement (Appendix 4). The team consisted of seven members and at least two representatives from each part of the team (academic language and learning specialists, discipline lecturers and elearning specialists). This meant that if an individual did not want to participate, their views could potentially be conveyed by one of the other participants from that part of the team. It was considered unlikely that team members would not wish to be involved in the research, given the level of interest in the project and the benefits. As with student participants, team members were assured of confidentiality and anonymity.

4.3.2 Researcher reflexivity

The research on the FLERT program within an EDR framework was carried out predominantly by an academic language and learning specialist as the researcher, namely, the author of this thesis. Since I was not only the researcher but also an active participant in all stages of the EDR process and indeed, at one stage an object of research myself (Chapter 5), the approach to research of necessity demanded reflexivity. Reflexivity is generally associated with qualitative research and is understood to be an approach where the researcher explicitly recognises their own subjectivity in their choice of research aims, methodology and methods and interpretation of outcomes. It is now widely accepted that all research, even that in the laboratory (Latour & Woolgar, 1979) is shaped by the personal and social and therefore, it can be argued, that a reflexive approach enables a more comprehensive and accurate account and interpretation of the research process and outcomes.
Reflexivity is understood to be a continuous interdependent process between
the researcher and the object of research as the research unfolds and each influences
and is influenced by the other. Alvesson and Skoldberg (2000) emphasise the
importance of reflexivity in terms of a reflective approach to interpretation which they
term *reflexive interpretation*: "Less concentration on the collection and processing of
data and more on interpretation and reflection" (Alvesson & Skoldberg, 2000, p. 241).
This approach requires the researcher to be aware of, and question, their own
assumptions in interpreting data, their philosophical and theoretical orientations while
at the same time reflecting on themselves as a researcher embedded within the
sociocultural and intellectual traditions of a research community. "Reflection becomes
a form of interpretation of the interpretation and this is what makes the research
reflexive" (Haynes, 2012, p. 73).

In this research, my motivation has been to address a real-world practical
problem of how to support students to improve their writing in the sciences through
the design, development, implementation and evaluation of discipline specific online
learning materials. Philosophically, this aligns with the paradigm or worldview of
pragmatism as the nature of the research is applied to a real-world situation and aims
to provide a solution (Teddlie & Tashakkori, 2009). I acknowledge that I am working
within a sociocultural theory of learning drawing on a multimodal social semiotic
theory of meaning making as well as Systemic Functional Linguistics (SFL) to analyse
and interpret visual and verbal data (Chapters 2 and 3). However, I also consider the
contributions of other theoretical approaches to learning in the online context (Chapter
3) and other approaches to data analysis and interpretation. For example, I consider
grounded theory, albeit still within the broad area of a sociocultural theory of learning.
I have also been open to the possibility of using a cognitive approach to collect students' *think aloud* protocols of their perceptions of their learning with the online program, FLERT: an approach I have had to review in adopting a reflective interpretation of the data.

The most challenging aspect in practising reflexivity in my research has been in the collection, analysis and interpretation of audio and video data of myself and other team members engaged in the design process. Here I have been able to reveal and acknowledge, through the analysis and interpretation of interactive dialogue, my own attachment to my designs of learning materials (Chapter 5). This aspect of my research experience has emphasised the importance of a reflexive approach to knowledge building in this thesis. Thus, I have consistently and consciously selected and analysed data to remove any personal bias towards an interpretation that could unduly privilege a positive evaluation of the FLERT program: a program where I have had a substantial input into all phases of its development.

**4.4 Context and stages of research: the FLERT program**

The aspects of this study related to the FLERT program took place within a second-year unit of study within the Discipline of Physiology, namely Integrated Physiology. Teaching consists of lectures and tutorials and practical laboratory sessions. In terms of the development of written communication for laboratory report writing, students are expected to either work in teams or individually, to take laboratory notes and write up laboratory reports either as practice reports or for assessment. As discussed in the introductory chapter, there is little room in the science curriculum for supporting the development of students’ written communication, despite an obvious need. This led to the FLERT project under investigation in this thesis: the design and development, implementation and evaluation of an online program for supporting students to achieve success in report writing in the context of
their second-year course in physiology. Although the main thrust of the project was to develop online learning resources and assess their effectiveness, the whole project was also conceived as a site for EDR. Therefore, research methods were developed for each stage of the project. The three project stages and associated research methods as shown in Figure 4.1 were designed to answer the first and third research questions. The first stage focuses on design and development of FLERT; the second on formative evaluation of the learning resources and student learning and the third on summative evaluation of student learning. The stages continued over 3 semesters, an 18-month period, and involved two student cohorts. Ethics approval for all research activities involving participants was obtained from the University of Sydney Human Research Ethics Committee. (See Appendix 4.)

Figure 4.1 Stages of the study of the FLERT project

Each stage will be discussed in turn, covering the research methods, participants, materials, instruments, data and data collection procedures.
4.5 Stage 1 Design and development

4.5.1 Research focus

The design and development phase of the project resulted in two separate parts or modules of the program, *Help with understanding content* and *Help with report writing*, as shown in Figure 4.2 and Figure 4.3, the home page of the program.

![Figure 4.2 Modules of the FLERT program](image-url)
Although the focus of the online program was to develop resources to support students to improve their report writing, the project team drew on earlier research which suggested that students would be more likely to use the website if there was also support to help them understand the content and concepts behind the report they were currently writing (Drury, 2004; Drury et al., 2006; Muir & Drury, 2006; Muir et al., 2005). At the same time, putting resources for report content online and aligning them with knowledge about the structure and language of a report emphasises the
importance of understanding both the discipline content and how to communicate this in a report genre.

The Help with understanding content module was developed solely by discipline staff using quiz software (Question Tools (http://www.questiontools.com/)) which presents staff with a template to create explanations and quizzes (radio button and check box). These kinds of quizzes are typically used in science disciplines as a check list for students to review their understanding of content and concepts related to their laboratory work (Jones et al., 2011). Discipline staff worked collaboratively to identify and develop appropriate content for this module, sharing their experience of concepts that students find challenging, the threshold concepts (Land, Meyer, & Baillie, 2010), and designing feedback for the quizzes to improve student understanding. However, since the discipline team meetings did not involve the language and learning team members and only involved the elearning team in terms of training staff to use the software, a decision was made by the researcher to focus only on the design and development of the Help with report writing module. This module was also the largest part of the program in terms of menu items, hierarchy and screen numbers.

4.5.2 Research methods for design and development of Help with report writing module

A summary of the participants, instruments for data collection, the nature of the data and the data collection procedure is shown in Figure 4.4
Participants

The design and development team for this module consisted of the following participants:

- academic language and learning (ALL) specialists: 2 participants
- physiology discipline lecturers: 3 participants
- elearning specialists: 2 participants

The team had formed to submit a project proposal for internal funding and support for the project. In this way, interpersonal and professional working relationships among team members had been established prior to the beginning of Stage 1. Team members varied in terms of their professional affiliation, status in the university and their roles and responsibilities in the project. The ALL specialists are academic staff but are not affiliated with a faculty, whereas the discipline staff are members of the Faculty of Medicine and Health. The ALL specialists were responsible for the pilot learning materials for the Help with report writing module. However, discipline staff were responsible for feedback on these pilot materials. One of the
discipline staff was the project leader. The elearning specialists are professional staff members. One of the elearning specialists was responsible for overall management of the project and the other, for the computational and graphic design elements of the online resources. The researcher, an ALL specialist, was embedded in the team as one of the two ALL participants.

**Instruments and data**

Audio and video recordings of interactions in meetings were made over a nine-month period. A sample of Word documents, consisting of diagrams and text of possible materials for the online design, as well as images of prototype designs taken from videos of team interaction, were collected. These documents accompanied discussions in meetings. Documents where there was negotiation about the final online versions motivated the collection. Samples of story board diagrams illustrating the structure of the web design and a sample of agenda and minutes of meetings were also collected.

**Procedure**

Recordings of team interactions were conducted at intervals throughout the design and development phase. Since the researcher was embedded in the team, decisions on the type of recording (audio or video), location and timing were made by the researcher with the consent of participants. Selected recordings were made of discussions about the content and design of key sections of the module at different stages of design and development. Most recordings were audio, covering the whole meeting time, usually an hour’s duration, although shorter meetings were also recorded. Video recordings were carried out when important visual design decisions were being made, for example, menu and screen banner designs. Approximately seven hours of audio and two hours of video recordings were made. Most meetings tended to
be informal, although formal meetings were held when the project manager was present, and these usually included an agenda and were documented by meeting minutes. Recordings were made as unobtrusively as possible and sometimes this compromised the quality of recordings. This meant that sections of dialogue were indistinct, although overall, a substantial amount of dialogue was available for analysis.

4.6 Stage 2 Implementation and evaluation: formative

A summary of the participants, instruments and data, and data collection procedure and timing is shown in Table 4.1
Table 4.1 Summary of participants, instruments, data and procedure in Stage 2 of the FLERT project

<table>
<thead>
<tr>
<th>Participants</th>
<th>Instruments and data</th>
<th>Procedure and timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second year student cohort 1 (approximately 250 students)</td>
<td></td>
<td>Introduction to the project. Distribution of Student participant information statement and consent forms to fulfil Human Research Ethics Committee requirements. Students invited to be involved in more detailed evaluation e.g. focus group etc.</td>
</tr>
<tr>
<td>Second year student cohort 1</td>
<td>Questionnaire 1</td>
<td>Administered in semester 1, week 2</td>
</tr>
<tr>
<td>Second year student volunteers (10 students)</td>
<td>Focus group 1</td>
<td>Follow up of Questionnaire 1, week 4</td>
</tr>
<tr>
<td>Second year student cohort 1</td>
<td>Pre-test</td>
<td>Administered in semester 1, week 5</td>
</tr>
<tr>
<td>Second year student cohort 1</td>
<td>Questionnaire 2</td>
<td>Administered after submission of first assessed assignment, the nerve report, week 6</td>
</tr>
<tr>
<td>Second year student volunteers</td>
<td>Focus group 2</td>
<td>Follow up of Questionnaire 2, week 7</td>
</tr>
<tr>
<td>Second year student cohort 1</td>
<td></td>
<td>Demonstration of online resources before release, week 9</td>
</tr>
<tr>
<td>Second year focus group volunteers Third year student volunteers (4)</td>
<td>audio recording and observation of trialling of resources, followed by questionnaire</td>
<td>Guided set tasks based on online resources, individual or paired in computer laboratory setting, week 9</td>
</tr>
<tr>
<td>Second year student cohort 1</td>
<td>Website tracking</td>
<td>Week 9 to week 12</td>
</tr>
<tr>
<td>Second year student volunteers</td>
<td>Audio recordings of reflective recounts</td>
<td>Week 9 to 12</td>
</tr>
<tr>
<td>Second year student cohort 1</td>
<td>Questionnaire 3</td>
<td>Administered after submission of cardiovascular report, week 13</td>
</tr>
<tr>
<td>Second year student cohort 1</td>
<td>Post-test</td>
<td>Administered in week 13</td>
</tr>
<tr>
<td>Second year student volunteers</td>
<td>Focus group 3</td>
<td>Follow up of Questionnaire 3, week 13</td>
</tr>
<tr>
<td>Second year student cohort 1</td>
<td>Report marks</td>
<td>Report marks for both reports recorded</td>
</tr>
<tr>
<td>Experts (discipline lecturers not involved in the project) Language and learning specialists not involved in the project</td>
<td>Questionnaire</td>
<td>Questionnaire distributed or emailed. Semester 2</td>
</tr>
</tbody>
</table>
Participants

A typical cohort of second year Physiology students at the University of Sydney is between 200 to 300 students, two thirds female and over two thirds native speakers of English. All students in the first cohort (250), Cohort 1, were invited to take part in the project. The response rate for the first questionnaire comprised 205 students (92% of the whole enrolled cohort). As expected, the response rate declined over the two subsequent questionnaires, to 123 and 78 respectively. 178 students from the cohort undertook the pre-test and 78 completed the post-test. A smaller student sample comprising student volunteers (10 students) took part in trialling of the prototype online materials and activities, gave feedback in focus groups and provided reflective recounts while writing their second assessed report using the online resources. The participation of this group varied among these activities. This group was offered an incentive to participate in the evaluation. Third year students were also invited to trial the prototype materials and a total of four students volunteered to be involved. Expert feedback on the website was also sought from discipline lecturers and ALL specialists who were not involved in the team.

Instruments

Both quantitative and qualitative data were collected using a variety of instruments as shown in Figure 4.5
4.6.1 Data: Quantitative and qualitative data: Instruments and procedures

Questionnaires

Questionnaires were used to gather both quantitative and qualitative data. Questionnaire design was based on earlier evaluations of learning from online report writing programs (Drury et al., 2006). The first questionnaire, *Previous writing experience*, was a base-line questionnaire which aimed to establish students’ demographic backgrounds, their past experience in academic writing in terms of the type and length of academic texts they had written, their confidence and competence in academic writing and their general areas of difficulty. Questionnaire 2, a pre-implementation questionnaire, *Writing the nerve report*, targeted the writing of students’ first laboratory report and gathered data on the writing process, areas of difficulty specific to report writing and students’ expectations in terms of performance. The post-implementation questionnaire, Questionnaire 3, *Writing the cardiovascular (CV) report*, not only asked students how they had used the prototype online module
but whether their understanding of certain aspects of report writing had increased and their confidence in writing improved. Reasons why students had not used the module were also elicited. This questionnaire, Questionnaire 3, contained three open-ended questions which asked students what they found most and least helpful in the program and what design changes they would make. Questionnaires were designed to be short, usually only a page in length. Questionnaires were also used to gain feedback from experts and as part of the student prototype website trial. Questionnaires 1-3 are included in Appendix 1.

**Data collection procedures: Questionnaires**

Questionnaires were administered as shown in the timeline in Table 4.1. Students were encouraged to contribute to the project by team members in lectures and the value of completing questionnaires was explained. However, completion was voluntary and rates varied from survey to survey. Before the release of the online resources, both for writing *(Introduction, Results and Discussion* sections only) and for understanding content, students were shown these resources in a tutorial and strongly encouraged to use them while writing their second assessed report on the CV experiment. Questionnaires were paper-based rather than online and time was allocated within tutorial sessions for students to complete them. Both of these measures aimed to increase response rates, as anecdotal evidence suggests that students tend to compete surveys if presented in a physical paper-based format and administered in formal learning settings. Questionnaires were also distributed to experts as email attachments.

**4.6.2 Data: Quantitative data: Instruments and procedures**

**Report marks**

Performance data for two laboratory reports were collected, namely the nerve
report where students did not have access to the online resources and the CV report where they did have access to the resources. This data, although important and easy to collect, given ethics approval, are influenced by a number of factors other than the online module. Such factors as the students’ growing knowledge and understanding in the subject area brought about by all of their interactions with fellow students, discipline staff, learning materials and activities will inevitably influence their performance in report writing. Therefore, to improve both the construct and internal validity of measuring learning brought about by the program, pre- and post-tests were used.

**Pre- and post-tests**

Pre- and post-tests are widely used in educational research where the same test is administered to the same group of participants, normally before and after some kind of intervention (Creswell, 1994). Pre- and post-tests based on the structure and language aspects of laboratory report writing had been used in past project evaluations (Drury et al., 2006). In this project, 5 questions: 2 multiple choice, 2 ‘Yes/No’ questions and one gap-filling exercise comprised the pre- and post-tests. These questions targeted the introduction, hypothesis, results and discussion sections of a report. The number of students who participated in the pre-test was 178 compared to 72 who undertook the post-test, 69 of whom had used FLERT. A copy of the pre- and post-test can be found in Appendix 2.

This data also has limitations as it can only reveal student learning of information necessary to correctly complete the online exercises in the module. Although this information is relevant to the report writing task, it has to be transferred to that task if successful learning outcomes are to occur.
Website tracking

Software tracking was used to identify how many times students accessed FLERT and also the length of time on the program.

4.6.3 Data: Qualitative data: Instruments and procedures

Focus group discussions

Focus groups were held following an explanatory sequential design where each focus group was held after a questionnaire (Creswell & Plano Clark, 2011). The 'focus' was to probe outcomes of the questionnaires and encourage participants to provide possible explanations for these outcomes. They comprised open-ended items and followed a semi-structured informal pattern, based on earlier approaches used in evaluations of online report writing programs (Drury et al., 2006). For example, a focus group protocol following Questionnaire 2, Writing the nerve report comprised a summary of students' ratings of themselves as 'poor' or 'only fair' on their performance on aspects of preparing and/or writing their report. Focus group participants were invited to comment or provide possible explanations for these ratings. A further item asked participants for suggestions on what would have helped them to write a better report. (See Appendix 3.)

As the moderator, my role was to maintain the focus on the topic while at the same time allowing participants to feel comfortable about voicing their opinions, in Krueger's terms (1998, p. 46), a "seeker of wisdom" or a facilitator who believes that participants have insights and understandings to share if prompted by relevant questions/items. The challenge in running a focus group is to enable and control group dynamics so as to allow all participants to voice their opinions and to maintain focus on the topic while at the same time probing for additional information which may prove more significant (Carey & Asbury, 2012).
A typical focus group comprises between five to ten or twelve participants (Tashakkori & Teddlie, 2003; Carey & Asbury, 2012). Smaller numbers enable more in-depth discussion and inclusive participation and are especially useful for more complex and sensitive topics (Guest et al., 2017). For this research, where the topics under discussion were not controversial, a larger focus group comprising ten participants was deemed more suitable. The group consisted of volunteers who had completed the questionnaires which were the basis for the topics under discussion. The group composition was homogenous in terms of their year and study discipline.

Three focus groups were held with the same participants, one after each questionnaire, and they lasted approximately an hour. Summaries of the discussions were made by the researcher after the meetings, then emailed to participants who were invited to make additions or changes. Few participants took advantage of this invitation and the summaries remained largely unchanged.

**Observation and audio recordings of student interactions**

Qualitative data obtained by nonparticipant observation can be used to identify trends in participants’ behaviours and interactions in the research setting (Tashakkori & Teddlie, 1998). Observation of student interactions with set tasks from the prototype learning materials were carried out under laboratory conditions and documented by the ALL specialists using a template aligned with the set tasks. Audio recordings of student interactions with the learning materials were also made. Post-observation informal interviews or conversations with students were held to probe observation data and students completed a questionnaire (*Trial of scientific report writing tool*) on their experiences. This was incorporated with the guidelines for the set tasks.

**Reflective recounts based on think aloud protocols**

A *think aloud* protocol approach was adopted to gain insight into students' use
of FLERT while writing. This is a psychological research method which aims to reveal participants’ thought processes while they are carrying out an activity. One area where it has been used is to investigate tertiary students’ writing practices (Hayes & Flower, 1980). In this study it was chosen as an instrument to probe how students used the online resources while writing their reports. Students involved in the focus groups also volunteered to record their ‘thoughts’ while writing. In a prior focus group meeting, they were given training on the how to carry out this task while writing and using FLERT. Recordings were transcribed for analysis.

4.7 Stage 3 Implementation and evaluation: summative

Stage 3 took place in the year following stage 2 when the website was complete. It involved a new cohort of students undertaking the second-year course in Physiology, Cohort 2. A summary of the participants, instruments and data, and data collection procedure and timing is shown in Table 4.2

<table>
<thead>
<tr>
<th>Participants</th>
<th>Instruments and data</th>
<th>Procedure and timing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second year student cohort 2 (184 students)</td>
<td>Introduction to FLERT and use of FLERT in tutorials. Distribution of Student participant information statement and consent forms to fulfil Human Research Ethics Committee requirements.</td>
<td>Administered after submission of first assessed assignment, week 6 (Alveolar gas report).</td>
</tr>
<tr>
<td>Second year student cohort 2</td>
<td>Questionnaire 4</td>
<td></td>
</tr>
<tr>
<td>Second year student cohort 2</td>
<td>Student report marks</td>
<td>Record of student report marks.</td>
</tr>
</tbody>
</table>

**Participants**

All students in cohort 2 (184 students) were invited to be part of the evaluation project by completing a questionnaire, *Evaluation of the FLERT online program*. 163 students completed the questionnaire (89% of the whole enrolled cohort).
4.7.1 Data: Quantitative and qualitative data: Instruments and procedures

Questionnaire

The questionnaire for cohort 2, *Evaluation of the FLERT online program*, was based on the questionnaires from the previous year so that comparisons could be made across cohorts. There were two parts to the questionnaire. The first, for all student participants, elicited demographic data, data on writing history, preparation for writing the report and self-evaluation of skills for report writing as well as reasons for not using FLERT, if relevant. The second part of the questionnaire asked students about their pathway through the program and their perceptions of learning from different aspects of the program. In addition, there were six open-ended questions which asked students:

- whether they had made changes to their writing based on their interactions with the program and if so, how and why;
- what was most and least helpful in FLERT;
- what the online resources had taught them about writing in Physiology;
- and what they thought would help them improve their report writing.

(Appendix 1).

The implementation process for this second cohort differed from the first in that students had a hands-on experience of using the program in a time-tabled tutorial. The program was introduced by discipline staff who emphasised the outcomes of the previous Stage 2 research, namely the trend in improved report performance after using the program. The tutorial also allowed for discussion of other report writing issues. The questionnaire was paper-based, administered in a tutorial session after submission of the first assessed assignment.
4.7.2 Data: Quantitative data: Instruments and procedures

Report marks

Report marks were awarded and recorded by discipline staff for the Alveolar gas report using the same rubric as in the previous year.

4.8 Context and data for analysis of evolving program designs for writing laboratory reports

The design of learning materials for FLERT represents the evolution of online learning materials for laboratory report writing over a nine-year period as shown in Figure 4.6 (Drury, 2001; Drury et al., 2006).

Figure 4.6 Components and software of report writing programs for science and engineering over a nine-year period

Over this time period, different software became available to teacher-designers and elearning specialists offering different potentials or affordances for design. Also, each design iteration yielded student evaluation data contributing to the design or redesign of the next program, culminating in the design for the FLERT program. These iterative designs represent a rich data set for analysis. Typically, a multimodal analysis
of designed products in an EDR framework is not undertaken from a sociocultural multimodal theory based on an SFL approach to language. However, this kind of analysis described below is important if potential links between the components of the designed products and student learning are to be made. These online learning programs are the end product of the design and development process. They embody the learning potential of the design from the perspective of the teacher-designers and e-learning specialists. The components of the online learning resources comprise the qualitative data to answer the second broad research question, namely, how do programs evolve and how do their components contribute to student learning.

Materials

Online materials for data analysis comprise selections of screens from each of the programs in Figure 4.6. Selections were made from screens indicating different levels of hierarchical organisation as well as different displays of content for different purposes, reflecting the learning theory behind the design, genre pedagogy. Screen components comprised graphic elements, text, audio, animation and other interactive elements, such as rollovers, as well as navigation features.

Data and data collection procedures

Since the researcher has been involved in the design of online report writing programs over a number of years using a variety of media, an evolutionary approach was taken to the selection of web-based materials. Screens from early report writing programs were selected as data, as well as those from FLERT or other laboratory report writing programs based on the FLERT prototype design. In this way, comparison of design elements could be undertaken with associated evaluation of student learning. As far as possible, screens presenting similar report writing features, structure and language were selected.
4.9 Data analysis techniques: Project stage 1

4.9.1 Analysis of team interactions: audio and video recordings

Audio and video recordings of team meeting interactions were made to identify key elements of the collaborative negotiation of design which became embodied in the FLERT program. The meeting itself was taken as a unit of analysis, as meetings were constrained in both time and place as well as by the aim of achieving an outcome in terms of project goals. In this sense, the meeting represents a genre defined as “a staged goal oriented social process …to get things done” (Martin & Rose, 2008, p. 6). An initial analysis of recordings of meeting interactions was made to identify the possible stages in the meeting genre, stretches of discourse where design based knowledge propositions were put forward and negotiated among participants until a consensus was reached, such as the banner for the program or the explanation of the term ‘hypothesis’.

Two approaches to identification of these stages were adopted. The first is based on Bereiter’s (2002) approach to collaborative knowledge building and the identification of cognitive or conceptual knowledge artefacts which are negotiated over a meeting phase and may develop into physical objects, such as written texts, notes, diagrams etc. in the interaction process. A related approach is Markauskaite and Goodyear’s (2017) concept of epistemic tools and artefacts used in shared, situated practice. Epistemic tools for knowledge building are the meaning making resources, primarily language, deployed in the social and situational context which result in epistemic artifacts, new conceptual shared knowledge. A meeting phase or stage can be identified by the use of certain epistemic tools to build new knowledge.

The second is based on Halliday’s SFL theory of meaning making in language, where language simultaneously conveys three meanings, ideational, interpersonal and
textual as summarised in Chapter 2. In the specific situational context of a meeting, these are expressed as the field of the discourse or the topic, the tenor, the relationships among the participants as they negotiate meanings, and the mode, the ways in which speakers are organising the ongoing conversation. Of particular importance in identifying stages is the confluence of meanings of field, tenor and mode that occur around topic change and topic closure, and in this way identify the stages of the meeting genre.

Within each stage, discourse analysis in the SFL tradition is used to identify negotiation strategies using the concepts of exchange structure and within an exchange the concept of speech function or move. Speakers have a basic choice of speech function, whether to offer, command, state or question. Once a speech function is initiated, the negotiation of the exchange continues until closure is reached or the exchange aborted. Table 4.3, below, illustrates the application of these two approaches to the identification of a meeting stage which consists of a number of exchanges. Only the beginning and end of the stage is shown in the extracts in this Table. In Bereiter’s terms, this phase is about the explanation of the concept of the hypothesis and in Markauskaite and Goodyear’s, the epistemic tools for knowledge building are the deployment of language which is illustrated through the SFL analysis used in this extract.

In the beginning of this stage, the topic under negotiation in the meeting, the description or definition of the hypothesis (ideational meanings), is introduced as participants read from the draft learning materials created by the academic language and learning specialist, ALL 1. The first speech move is made by the discipline lecturer, a statement of opinion about the definition showing tentative disagreement (interpersonal meanings, highlighted in italics). Further speech moves are made by the
discipline lecturer elaborating/justifying this disagreement through logical connections in the discourse (textual meanings, highlighted through underlining). This beginning phase opens the negotiation as the discipline lecturer clearly disagrees with the definition. In the concluding phase, the discipline lecturer presents new wordings for part of the definition through a statement of fact and further elaborations justifying this definition, negotiated through the stages of the exchange not shown in this Table.

These analyses are presented in detail in Chapter 5.

_Table 4.3 Extracts illustrating SFL move analysis from beginning stage and concluding stage of an exchange in a FLERT design meeting_

<table>
<thead>
<tr>
<th>BEGINNING PHASE</th>
<th>CONCLUDING PHASE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Speech/Move function</strong></td>
<td><strong>Speech/Move function</strong></td>
</tr>
<tr>
<td><strong>Turn/Move</strong></td>
<td><strong>Speaker</strong></td>
</tr>
<tr>
<td><strong>Give opinion</strong></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3/a</td>
</tr>
<tr>
<td></td>
<td>3/b</td>
</tr>
<tr>
<td></td>
<td>3/c</td>
</tr>
<tr>
<td></td>
<td>3/d</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td><strong>Elaborate</strong></td>
<td>1a</td>
</tr>
<tr>
<td></td>
<td>1b</td>
</tr>
<tr>
<td></td>
<td>1c</td>
</tr>
<tr>
<td></td>
<td>1d</td>
</tr>
<tr>
<td></td>
<td>1e</td>
</tr>
<tr>
<td></td>
<td>1f</td>
</tr>
<tr>
<td><strong>Respond</strong></td>
<td>2</td>
</tr>
</tbody>
</table>
4.10 Data analysis techniques: Project stages 2 and 3

4.10.1 Quantitative data

Statistical data analyses of quantitative data were applied to performance data, pre- and post-test data, questionnaire data and website tracking data in order to address the question of whether student learning had occurred or was perceived by students to have occurred. Firstly, descriptive statistical analyses were carried out to provide a summary of cohort characteristics and to enable comparison between cohorts, between cohort users of FLERT and between users and non-users. Means and standard deviations were calculated to provide descriptions of average trends and spread in cohort, user and non-user data sets. Inferential statistical analyses were carried out to assess the relationships among characteristics of cohorts, users and non-users and whether differences were statistically significant or could be attributed to chance. In terms of inferring or generalising from the quantitative data, the main outcome was to address whether using FLERT brought about improved learning of the report genre in physiology compared with not using the program. Analyses included correlation, t-tests and chi-squared tests using SPSS. Values of p<0.05 were considered statistically significant. The outcomes of these analyses are presented in Chapter 7.

4.10.2 Qualitative data

Open-ended questionnaire data, audio recordings of student interactions and reflective recounts

Qualitative data consisting of open-ended responses on questionnaires, focus group discussions, post-trialling comments and observation data were analysed using an inductive approach where common patterns were identified and coded. Broader themes or categories were then drawn from these codings to enable analysis and interpretation (Gibbs, 2007). Summaries were then made of focus group discussions,
post-trialing comments and observational data while descriptive statistics were used to provide an overview of themes in open-ended responses. (See Table 4.4 for an example.) Audio recordings of student interactions with FLERT were broadly analysed using the metafunctional approach described in 4.6.1 with the emphasis on identifying exchanges which revealed students’ commentary and understandings of the FLERT design. Extracts were then further analysed using SFL discourse analysis. (See 4.6.1 and Chapter 8.)

Table 4.4 Example of breakdowns of themes about most helpful parts of FLERT

<table>
<thead>
<tr>
<th>Parts of FLERT (most helpful)</th>
<th>Cohort 1 (n=33)</th>
<th>Cohort 2 (n=63)</th>
<th>Example responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Help with understanding content</td>
<td>2</td>
<td>16</td>
<td>the list of suggested concepts for intro and discussion</td>
</tr>
<tr>
<td>Help with report writing</td>
<td>31</td>
<td>44</td>
<td>the report part</td>
</tr>
<tr>
<td>Examples</td>
<td>11</td>
<td>21</td>
<td>the example given for writing each section of the report</td>
</tr>
<tr>
<td>Explanations</td>
<td>3</td>
<td>8</td>
<td>explanations beside each section</td>
</tr>
<tr>
<td>Exercises</td>
<td>4</td>
<td>5</td>
<td>quiz exercises</td>
</tr>
<tr>
<td>Diagrams</td>
<td>2</td>
<td>2</td>
<td>the diagrams of content of each section</td>
</tr>
<tr>
<td>References</td>
<td>2</td>
<td>2</td>
<td>reference list example</td>
</tr>
<tr>
<td>Feedback</td>
<td>1</td>
<td></td>
<td>feedback on exercises</td>
</tr>
<tr>
<td>Structure/ Sections of report</td>
<td>10</td>
<td>16</td>
<td>what to include in each section</td>
</tr>
</tbody>
</table>

Coding and theme analysis are typically used to identify the most important patterns that describe and explain qualitative data. However potentially significant meanings in the detail of qualitative data may be omitted in the process. A linguistic analysis approach, using the tools of SFL, was undertaken in this study to explore the more detailed meanings in students’ open-ended responses. SFL offers a comprehensive array of linguistic techniques to probe the language choices of
participants and to assess whether they recognised the components of the online program, its pedagogy and their learning experiences. All of these aspects can together contribute to an assessment of whether learning has taken place from students’ interactions with the program.

4.10.3 SFL techniques for analysis of qualitative questionnaire data

From an SFL perspective, all language choices realise three kinds of meaning, the metafunctions as described in Chapter 2 and repeated here briefly to aid understanding of the analytical approach. Ideational meanings convey our experience of the external and internal world reflected in the subject matter or content of language; interpersonal, our relationships with others as well as our attitudes reflected in interactive language; and textual, the way in which we organise these meaning so they make sense in the situation where language is used (Halliday, 1985).

In examining students’ open-ended responses, the main focus is on how they experience the online program, in other words their selection of ideational meanings. Ideational meanings express relationships between phenomena or entities (people, objects etc.), the processes they are involved in and the circumstances surrounding these and these relationships are realised in the grammar of the noun phrase or clause. For example, in the brief open-ended responses relating to the parts of FLERT the students found most useful, the specific part is the ‘phenomenon’ or ‘thing’ that the student identifies, for example, ‘exercises’. Qualifying information or extra information about this ‘phenomenon’ occurs both before (premodifier) and after (postmodifier) the ‘phenomenon’ or ‘Head’ word in the phrase and provides more detail about specific aspects of what students found most useful or why they found a certain aspect useful. For example, in Table 4.5, student comments on the paragraph identify the sample that was included in each section as most useful (premodifier) and
their comment on why exercises were most useful is because they helped this student to know what to put in each section of their report (postmodifier).

Table 4.5 Aspects of the phenomenon (part of the program) students found most useful

<table>
<thead>
<tr>
<th>Examples of student responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premodifier</td>
</tr>
<tr>
<td>The sample</td>
</tr>
<tr>
<td>exercises</td>
</tr>
</tbody>
</table>

In student responses about their experiences of learning from FLERT, the ideational meanings of interest concern the processes students used to describe the impact of FLERT on their learning. Grammatical patterns of process types distinguish between those of doing or happening (material); thinking, feeling or seeing (mental); saying (verbal) and being or having (relational). Students made choices among these processes in their responses to the question about the how FLERT contributed to the way they wrote their report. For example:

[FLERT] *helped me to decide on format and how little/much detail to put in*

In this example, FLERT has a causative positive influence on the students’ understanding of the format of a report and the need to be concise. Such comments can illuminate the effect FLERT has on student learning. Further discussion of these analyses is found in Chapter 8.

*Reflective recounts*

Students’ ‘thoughts’ while they were writing were transcribed and an initial theme-based approach was adopted to identify broad patterns in the data with an emphasis on those patterns where students linked their writing to features of the online...
program. The choice of themes was also informed by research into cognitive theories of writing which use *think aloud* protocols to illuminate students’ writing processes (Bereiter & Scardamalia, 1987; Flower & Hayes, 1981). Bereiter and Scardamalia conceive the composing process as a problem-solving interaction between the ‘content space’ essentially the knowledge students need to convey and the ‘rhetorical space’ the text organising structures or schemes students use to present this knowledge. The ongoing interaction between these ‘spaces’ constitutes the reflective process in writing. Hayes and Flower (1980) used a thematic analysis of think aloud protocols to create a model of the writing process used by expert writers. They describe the composing process as dynamic, hierarchical, recursive and embedded. This process involves:

- the task environment (assignment topic and audience, text produced so far),
- the writer’s long-term memory (knowledge of topic and genre)
- and the writing process, itself consisting of
  - planning (generating, organising, goal setting),
  - translating (thoughts/ideas into language)
  - and reviewing (evaluating, revising).

The last part of the model is the monitor, where the writer decides when to move from one part of the process to the next. Both Bereiter and Scardamalia and Hayes and Flower emphasise the importance of reflection in the writing process or metacognition as a practice of competent writers.

These models were developed when there was little available either face-to-face or online for the individual student writer to support both the writing process and product. Since students were using FLERT while they were writing, they understood the purpose of the study was to identify how they used the online program to support them both in the writing process and in understanding the structure, language and
content of the particular laboratory report they were writing. From this perspective, students, when *thinking aloud*, were commenting on the program and reflecting on how it helped or did not help them. The texts they produced tended to be recounts of these experiences rather than a *think aloud* protocol. Therefore, an SFL genre analysis approach was used as well as an adaptation of the Hayes and Flower model to identify and describe the ways students were thinking and reflecting while writing with FLERT. The SFL analysis is based on the description of phases in story genres where there are commentary and reflection phases. (Martin & Rose, 2008). Therefore, the kinds of texts students recorded have been termed in this study *reflective recounts*.

A more detailed SFL discourse analysis was also undertaken on a selection of extracts where students referred to the online program in their recounts. This analysis traced the student’s point of view through the method of development of their recount in terms of the meanings they foreground in clause beginnings (Themes) and what they elaborate on in their choice of clause endings (News) (Theme analysis follows Halliday & Matthiessen (2004)).

An example of an SFL genre analysis and an adapted Hayes and Flower analysis is shown in Table 4.6 and an SFL discourse analysis of the same extract is shown in Extract 4.1. The language of comment and reflection is underlined in Table 4.6.
Table 4.6 Analysis of a reflective recount using genre analysis and an adaptation of the Hayes and Flower writing process model

<table>
<thead>
<tr>
<th>Task environment</th>
<th>Genre stages/ Writing process</th>
<th>Recount script</th>
</tr>
</thead>
<tbody>
<tr>
<td>Writing a laboratory report with FLERT</td>
<td>Awareness of task at level of genre and topic</td>
<td>Set goal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Identify problem</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Set goal</td>
</tr>
<tr>
<td></td>
<td>Recount script</td>
<td>Oh I’ve got the limitation sections to do and, apparently because the hypothesis wasn’t supported, I should be coming up with a few, few good points</td>
</tr>
<tr>
<td></td>
<td>Awareness of audience</td>
<td>Comment</td>
</tr>
<tr>
<td></td>
<td>Awareness of referring to FLERT</td>
<td>but...I checked FLERT to get a feel as to what they were looking for and it kind of made sense with that experiment</td>
</tr>
<tr>
<td></td>
<td>Comment and evaluation of FLERT</td>
<td>Identify problem</td>
</tr>
<tr>
<td></td>
<td>Reflect</td>
<td>but couldn’t really directly relate it to my own, or couldn’t really relate it to cardiovascular</td>
</tr>
<tr>
<td></td>
<td>Reflect</td>
<td>because it was just, you know, it’s different, it’s a different experiment altogether.</td>
</tr>
<tr>
<td></td>
<td>Awareness of need to transfer from FLERT to new experiment</td>
<td>Self-reflection on using FLERT</td>
</tr>
<tr>
<td></td>
<td>Self-reflection on own task compared with FLERT</td>
<td>Reflect</td>
</tr>
</tbody>
</table>


Oh I’ve got the limitation sections to do

and, apparently because the hypothesis wasn’t supported,

I should be coming up with a few, few good points

but...I checked FLERT to get a feel as to what they were looking for

and it kind of made sense with that experiment

but couldn’t really directly relate it to my own,

or couldn’t really relate it to cardiovascular

because it was just, you know, it’s different,

it’s a different experiment altogether

Both analyses illustrate how the student is referring to FLERT in the process of writing. The student’s comments and reflections show that they understand the FLERT content, specifically the example for the limitations stage in a discussion section of a report and that the structure of the FLERT example cannot be used for the specific purpose and content of their own report. Realising that the genre of the laboratory report has to be adapted to different experimental topics and purposes is an important learning experience as students move between different science disciplines and progress through the undergraduate years. More detailed analysis and discussion of reflective recounts is presented in Chapter 8.

4.11 Data analysis of evolution of online program designs for writing laboratory reports

Teaching and learning is a multimodal socially situated activity whether face-to-face or online (Kress, Jewitt, Ogborn, & Tsatsarelis, 2001). Multiple modes, writing, image, speech, etc. are chosen by teacher-designers (and if online, in
collaboration with elearning specialists) to bring about student learning. The multimodal analysis of iterations of online programs that aim to make explicit the structure and language features of each stage of a laboratory report and how students interact with the features of these programs can contribute to the development of design principles for teaching academic writing on screen and online. A multimodal analysis of evolving screen designs was undertaken of three design iterations which were developed over a nine-year period culminating in the design for the FLERT program (Figure 4.6).

The approach to analysis is twofold, firstly using the SFL metafunctions and secondly the four rhetorical/semiotic principles of multimodal communication provided by Bezemer and Kress (2008). These are the selection of the meaning making materials or modes, their arrangement, their foregrounding and the social relations they create (Chapters 2 and 6).

As an example, the analysis of one mode, colour, in the screenshot in Figure 4.7 is presented below the Figure.
Figure 4.7 Screenshot from Biochemistry online program, an example of the second stage in the development of online programs for laboratory report writing

- Mode selection: colour
  - Different colours are used to distinguish ideational functions
    - e.g. orange background with black typography to number stages; yellow background with red typography to describe each stage and black typography on white background to illustrate examples of each stage

- Modal arrangement
  - Framed blocks of colour behind text are used to divide the screen into its functions e.g. light brown image for the menu background and light yellow for the explanation text

- Modal foregrounding
  - Bright orange and yellow blocks of colour are used to foreground the most salient content in the centre of the screen
• Social arrangements
  • The Leonardo da Vinci image is used as a banner behind the menu items and the title of the program to engage students and as a way to encourage them to identify with the discipline area of biochemistry

Student feedback points to the importance of colour in website design, for example:

“Seeing those different colours is what helped me the most …”

4.12 Summary

This chapter has described the methodology and the wide ranging multi- and mixed methods approach to data collection and analysis used in the research underpinning this thesis. The range of methods used is a reflection of the complexity of capturing key aspects of the EDR process, from design through to evaluation, and of addressing the research aims. The methodology and methods provide insights into:

• the interactions of teacher-designers and elearning specialists in the creation of the learning potential of FLERT
• the students’ experience and learning from the program
• the design elements of the program which bring about learning.

The next chapter, Chapter 5, presents the first stage of the EDR process: the analysis of teacher-designers (ALL and discipline teachers) and elearning specialists’ interactions in design meetings. It is based on the first of the published papers presented in this thesis.
Chapter references


CHAPTER 5
DESIGN PROCESS

5.1 Introduction to Chapter 5

This chapter presents the first of the published papers in this thesis, although, chronologically, it is the last to be published. The chapter version is longer than the published paper and includes more text extracts and analysis. In terms of the narrative journey of the thesis within an EDR framework, this chapter focuses on the process of designing the online teaching and learning materials.

I use an SFL approach to conversational analysis to research the dialogic interactions among team members as they negotiate the design of FLERT. This analysis aims to reveal how knowledge is shared and built. Other approaches used to investigate the design process are grounded theory and Legitimation Code Theory. Grounded theory involves the application of qualitative methods such as theme analysis, coding and discourse analysis to knowledge building interactions. (See for example, Damsa (2014); Damsa & Ludvigsen (2016).) Legitimation Code Theory (LCT) (Maton, 2013a) is used to provide insights into knowledge and knowers in sociocultural practices. The analytical tools of LCT can be used to trace the meanings team members share, shaped by the different knowledge and practices they bring to team meetings. The ways in which members express meanings are described in LCT terms as waves of meaning making or semantic waves, a ‘waving’ movement between more abstract and less abstract meanings as knowledge is shared. This pattern in team interactions creates the potential for new knowledge and understandings (Maton, 2013b). LCT has been used in combination with SFL to explore knowledge building in educational contexts (Christie & Maton, 2011; Maton, Hood, & Shay, 2014). It has
also been used to explore the knowledge building features of online learning resources and programs (Carvalho & Goodyear, 2014).

The SFL approach to conversational analysis used in this thesis is a novel way to explore the process of design. Although SFL has been used in combination with computational approaches to analyse team interaction (Dong, Davis, & McInnes, 2005), the kind of SFL conversational analysis technique undertaken in this chapter has not been used.

5.2 Publication


Note: the paper included in this Chapter is a longer version of the published paper.

5.3 Knowledge building: How interdisciplinary understandings are realised in team negotiation

Abstract

Successful research and teaching of discipline genres is based on collaboration among language and learning specialists with expertise in applied linguistics, and subject area specialists with expertise in the knowledge and communication practices of their disciplines. These interdisciplinary collaborations involve experts coming together around an area of shared interest in a community of practice (Lave & Wenger, 1991), where members are committed to building relationships to learn from each other, and in this process build new knowledge (Scardamalia & Bereiter, 2006). This paper aims to identify the kinds of knowledge building negotiations involving a team of discipline staff, language and learning specialists, and elearning specialists as they collaborate in the design of online learning materials to support students in writing the laboratory report genre in physiology. The data consist of recordings of team
members’ spoken interactions, with or without other artefacts, such as storyboards and word documents of website content, over a period of nine months as the design for the website evolved. Initial analysis of transcripts, based on the metafunctions from Systemic Functional Linguistics (SFL) (Halliday, 1985a), is used to identify phases where the emphasis is on negotiation of ideational, or discipline content meanings, enabled by interpersonal and textual meanings. A sample of these phases is then analysed in detail using exchange structure (Martin, 1992) to identify possible genres which build new knowledge and embody it in the online resources. At the same time, these analyses can make explicit how successful and effective interdisciplinary collaboration unfolds leading to consensus around better learning design potential.

*it is through interaction that institutions are brought to life and made actionable in the everyday world.* (Heritage & Clayman, 2010, p. 7)

*... the complexity of spoken language is its intricacy of movement, liquid like that of a rapidly running river.* (Halliday, 1985b, p. 87)

### 5.4 Introduction and background

Universities, like other organisations, are changing and this means that there is greater fluidity across discipline boundaries, and professional roles (Iedema, 2003; Iedema & Sheeres, 2003; Manathunga & Brew, 2012; Markauskaite & Goodyear, 2017). At the same time, the traditional hierarchical structure co-exists with these new forms and ways of working, creating tensions in terms of academic and professional identities, and associated work responsibilities. One of these areas of change involves the approach to the design and development of discipline curricula, especially where
curricula are moving online. The creation of discipline content, with associated
teaching approaches and methods, is still predominantly the domain of an individual
academic, or in larger courses, a co-ordinator and team of discipline academics and
tutors. However, as universities move towards online teaching and learning, either in a
blended approach or fully online, academics are of necessity involved in a more
collaborative approach to the design of their discipline content to suit the online
environment. This involves working with elearning specialists or instructional
designers who, not only have different roles and status within the university
community, but also different epistemic backgrounds. When the online resources need
to address students’ written communication and the genres of the discipline, this adds
an extra layer of complexity, as well as the need to involve language and learning
specialists in the collaboration. This paper addresses the issue of how such a
collaboration functions through an analysis of talk in team meetings in order to
develop an online learning resource for students writing the laboratory report in

The laboratory or experimental report is a key genre in the sciences (Nesi &
Gardner, 2012; Parkinson, 2017). However, developing communicative competence in
this genre is often a struggle for science students, especially as the demands of the
genre vary among disciplines and change over the undergraduate years (Gardner,
2012). Clearly, this is cause for concern for both universities and employers (Bennett,
Richardson, & MacKinnon, 2016; Graduate Careers Australia, 2016; Norton &
Cakitaki, 2016). Addressing this issue is challenging in a crowded science curriculum,
where academics are reluctant to teach writing because they feel it is beyond their
remit or expertise (Goldsmith & Willey, 2016). Therefore, the practice of collaboration
between discipline staff and language and learning specialists is well established with
the aim of embedding and integrating the teaching and learning of discipline genres into course curricula, albeit with varying degrees of collaboration and integration. (See for example, Briguglio, 2014; Coffin & Donohue, 2014; Harris & Ashton, 2011; Jones, Bonanno, & Scouller, 2001; Skillen, Merten, Trivett, & Percy, 1998; Wingate, 2006.) Despite this, curriculum constraints mean that there is little scope for addressing discipline communication in science in face-to-face teaching. Hence the team collaboration among discipline staff, language and learning specialists, and elearning specialists described in this paper was initiated, with the aim of meeting student report writing needs online.

Firstly, this paper will situate the discussion of design negotiations for the online learning resources in team meetings in the broad theoretical framework of educational design research, and the concepts of discourse and discipline communities, communities of practice, and situated knowledge building and learning. This will lead to the research questions that this paper will address. Then the Systemic Functional Linguistics (SFL) approach to the analysis of spoken discourse will be introduced, followed by its application to data extracts to illustrate patterns in knowledge negotiation and building. This will lead to the discussion of possible design meeting genres. Finally, the contribution of this investigation of the discourse of knowledge building and negotiation across disciplines and professions will be explored in the context of designing online learning resources.

5.5 Broad theoretical framework

This research is situated in the field of educational design research (McKenney & Reeves, 2012) where applied outcomes are sought for practical educational problems and design, development, implementation, and evaluation follow an iterative cycle. Outcomes are based on the premise that practitioners are closely involved with
researchers in all stages of the cycle, and in the case of online designs, with elearning or instructional designers. There is a significant literature on the contributions of educational design research in a number of different contexts, and at varying levels of education, as well as a general framework for conducting this kind of research. (See McKenney & Reeves, 2012, p. 77.) A recent focus of the literature has been on what actually happens in design meetings where educational researchers, practitioners, and elearning specialists create designs through multimodal interactions. This aspect has not received enough attention in previous research, where the emphasis has been on evaluating the outcomes of educational design interventions on student learning (Goodyear, 2015; Kali, Goodyear, & Markauskaite, 2011). Although this is important, particularly to meet stakeholder reporting demands, it is now recognised that a focus on discourse and social semiotic interactions in design processes can provide deeper insights into how design actually happens, and provide possible principles for more effective design (Cober, Tan, Slotta, So, & Konings, 2015; Kali, McKenney, & Sagy, 2015; Markauskaite & Goodyear, 2014, 2017). At the same time, the sharing of different disciplinary and professional knowledges in design meetings can enable participants to acquire new understandings and learning in new domains with the aim of building new knowledge, and in this way develop better learning designs (Akkerman & Bruining, 2016; Rapanta, Maina, Lotz, & Bacchelli, 2013). This means that those involved in learning design work need to cross discipline and professional boundaries (Akkerman & Bakker, 2011) and develop ‘epistemic fluency’ – “the ability to recognise and combine different epistemic practices – working with different forms of knowledge and ways of knowing” (Goodyear, 2011, p. 255). This study with its main focus on naturally occurring spoken discourse in interdisciplinary design meetings aims to show how knowledge is shared and built through talk and interaction
in design work.

In the context of this interdisciplinary work, especially work that addresses the design and development of learning materials for discipline genres, the conceptual frameworks of discourse and discipline community, (Swales, 1990), and community of practice, (Lave & Wenger, 1991), are helpful in examining the confluence of expertise, knowledge, and practices for carrying out this task. Discourse community is particularly pertinent, as it encompasses the concept of genres. Genres, texts both spoken, written and multimodal, are discipline or professional communication practices, and as they change, over time and use, they contribute to the evolution of their communities. Genre analysis, and associated genre pedagogy, are key approaches in teaching academic and professional literacy, and the design of the online learning resources in this study is based on these approaches. The association between genre and discourse community is encapsulated in John Swales’s seminal work:

*Discourse communities are sociorhetorical networks that form in order to work towards a set of common goals. ... discourse communities possess... familiarity with the particular genres that are used in the communicative furtherance of those sets of goals. (1990, p. 9)*

Although in later work, partly in response to issues in defining a discourse community, (a ‘troubled concept’ (Swales, 1998, p. 20)), Swales went on to describe a more local concept, “a place discourse community” based on his research into the practices of a small set of professional and discipline communities sharing the same university building. He noted how “place discourse communities” align with the concept of “communities of practice” in terms of members working towards common
goals and engaging in situated learning activities – “legitimate peripheral participation”, (Lave & Wenger, 1991, p. 29) -for enabling those new to the community to acquire disciplinary practices including those relating to communication. 

Discourse community is also closely aligned with the concept of disciplinary community, fields of study that not only share discourse, but also knowledge domains, intellectual and social practices, and traditions, and where individuals have a strong sense of disciplinary identity (Becher & Trowler, 2001; Hyland, 2012). Recent trends in university study and research have emphasised the fluidity of discipline boundaries, and the increasing practice of interdisciplinarity to address real world problems, and overcome the perceived narrow focus, and rigid boundaries of disciplines (Manathunga & Brew, 2012; Trowler, Saunders, & Bamber, 2012). However, although the organisation and practice of disciplinary work within institutions is changing, an academic identity is still linked to disciplinary membership (Hyland, 2012), and is necessary for interdisciplinary work, “without a secure identity, a discipline cannot be part of an interdisciplinary activity” (Flowerdew & Costley, 2017, p. 3). Also, interdisciplinary practices, (as opposed to multidisciplinary), need to bring about new understandings, new knowledge for the disciplines involved.

*Disciplinarity and interdisciplinarity are ... not opposed but rather two sides of the same coin, two dimensions of knowledge formation that together enrich intellectual and educational practices.* (Christie & Maton, 2011, p. 7)

The discipline affiliations of those involved in this project’s interdisciplinary team are illustrated in Figure 5.1, together with the shared enterprise they are engaged in.
Figure 5.1 Discipline identities and epistemologies and shared area of enterprise

Although team members bring with them their own discipline and epistemic identities, the point of contact in Figure 5.1 is negotiating a shared approach to designing appropriate pedagogy through talk in project meetings. However, while it may be the case that team members share pedagogical approaches at an ideological level, for example, student-centred learning, at the discipline and professional level approaches to pedagogy vary, for example, inquiry-based learning in the sciences, genre pedagogy in academic literacy and constructivism in elearning. In addition, although team members have all experienced negotiation in meetings in their discipline community, many of which will have been largely administrative, the task of negotiating the design of learning resources across discipline boundaries may be a new experience for team members. Nevertheless, this point of confluence in the diagram, the task of designing online pedagogy, offers a space for creating new roles and identities as well as new knowledge.

This shared interdisciplinary space can be conceived of as a unique, local “community of practice” (Lave & Wenger, 1991) with the potential for individuals to
move across discipline and professional boundaries to achieve their project goal.

Communities of practice are groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis. (Wenger, McDermott, & Snyder, 2002, p. 4)

In many respects, the team fulfills the crucial characteristics of a ‘community’ as identified by Etienne Wenger (1998) in terms of the three concepts of ‘domain’, ‘community’ and ‘practice’. ‘Domain’ or the shared interest of the group and the reason for its existence is the team’s commitment to improving students’ academic writing in their discipline context. ‘Community’ comprises the team members who are committed to building relationships so that they can learn from each other to achieve their shared goal. ‘Practice’ describes the necessary activities that they engage in to develop a shared practice and knowledge base to achieve their goal.

Sharing practice and knowledge in a community of practice context are preconditions for building and advancing knowledge (Scardamalia & Bereiter, 2006), an ongoing process, as participants will take their new knowledge and experiences in the team project into new contexts. ‘Knowledge Building’ is a socially situated activity created during collaborative interactions and made explicit through dialogue where discourse not only facilitates knowledge sharing but also knowledge advancement.

Although it must be recognized that there is more to knowledge creation than discourse, it is also true that if knowledge-building dialogue fails, knowledge building fails, and conversely if a dialogue succeeds in
advancing from one shared knowledge state to a more advanced knowledge state, knowledge has been created. (Bereiter & Scardamalia, 2014, p. 45)

Thus, the focus in this research is to analyze episodes of naturally occurring dialogue in the interactions of the team as they address the issue of designing online learning resources for students to learn the laboratory report genre in physiology.

In particular, the main research questions are:

1. What kinds of knowledge and experience do team members share and build and what spoken interactions and use of artifacts facilitate this process?
2. Do patterns/genres of team practices and knowledge building develop?

A further aim of this paper is to illustrate how the outcomes of knowledge building are embodied in learning resources.

5.6 Analysis of talk in institutional meetings

There is a large body of literature both from a sociological and linguistic perspective on approaches to the analysis of the discourse of spoken language or conversational analysis in the workplace. (See for example, de Silva Joyce, 2016; Heritage & Clayman, 2010; Iedema, 2003.) Research has been carried out on formal and informal dialogue in meetings in a number of locations, for example in hospitals (Iedema, 2007) and business (Bargiela-Chiappini & Harris, 1997; Clifton, 2009; Handford, 2010), as well as virtual and telephonic meetings (Lockwood & Forey, 2016). In addition, a range of discourse analysis methodologies have been used. (For an overview of discourse analysis approaches and other approaches to conversational
analysis, see Bhatia, Flowerdew, & Jones, 2008; Eggins & Slade, 1997; Handford, 2010; Heritage & Clayman, 2010; Van Dijk, 1997.) The focus of research has varied from the discourse of leadership in meetings (Cliftion, 2006) to that of humour (Eggins & Slade, 1997; Thomson, 2016). The discourse analysis approach in this research is based on Systemic Functional Linguistics (SFL). SFL provides a comprehensive theory of language as a meaning making system of choices, where contextual influences can be related to discourse and lexicogrammatical choices, and in spoken language to phonological choices. Thus, detailed analysis of the evidence of language choices in a text can provide insights into what is happening in the situational and sociocultural contexts that influence, and are themselves influenced by these choices.

SFL proposes that choices in language and other semiotic systems (e.g., images, sound) combine a complex of three types of meanings motivated to achieve a particular purpose or function. These functional choices constitute the topic or content of talk (ideational), the social relations among participants (interpersonal) and lastly, choices that organise the conversation so that it makes sense (textual). In analysing conversation, these meanings, ideational, interpersonal and textual, termed metafunctions, provide a framework for discussing what is being negotiated, (the subject matter or content), how people are interacting, (role relations and attitudes), and how the interaction is initiated, continued, and closed.

Since this study is concerned with knowledge negotiation and sharing, it will focus on ideational meanings, essentially what topics are discussed. However, interpersonal meanings are also critical in the task of negotiating content, as knowledge is connected to discipline and professional identity and the roles of the interactants. Textual meanings are also involved, as they provide the framework for the negotiation, when and how topics are changed and discussion brought to a close. In
any situation, in this case negotiating knowledge for the development of learning resources, the metafunctions map onto the register variables, the variables of the specific discourse situation, namely, field (ideational), tenor (interpersonal) and mode (textual). The dimension of field in these negotiations brings together knowledge and experience from disciplinary and professional perspectives, for example, physiology concepts, such as, the hypothesis, together with applied linguistic concepts, such as genre, and instructional design concepts, such as cognitive load. “Field is concerned with the discourse patterns that realise the domestic or institutionalised activity that is going on….. a set of activity sequences that are oriented to some global institutional purpose” (Martin & White, 2005, p. 27).

The approach to analysis will focus on the level of discourse, in SFL terms discourse semantics (Martin, 1992). However, meanings at risk at this level are informed by choices in the lexicogrammar and phonology, although the latter will be discussed minimally in this paper. At the level of lexicogrammar the ‘Mood’ element (subject and finite) is the “component [that] carries the argument forward” (Halliday, 1985a, p. 71). Where “language is used to exchange information” termed a ‘Proposition’ by Michael Halliday (1985a, p. 70), as is the case in this research, it is “something that can be argued about--something that can be affirmed or denied, and also doubted, contradicted, insisted on, accepted with reservation, qualified, tempered, regretted and so on” (Halliday, 1985a, p. 70).

The different choices of Mood in the structure of the clause realise the basic initiating speech functions or moves at the level of discourse namely, offer, (giving goods and services), command, (demanding goods and services), statement, (giving information (fact or opinion (Eggins & Slade, 1997)), and question, (demanding information (fact or opinion)). Responding moves can bring about closure of the
negotiation of the content of the initiating move. This typical turn taking structure is shown in Figure 5.2 as a network of synoptic moves. Synoptic moves offer a static choice system for potential meaning making where the choices predict conversation closure. However, conversation is a dynamic process unfolding in time so any choice network has also to offer potential meaning making moves to continue the conversation (Martin, 1985). Although a move is typically defined as “a clause selecting independently for mood” (Martin, 1992, p. 59) or “a unit after which a speaker change could occur without turn transfer being seen as an interruption” (Eggins & Slade, 1997, p. 186), the identification of moves in a dynamically unfolding conversation is not clear cut as it is influenced by the surrounding discourse and context.

... it is not possible to define discourse units [such as moves] as categorically as grammatical ones. There is a system, but its potential for ongoing re-contextualisation means that there will always be rough edges for the analyst. Analysis in other words will inevitably involve interpretation. (Martin, 1992, p. 59)

In order to capture this dynamism, researchers have proposed dynamic moves as shown in Figure 2. Moves, for example, can be developed further into a move complex (Eggins & Slade, 1997; Ventola, 1998) through Halliday’s (1985a) ‘logicosemantic’ relations of ‘elaboration’ (clarifying, restating or exemplifying), ‘expansion’ (adding or contrasting) and ‘enhancement’ (qualifying or modifying). In Figure 5.2, these are shown as a sustaining choice for initiating moves in the network (Eggins & Slade, 1997, p. 195). Other dynamic moves offer tracking or challenging choices to disrupt the typical static or synoptic response of the turn taking ‘adjacency
pair’. When an initiating move reaches closure, this is termed an exchange defined as “a sequence of moves concerned with negotiating a proposition stated or implied in an initiating move. An exchange can be identified as beginning with an opening move, and continuing until another opening move occurs” (Eggins & Slade, 1997, p. 222). However cohesive devices, such as text reference and conjunction, also have to be taken into consideration in determining possible exchange boundaries.

![Speech function or move system network for discourse analysis of institutional conversation](adapted from Eggins & Slade, 1997; Jones, 2006; Martin, 1992; Ventola, 1998)

**Figure 5.2** Speech function or move system network for discourse analysis of institutional conversation (adapted from Eggins & Slade, 1997; Jones, 2006; Martin, 1992; Ventola, 1998)
5.6.1 Data and participants

The data consist of audio and video recordings of meetings among participants over a nine-month period, during the development and trialling of the prototype. A random selection of meetings was recorded at different stages of development, comprising a total of approximately seven hours of audio, and two hours of video recording. Meetings were typically one hour in duration. Not all participants were present at all recorded meetings. Meetings were accompanied by draft Word documents of the content for particular parts of the website, and diagrams of the structure of the website, both paper-based and on screen, as well as prototype screens. Discussions in meetings were developed around these artefacts and often changes were made on screen, for example to Word documents, as consensus was reached during meetings. Formal meetings were accompanied by an agenda and tended to occur only when the elearning project manager was present. These were recorded in minutes. However, other meetings were less formal, and did not result in formal minutes, although summaries of work to be done, when, and by whom, were circulated via email. The transcribed extracts chosen for analysis in this paper have been selected in terms of the research questions, with the aim of illustrating how knowledge is negotiated across discipline boundaries to achieve a consensus about the design and composition of the learning resources. Additionally, a broader analysis of one example meeting has been used to ascertain whether there are generic stages that facilitate the negotiation process.

Participants, team members, in the meetings comprised discipline academics in Physiology, (D1, D2 and D3), language and learning academics, (L1 and L2), and elearning professionals, the project manager (EM), and the elearning computer programmer and graphic designer (E). In terms of tenor or interpersonal relations among participants, each has a discipline or professional affiliation as described above.
Collegial contact between D1 and L1 has been frequent, as they have worked on a number of projects together, and both are joint leaders of this project. Similarly, L1 and L2 have frequent contact with each other, both as colleagues and friends. L1 and L2 have worked extensively with E in this project and have developed a close relationship over this time. EM has had little contact and minimal involvement in the regular meetings of the project team. The status of the physiology participants is reasonably equal in terms of D1 and D2, both senior academics, although D2 has a longer teaching and research history, but no interdisciplinary project experience. D3 is a more junior academic and has not been involved in project work. Although L1 and L2 are also senior academics, their non-faculty status is often viewed in the university context, as being of lower status. Both have extensive interdisciplinary project experience with faculty and professional elearning staff. E and EM are professional staff with extensive elearning project development experience. As professional staff, they are also often perceived to be of lower status in an academic university environment, although EM has taken senior roles in a number of projects and also in this project, as project manager. Although participants vary to some extent in their sociocultural background, they do not vary in terms of ethnicity or gender. University of Sydney Human Ethics Committee approval was gained for the recording of interactions. (See Appendix 4.) The researcher (L1) was embedded in the team.

5.7 Analysis

The extracts chosen for analysis can be seen to represent three kinds of knowledge building, negotiating knowledge, disputing or challenging knowledge, and explaining or presenting knowledge. These kinds of knowledge building are frequently found in the data but are not meant to be a comprehensive account of all knowledge building interactions. Each will be discussed in turn.


5.7.1 Negotiating knowledge

The first series of exchanges concerns the negotiation around how to explain the meaning of a hypothesis for a student writing a physiology report. Although the language and learning specialist proposes an explanation in a draft Word document, (Text 5.1), this needs to be discussed with a discipline lecturer, before it is approved for the website. The following discussion takes place between the two language and learning specialists, (L1 and L2), and the more junior discipline lecturer (D3). The discussion comprises three exchanges to reach consensus, and each is presented in turn. The exchanges are analysed for speech function or moves, turns are numbered and moves identified using a, b notation. Subject and finite are identified where possible. Incomplete moves and minor clauses (i.e., those without a Mood structure) are also part of the exchange, but, in some cases, they are not analysed for speech or move function. The transcription key for all exchange analyses is shown after Exchange 5.1.

Text 5.1 L1 draft of definition of the hypothesis

Your hypothesis is like a good guess or prediction of what you expect to find from carrying out your experiment - in other words, it is like an answer to your aim. However, even though your hypothesis is a good guess, it is stated with certainty e.g. X ‘will’ or ‘will not’ happen.
**Exchange 5.1**

<table>
<thead>
<tr>
<th>Speech/Move function</th>
<th>Turn/Move</th>
<th>Speaker</th>
<th>Talk</th>
<th>Subject</th>
<th>Finite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Give opinion</td>
<td>1</td>
<td>D3</td>
<td>the hypothesis [READING] your hypothesis is like [READING]</td>
<td>your hypothesis is</td>
<td>'m</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>L1</td>
<td>your hypothesis is like [READING]</td>
<td>I</td>
<td>'m</td>
</tr>
<tr>
<td></td>
<td>3/a</td>
<td>D3</td>
<td>hm hm ye // I'm just worried about the eh…</td>
<td>it [hypothesis]</td>
<td>'s</td>
</tr>
<tr>
<td>Elaborate</td>
<td>3/b</td>
<td>D3</td>
<td>// says here it's a good guess or prediction</td>
<td>it</td>
<td>'s</td>
</tr>
<tr>
<td>Back channel</td>
<td>4</td>
<td>L1</td>
<td>uhuh</td>
<td>it</td>
<td>'s</td>
</tr>
<tr>
<td>Extension</td>
<td>3/c</td>
<td>D3</td>
<td>// but then here it's stated with certainty</td>
<td>it</td>
<td>'s</td>
</tr>
<tr>
<td>Enhance</td>
<td>3/d</td>
<td>L1</td>
<td>// don't know whether that will… well that means will they be able to…</td>
<td>{I} …don't/ that will they [students] will</td>
<td></td>
</tr>
<tr>
<td>Track/Clarify</td>
<td>5</td>
<td>L1</td>
<td>ye ==</td>
<td>it</td>
<td>'s</td>
</tr>
<tr>
<td>Enhance</td>
<td>3/e</td>
<td>D3</td>
<td>// because on the one hand it's a prediction</td>
<td>it</td>
<td>'s</td>
</tr>
<tr>
<td></td>
<td>3/f</td>
<td>L2</td>
<td>// on the other hand it’s …</td>
<td>it</td>
<td>'s</td>
</tr>
<tr>
<td>Back channel</td>
<td>3/f</td>
<td>D3</td>
<td>ye ==</td>
<td>it</td>
<td>'m</td>
</tr>
<tr>
<td>Demand opinion</td>
<td>3/g</td>
<td>L1</td>
<td>// so I'm just wondering …</td>
<td>I</td>
<td>'m</td>
</tr>
<tr>
<td>Counter</td>
<td>7/a</td>
<td>L1</td>
<td>well we could put it is the accepted convention</td>
<td>we</td>
<td>could</td>
</tr>
<tr>
<td>Elaborate</td>
<td>7/b</td>
<td>L1</td>
<td>// but they might not understand that either</td>
<td>they</td>
<td>might not</td>
</tr>
<tr>
<td>Elaborate</td>
<td>7/c</td>
<td>L1</td>
<td>// but that's what it is the accepted convention</td>
<td>that</td>
<td>'s</td>
</tr>
</tbody>
</table>

Transcription key: // clause or clause complex boundaries; … hesitation, incompletion, speaker trails off; == overlapping talk; [CAPITALS] notes on surrounding context; italics language of appraisal or evaluation; underlined textual cohesive elements; { } ellipsed subjects/finites; [ ] identity of reference/ellipsed elements in subjects; ( ) untranscribable talk; XXX name of person.

The hypothesis is both the ideational, or content focus, and the textual, or thematic focus, of the exchange. It is introduced by D3 and L1 in the first two moves and subsequently referred to in subject position with the reference item ‘it’. However, what is really being negotiated in terms of content is the explanation of the hypothesis and its contradictory nature. It is this initial explanation that D3 is ‘worried’ about and this introduces the interpersonal element into the negotiation (an affective or emotional response: see Martin & White (2005) for an account of attitudinal evaluation or appraisal in SFL). D3 takes personal responsibility in subject position (modal responsibility (Martin, 1992)) for her negative evaluation, and further clarifies and justifies this in the following moves. However, her failure to complete moves where
she is expressing her opinion, as well as her use of the mitigating adjunct ‘just’ (don’t know, I’m just wondering) suggests that she is tentative about disagreeing with the explanation, and mindful of L1’s discipline expertise.

Therefore, L1’s response or interruption is not unexpected and could either be interpreted as an attempt to clarify D3’s worry (that means..) or as a challenge to D3’s implied criticism of her explanation. In the latter case, this is a stronger interpersonal response. At the same time, L1 suggests that it is the student users, the target of the online program, now in subject position, that are the reason for D3’s worry and their ability to understand the explanation. However, this is unclear, as the move is not completed. In summarising her position in 3g, (so) it is likely that D3 is questioning whether a different definition would be better, although this tentative move is not completed. This provides an opening for L1 to propose an alternative (could put …), an alternative that is more abstract and possibly more acceptable from a discipline point of view. L1 then proceeds to evaluate this alternative as equally problematic for students, perhaps as an attempt to support her original definition. In putting forward this new proposition, L1 is mindful to include the team in subject position (we) indicating that this is a joint decision and mitigating her strong stance and attachment to her explanation. Her interruption, as well as her alternative suggestion, which she dismisses, thwart D3’s attempt to formulate what could be an acceptable alternative from a physiology perspective. The exchange is tied together by cohesive devices, such as the continuative ‘well’, the conjunction ‘so’ and reference items ‘that’. However, at this stage, the negotiation of the ideational content, the explanation for the hypothesis, has not been resolved and continues into the next exchange.
Exchange 5.2

<table>
<thead>
<tr>
<th>Speech/Move function</th>
<th>Turn/Move</th>
<th>Speaker</th>
<th>Talk</th>
<th>Subject Finite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand opinion</td>
<td>1a-b</td>
<td>L2</td>
<td>do you mean – //do you mean that it’s a statement</td>
<td>you do / it's</td>
</tr>
<tr>
<td>Respond</td>
<td>2a</td>
<td>L1</td>
<td>I mean that … formulated as a statement</td>
<td>I mean</td>
</tr>
<tr>
<td>Elaborate</td>
<td>1c</td>
<td>L2</td>
<td>it’s formulated as a statement</td>
<td>{it} {’s}</td>
</tr>
<tr>
<td>Track/Confirm</td>
<td>2b</td>
<td>L1</td>
<td>//but you don’t say something like em if the stimulus is increased it is likely that …</td>
<td>it 's</td>
</tr>
<tr>
<td>Track/Clarify</td>
<td>2c</td>
<td>D3</td>
<td>Oh ok //don’t usually say likely</td>
<td>you don’t</td>
</tr>
<tr>
<td>Respond</td>
<td>3</td>
<td>D3</td>
<td>No</td>
<td>{you} don’t</td>
</tr>
<tr>
<td>Track/Clarify</td>
<td>2d</td>
<td>L1</td>
<td>or probably</td>
<td></td>
</tr>
<tr>
<td>Follow up</td>
<td>4</td>
<td>D3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Track/Clarify</td>
<td>2d</td>
<td>L1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In this second exchange, L2 intervenes to try to further the negotiation by questioning L1 in a tentative way, while at the same time offering another explanation. L1’s response shows her taking responsibility for defining the hypothesis (I mean) and agreeing with L2. She clarifies her explanation addressing L2 (you), although ‘you’ is more likely used in a generic way, referring to an outside disciplinary authority. D3’s response and follow up suggest agreement with L1, although the explanation of the hypothesis as a statement is not taken any further.

Exchange 5.3

<table>
<thead>
<tr>
<th>Speech/Move function</th>
<th>Turn/Move</th>
<th>Speaker</th>
<th>Talk</th>
<th>Subject Finite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Give fact</td>
<td>1a</td>
<td>D3</td>
<td>definite prediction</td>
<td>it {hypothesis} may</td>
</tr>
<tr>
<td>Respond</td>
<td>2</td>
<td>L1</td>
<td>yes it may be that ddd … your prediction is stated with some certainty</td>
<td>it will</td>
</tr>
<tr>
<td>Elaborate</td>
<td>1b</td>
<td>D3</td>
<td></td>
<td>{it} will</td>
</tr>
<tr>
<td>Counter</td>
<td>3</td>
<td>L1</td>
<td>well it will</td>
<td></td>
</tr>
<tr>
<td>Confirm</td>
<td>4</td>
<td>L2</td>
<td>will ye</td>
<td></td>
</tr>
<tr>
<td>Clarify</td>
<td>5</td>
<td>D3</td>
<td>with certainty</td>
<td></td>
</tr>
<tr>
<td>Confirm</td>
<td>6</td>
<td>L1</td>
<td>with certainty</td>
<td></td>
</tr>
</tbody>
</table>

Following on from Exchange 5.2, D3 introduces new wording for the explanation of the hypothesis, ‘a definite prediction’ as the starting point or theme of this exchange. L1 acknowledges this tentatively and D3 then begins to resolve the
exchange, and hence the explanation for the hypothesis, by bringing ‘your prediction’ into subject position. However, when she rewords this in a modified way (some certainty), L1 provides a counter position by introducing the obligatory finite (will), which is supported by L2. D3 agrees with this by adjusting her modification of ‘certainty’. The final wording continues to be discussed in the next section, Disputing knowledge.

In this series of exchanges, collaborative dialogue is working towards sharing knowledge about a pedagogically acceptable explanation for the term hypothesis from both a discipline and academic literacy point of view. Although a satisfactory outcome is not achieved, and it seems as if the dialogue has been circular (Handford, 2010), as the wording at the end of Exchange 3 remains the same as in Text 5.1, different viewpoints about the concept have been communicated. The hesitations and hedging language used by D3, L1 and L2 (just, we could, do you mean) are indications of a cooperative approach to negotiation as they modify the degree of assertiveness attached to the ideational content (Handford, 2010; Hyland, 1998). However, interruptions and overlapping talk can disempower participants (Iedema, 2003) and disrupt both collaboration and the purpose of the exchange (Eggins & Slade, 2012). L1, in interrupting D3, may perceive herself as the expert, both from her discipline perspective, and as the creator of the text. Those with the most status, power and expertise are more likely to interrupt in both formal and informal meetings (Bargiela-Chiappini & Harris, 1997). Interruptions can be successful in moving the dialogue forward and in this case, the pedagogical issue of whether students will understand the explanation of the hypothesis is introduced. An emphasis on end users is typically the concern of teachers involved in educational design (Cober et al., 2015). However, this is not developed further by D3 and the outcome of the exchange is at risk when L1
fails to allow D3 to suggest an alternative explanation and instead supplies her own. Her alternative is questionable as it increases the technicality of the explanation, probably making it more difficult for students to understand. L1 is likely to be aware of this and her reaction may be interpreted as defensive, believing her expertise and identity are at risk (Iedema & Sheeres, 2003). Her rejection of her alternative serves to close down negotiation at this point in the exchange (Iedema, 2003). In order to achieve the goal of the meeting, L2 intervenes to repair this impasse by introducing another possible explanation. Although unsuccessful, this allows for more knowledge to be explored and possibly provides D3 with thinking space which facilitates her suggested rewording at the beginning of Exchange 5.3. Although this series of exchanges reaches closure with agreement echoed by all participants, a new explanation for the concept of the hypothesis has not been achieved.

### 5.7.2 Disputing knowledge

The following exchanges continue on from the previous Exchange, 5.3, and concern the description of the hypothesis as ‘like an answer to your aim’, the second line in Text 5.1.

**Exchange 5.4**

<table>
<thead>
<tr>
<th>Speech/Move function</th>
<th>Turn/Move</th>
<th>Speaker</th>
<th>Talk</th>
<th>Subject</th>
<th>Finite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back channel</td>
<td>1</td>
<td>D3</td>
<td>your aim though em … yes</td>
<td>your aim is it will</td>
<td></td>
</tr>
<tr>
<td>Give opinion</td>
<td>2</td>
<td>L1</td>
<td>your aim is suggested that you ( ) it.. //and your hypothesis is that it will have an effect mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elaborate</td>
<td>3a</td>
<td>D3</td>
<td>I don’t like that like an answer to your aim really yes really</td>
<td>I</td>
<td>don’t</td>
</tr>
<tr>
<td></td>
<td>3b</td>
<td></td>
<td>no … no</td>
<td>it (your aim) ’s</td>
<td></td>
</tr>
<tr>
<td>Back channel</td>
<td>4</td>
<td>L1</td>
<td>it’s just the basis //and that’s what I wanted to get across ye however …</td>
<td>that (what I ) ’s</td>
<td></td>
</tr>
<tr>
<td>Give opinion</td>
<td>5</td>
<td>D3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check</td>
<td>6</td>
<td>L1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confirm</td>
<td>7</td>
<td>D3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check</td>
<td>8</td>
<td>L1L2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Give fact</td>
<td>9a</td>
<td>L1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enhance</td>
<td>9b</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Counter</td>
<td>10</td>
<td>D3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In Exchange 5.4, D3 begins the exchange with the topic or content theme of
‘your aim’, and the implication of, whether in discipline terms, the hypothesis is ‘an answer to your aim’. While her reasoning about this topic is unclear as there is a gap in the transcript, it is certainly clear, from turn 5, that she disagrees strongly with this description using an affective negative evaluation (I don’t like). L1’s intonation in her response shows surprise (tone 4: falling--rising, ‘seems to be certain but isn’t’). D3 confirms her evaluation with emphasis and intonation (tone 1: falling tone) followed by questioning intonation from both L1 and L2 (tone 2: rising tone, uncertainty). L1 then attempts to explain why the hypothesis could be an answer to an aim and although she takes responsibility for the explanation, she distances her involvement with the structure ‘what I wanted ..’ Her explanation is tentative, vague and incomplete, indicating that L1 is deferring to D3 as the discipline expert. The exchange concludes with D3 acknowledging L1’s incomplete explanation but still essentially disagreeing. This is followed by a pause, where neither L1 or L2 respond or offer an alternative wording.

**Exchange 5.5**

<table>
<thead>
<tr>
<th>Speech/Move function</th>
<th>Turn/Move</th>
<th>Speaker</th>
<th>Talk</th>
<th>Subject</th>
<th>Finite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exclaim</td>
<td>1</td>
<td>D3</td>
<td>no! … no!</td>
<td>{it} that makes</td>
<td>makes</td>
</tr>
<tr>
<td>Give opinion</td>
<td>2</td>
<td></td>
<td>I think that makes more sense now</td>
<td>your prediction has to be</td>
<td>you have to</td>
</tr>
<tr>
<td>Confirm</td>
<td>3</td>
<td>L1</td>
<td>your aim?</td>
<td>that(what I mean)’s</td>
<td>that(what I mean)’s</td>
</tr>
<tr>
<td>Reconfirm</td>
<td>4</td>
<td>D3</td>
<td>your prediction has to be -</td>
<td>{it} hypothesis is</td>
<td>{it} hypothesis is</td>
</tr>
<tr>
<td>Give fact</td>
<td>5a</td>
<td>D3</td>
<td>//you have to have a definite prediction</td>
<td>it (hypothesis) ’s</td>
<td>it (hypothesis) ’s</td>
</tr>
<tr>
<td>Elaborate</td>
<td>5b</td>
<td></td>
<td>//that’s what I mean really</td>
<td>that</td>
<td>that</td>
</tr>
<tr>
<td>Elaborate</td>
<td>5c</td>
<td></td>
<td>//is stated as a definite prediction</td>
<td>( )</td>
<td>( )</td>
</tr>
<tr>
<td>Elaborate</td>
<td>5d</td>
<td></td>
<td>//so although it’s ( )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elaborate</td>
<td>5e</td>
<td></td>
<td>//it is stated as a definite prediction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elaborate</td>
<td>5f</td>
<td></td>
<td>yes that’s better [Typing]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respond</td>
<td>6</td>
<td>L2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Exchange 5.5 begins with D3’s exclamation emphasized through stress and intonation (tone 1), countering her former position, and she continues with her
positive, evaluation her ‘appreciation’ (makes more sense) of the description ‘an answer to your aim’ (Martin & White, 2005). L1 confirms D3’s change of opinion (tone 2) and this is reconfirmed by D3. D3 then returns to the original negotiation concerning the hypothesis as a ‘definite prediction’ introduced in exchange 5.3. She justifies this explanation with strong modality (have to have), possibly addressing L1 and L2 (you), or using a generic form, attributing this to disciplinary practice, and then taking responsibility for this wording (what I mean). This wording is acknowledged by L2 with a positive (appreciative) comment and becomes the final version of the explanation as can be seen in the website (Figure 5.3).

Figure 5.3 Screen shot from FLERT showing the final version of the definition of the hypothesis in a physiology report and including the term ‘definite prediction’

Bringing together the concepts of aim and hypothesis as stages in the genre of an introduction to a physiology report is important in genre pedagogy (Figure 5.4). This may provide a new perspective, new knowledge, on what tend to be considered as separate concepts in physiology. This may explain D3’s initial objection. However, gaps in the transcript and also the rather vague justification provided by L1 for this wording make it difficult to understand the knowledge negotiation around these interrelated concepts. Nevertheless, the atmosphere of mutual respect and trust in the team, enabled D3 to express her opinions strongly.
Lab notes objective

To investigate the relationship between stimulus strength and response amplitude in a whole nerve.

Aim in your introduction

The aim of this experiment was to determine the relationship between stimulus strength and response amplitude in a whole nerve.

Hypothesis in your introduction

If the response amplitude of a whole nerve is dependent on the intensity of the stimulus applied, then increasing the strength of the stimulus will give greater response amplitude from a whole nerve.

Figure 5.4 Screen shot from FLERT showing how key topics for the experiment are linked from the lab notes through the aim to the hypothesis. On clicking, colour highlighting reveals the links, in this example, 'stimulus strength'.

The substitution of ‘stated as a definite prediction’ instead of ‘stated with certainty’ may appear to be of small consequence in knowledge building but consensus has been reached, and this decision may well mean that students will find this wording easier to understand. The circular and cyclical nature of the interaction where explanations were suggested but not developed and then returned to later is typical of decision making and problem solving in meetings (Figure 5.5) (Handford, 2010).
Taken together, Exchanges 5.1 to 5.5 can be considered from a teleological perspective to have reached closure, or to have achieved their communicative purpose (Martin, 1992, 1999). This purpose has been greatly facilitated by the use of interpersonal meaning making where team members have worked together to resolve tensions arising from differences in disciplinary understandings to achieve consensus and maintain team solidarity.

5.7.3 Explaining knowledge

As experts from different professions and discipline areas come together to share knowledge, they will also need to explain aspects of their own knowledge unfamiliar to other team members, which are necessary for creating the end product. This involves extended turns or monologues, so that new understandings can be reached. The example below concerns the elearning specialist (E), who is creating the
E’s monologue first refers team members to the whole diagram (that), and then to the activity parts, addressing them personally (you). Her monologue accompanies her action of pointing to the different parts of the diagram, otherwise moving from the
higher level in the hierarchy to the lower activities level would have been difficult to follow. In 1c, she introduces an example and distances herself from subject position by putting the focus on the diagram, (what we’re looking at), while at the same time including all team members. Her monologue, as well as the diagram itself, are examples of the genre of a compositional report, (part/whole), (Martin & Rose, 2008), and she explains the parts making up the diagram and hence the website design. Both L1 and D1 acknowledge her explanation in a supportive way.

*Exchange 5.7*

<table>
<thead>
<tr>
<th>Speech/Move function</th>
<th>Turn/Move</th>
<th>Speaker</th>
<th>Talk</th>
<th>Subject</th>
<th>Finite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Give fact</td>
<td>1a</td>
<td>E</td>
<td>so you have … // ‘cause the way the whole thing’s specified eh laid out is first of all you’ve got the heading on the page you have the way… is</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1b</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extend</td>
<td>1c</td>
<td></td>
<td>// then you’ve got the link to that particular page you’ve</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>’ve</td>
<td></td>
</tr>
<tr>
<td>Enhance</td>
<td>1d</td>
<td></td>
<td>// and then we’ve got nouns related to that particular page we’ve</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>’ve</td>
<td></td>
</tr>
<tr>
<td>Elaborate</td>
<td>1e</td>
<td></td>
<td>// I know what kind of activity it is eh I know</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extend</td>
<td>1f</td>
<td></td>
<td>// just the name of the activity that sort of helps me with eh with the naming convention I name of …helps</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elaborate</td>
<td>1g</td>
<td></td>
<td>// and just to sort of show you eh you will notice that for example in introduction I’ve got M4 you will</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extend</td>
<td>1h</td>
<td></td>
<td>// that means that this is module 4 this is</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1i</td>
<td></td>
<td>// and it’s module 4 when we look at that it’s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respond</td>
<td>2</td>
<td>D1</td>
<td>that’s right the diagram that’s</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1i</td>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

E continues her monologue in Exchange 5.7, directly addressing team members in subject position as ‘you’ and inclusively as ‘we’, before positioning herself in subject position to explain why the diagram is helpful for her. This monologue begins more as a spoken procedure, guiding the team through the hierarchical organisation of the diagram, with links like ‘first of all’ and ‘then’. Once again, this is language accompanying action as E indicates the relevant parts of the diagram. She continues by
explaining how important the labelling of different parts of the diagram is for her (naming of activities), a task shared with the language and learning academics. Once again D1 responds with an appreciative comment on both the diagram and E’s explanation. Interpersonally, E is tentative and lacks confidence in her presentation as is shown by frequent hesitation markers (eh) and the choice of the modifying adjuncts (just, sort of).

Exchange 5.8

<table>
<thead>
<tr>
<th>Speech/Move function</th>
<th>Turn/Move</th>
<th>Speaker</th>
<th>Talk</th>
<th>Subject</th>
<th>Finite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Give fact</td>
<td>1a</td>
<td>E</td>
<td>so I’m actually already planning for the entire tool</td>
<td>I</td>
<td>’m</td>
</tr>
<tr>
<td>Respond</td>
<td>2</td>
<td>D1</td>
<td>Yes ok == the whole thing</td>
<td>we</td>
<td>’re</td>
</tr>
<tr>
<td>Enhance</td>
<td>1b</td>
<td>E</td>
<td>= = so we’re gonna be building with the whole tool</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elaborate</td>
<td>1c</td>
<td></td>
<td>//I’m actually working with the whole structure</td>
<td>I</td>
<td>’m</td>
</tr>
<tr>
<td>Extend</td>
<td>1d</td>
<td></td>
<td>//I’m not sort of thinking only in terms of those 3</td>
<td>I</td>
<td>’m</td>
</tr>
<tr>
<td>Respond</td>
<td>3a</td>
<td>D1</td>
<td>that’s great</td>
<td>that</td>
<td>’s</td>
</tr>
<tr>
<td>Elaborate</td>
<td>3b</td>
<td></td>
<td>//that’s good</td>
<td>that</td>
<td>’s</td>
</tr>
<tr>
<td>Follow up</td>
<td>4</td>
<td>E</td>
<td>ye</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In Exchange 5.8, E sums up the monologue by explaining and evaluating her role as technical designer, adding emphasis through her choice of attitudinal lexis, such as ‘actually’ and ‘entire’. She takes subject position and responsibility while at the same time, including the whole team in this activity. D1 acknowledges E’s professional behaviour showing strong agreement with an echo response (the whole thing) and positive judgement (great, good). It is likely that both L1 and L2 are familiar with this diagram and hence do not take part in this interaction. Both E’s diagram and her accompanying monologue make her knowledge explicit in terms of her role and identity as an elearning designer.

Approximately half of E’s turns are devoted to explaining the content, while half are about her evaluation of both the diagram and how it facilitates her role. It can
be argued that without the diagram and her accompanying non-verbal communication, it would be difficult for the team to understand the structure of this part of the website. Her explanation could have followed the hierarchical structure in a more logical way, moving from higher levels to lower, and, it may be the case, that she was more concerned with justifying her role rather than explaining the structure of the website.

This may account for the following D2 initiating move, asking for clarification, in the subsequent exchange:

\[D2\] “is module the same as section”?

From the discipline perspective of physiology, accuracy in nomenclature is essential and hence this question. Space in this paper does not allow for the discussion of how this query is resolved.

In interdisciplinary teamwork, knowledge and practices from different disciplines and professions need to be made explicit. This activity is new for team members as these understandings are tacit within discipline and professional communities. Their articulation in interdisciplinary space can put at risk identities and roles (Iedema & Sheeres, 2003). This may explain the hesitant nature of E’s explanation, as well as her emphasis on her role.

Both the diagram and the accompanying discourse are examples of knowledge sharing with the potential for knowledge building as team members can take this approach into designing their own curricula. For example, they can conceive of curricula both in terms of composition as well as a linear, unfolding procedure. It may well be the case that they have already used this approach but have not formulated it in an explicit ‘story board’ type diagram and this tool or artefact could support further pedagogical planning.
5.8 Towards a meeting genre

Dialogue in institutional meetings, unlike casual conversation, is goal and outcome driven, as well as time constrained. Therefore, it is possible to investigate the stages meetings move through to achieve their purpose, in other words their genres, “a staged goal oriented social process …to get things done” (Martin & Rose, 2008, p. 6). The opening stage sets the tone of a meeting in terms of formality. The meetings in this study ranged in formality depending on the role and status of those involved, as well as their frequency of contact. More formal meetings tended to follow a stricter agenda which was elicited at the start of the meeting, as in Exchanges 5.9 and 5.10, compared with less formal openings as in Exchanges 5.11, 5.12, and 5.13.

5.8.1 Formal meeting: opening exchanges

Exchange 5.9

<table>
<thead>
<tr>
<th>Speech/Move function</th>
<th>Turn/Move</th>
<th>Speaker</th>
<th>Talk</th>
<th>Subject</th>
<th>Finite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Give fact/Command</td>
<td>1a</td>
<td>EM</td>
<td>so what we’ve got on this afternoon is ( ) quickly through like reviewing the templates designs um</td>
<td>what we’ve..</td>
<td>is</td>
</tr>
<tr>
<td>Elaborate</td>
<td>1b</td>
<td></td>
<td>// I think we need to talk a little bit more about um the second item</td>
<td>we</td>
<td>need</td>
</tr>
<tr>
<td>Enhance</td>
<td>1c</td>
<td></td>
<td>// and we’ve got some ideas for that specifically how the discipline specific materials can be ( ) in a bit more sustainable way</td>
<td>we</td>
<td>’ve</td>
</tr>
<tr>
<td>Enhance</td>
<td>1d</td>
<td></td>
<td>// so we can get onto that</td>
<td>we</td>
<td>can</td>
</tr>
<tr>
<td>Elaborate</td>
<td>1e</td>
<td></td>
<td>// we want to get onto that</td>
<td>we</td>
<td>want</td>
</tr>
<tr>
<td>Elaborate</td>
<td>1f</td>
<td></td>
<td>// um so go through those things down here looking at the file ( )</td>
<td>{we}</td>
<td>go</td>
</tr>
</tbody>
</table>

EM begins the exchange with a procedural monologue outlining the agenda. This is a common practice in more formal institutional meetings (Bargiela-Chiappini & Harris, 1997; Handford, 2010; Nielson, 2013). She includes the whole team in the activities that are on the schedule, making everyone responsible for what is to be discussed, while at the same time emphasizing the collaborative nature of the meeting.
However, activities are modulated in the finite in terms of necessity, ability and inclination, in this way reducing the impact of what are essentially commands. Evaluative language such as ‘sustainable’ reflects her role as manager with responsibility for budget. She is careful to downplay this role with the use of modifiers to mitigate these evaluations, such as ‘a little bit’, and a ‘bit more’, as well as ‘I think’, common strategies used by managers to reduce the sense of obligation in directives as well as create a more cooperative team atmosphere (Handford, 2010).

_E Exchange 5.10_

<table>
<thead>
<tr>
<th>Speech/Move function</th>
<th>Turn/Move</th>
<th>Speaker</th>
<th>Talk</th>
<th>Subject</th>
<th>Finite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Give fact</td>
<td>1a</td>
<td>EM</td>
<td>and then there is a review I need to do with how the project is going</td>
<td>there</td>
<td>’s</td>
</tr>
<tr>
<td>Enhance</td>
<td>1b</td>
<td>EM</td>
<td>//we’re getting close to not quite half way through our whole project period</td>
<td>we</td>
<td>’re</td>
</tr>
<tr>
<td>Enhance</td>
<td>1c</td>
<td>EM</td>
<td>// so it’s time for that to happen at some stage</td>
<td>it (time ..)</td>
<td>’s</td>
</tr>
<tr>
<td>Extend</td>
<td>1d</td>
<td>EM</td>
<td>//and then maybe a bit of discussion about getting the other sections done</td>
<td>{there}</td>
<td>{’s}</td>
</tr>
<tr>
<td>Enhance</td>
<td>1e</td>
<td>EM</td>
<td>//cos XXX is trying to make ( ) from the college perspective and actually getting the other sections done as well</td>
<td>XXX</td>
<td>is</td>
</tr>
<tr>
<td>Check</td>
<td>1f</td>
<td>EM</td>
<td>//so is that ..</td>
<td>XXX</td>
<td>is</td>
</tr>
<tr>
<td>Check</td>
<td>1g</td>
<td>L1, 2</td>
<td>// is that more or less ok</td>
<td>that</td>
<td>is</td>
</tr>
<tr>
<td>Respond</td>
<td>2</td>
<td>D1, 2</td>
<td>mm mm</td>
<td>that</td>
<td>is</td>
</tr>
</tbody>
</table>

In Exchange 5.10, EM continues her monologue, but in marked contrast to Exchange 5.9, her opening move replaces the team, ‘we’, in subject position, with the activities of a manager, namely a review. In this way, she depersonalises and objectifies her role, removing herself from subject position, despite her responsibility for carrying out the review. The only instance of the team as subject is in the justification for the review in 1b. Other activities associated with her role, such as ‘timing’ and ‘getting things done’, are foregrounded in subject position. Also, the reason for ‘getting things done’ is attributed to an outside authority, adding further
support, as this person is at a higher level in the university hierarchy. During her monologue, there are no other interactions until she invites the team to agree with the agenda, modifying her question with ‘more or less’.

As this more formal meeting develops, EM supports the team in their interactions and does not dominate proceedings. However, she does intervene in her role as chair to keep the meeting on track, emphasizing her responsibility for procedure as part of her identity as project manager (Clifton, 2006). For example, before Exchange 5.6, she says “we’ll get onto the discipline specific in a minute, let’s just stick with the other for now”. At the end of another exchange, where E has shown her design of animations, EM’s summary reminds the team about the demands on time and hence budget of E’s work, as well as directing them to the agenda, “mm and I mean to give you an idea that [building animations] sort of does take a bit of time for E which is where we might get onto thinking about the specific stuff, that sort of thing”. Once again her use of modulated and informal language (might, sort of, specific stuff, that sort of thing) downplays her role as manager, responsible for directing and controlling the meeting (Handford, 2010).

5.8.2 Informal meeting: opening exchanges

A typical activity at the beginning of a meeting is offering food and drink, or simply having food and drink accompany other casual conversation. In this case, Exchange 5.11 follows a goods and services pattern of offer, respond to offer and follow up. This kind of opening is found in both formal and informal meetings and is aimed at building interpersonal relations to support the effective working of the team. Subject position in Exchanges 5.11 and 5.12 are dominated by the personal pronouns, I and you, indicating closer and more personal interaction among participants, in contrast to those in the formal meeting where, the inclusive pronoun, we, referring to
the whole team is used.

**Exchange 5.11**

<table>
<thead>
<tr>
<th>Speech/Move function</th>
<th>Turn/Move</th>
<th>Speaker</th>
<th>Talk</th>
<th>Subject</th>
<th>Finite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Give goods</td>
<td>1a</td>
<td>L1</td>
<td>so I’ll …</td>
<td>I</td>
<td>’ll</td>
</tr>
<tr>
<td></td>
<td>1b</td>
<td></td>
<td></td>
<td>I</td>
<td>shall</td>
</tr>
<tr>
<td>(offer)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Give goods</td>
<td>1c</td>
<td>L1</td>
<td>I’ll get the coffees</td>
<td>I</td>
<td>’ll</td>
</tr>
<tr>
<td>Respond</td>
<td>2</td>
<td>L2</td>
<td>yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Follow up</td>
<td>3</td>
<td>D2</td>
<td>thank you</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Exchange 5.12**

<table>
<thead>
<tr>
<th>Speech/Move function</th>
<th>Turn/Move</th>
<th>Speaker</th>
<th>Talk</th>
<th>Subject</th>
<th>Finite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Give goods</td>
<td>1</td>
<td>L2</td>
<td>one or none [cakes]?</td>
<td>you</td>
<td>are</td>
</tr>
<tr>
<td>(offer)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demand opinion</td>
<td>2a</td>
<td>D1</td>
<td>are you just afraid I’d have an insulin reaction?</td>
<td>you</td>
<td>thought</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>I</td>
<td>checked</td>
</tr>
<tr>
<td>Enhance</td>
<td>2b</td>
<td></td>
<td>// and you thought you’d better ( )</td>
<td>you</td>
<td>don’t need</td>
</tr>
<tr>
<td>Elaborate</td>
<td>2c</td>
<td></td>
<td>// I checked my sugar before I left</td>
<td>I</td>
<td>don’t need</td>
</tr>
<tr>
<td>Challenge</td>
<td>3</td>
<td>L2</td>
<td>you don’t need one</td>
<td>it</td>
<td>won’t</td>
</tr>
<tr>
<td>Counter</td>
<td>4a</td>
<td>D1</td>
<td>I don’t need one</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extend</td>
<td>4b</td>
<td></td>
<td>// but it won’t do me any harm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respond</td>
<td>5</td>
<td>L2</td>
<td>ok ==</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extend</td>
<td>4c</td>
<td>D1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Counter</td>
<td>6a</td>
<td>L2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonverbal</td>
<td>6b</td>
<td>L1,D1,L2</td>
<td>[LAUGHTER]</td>
<td>I</td>
<td>wasn’t</td>
</tr>
<tr>
<td>Elaborate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Exchange 5.12 continues from 5.11 with the offer of food to the team, with the exception of D1 who L2 teases with the offer of ‘no cake’ or ‘none’. This is an indication of their close relationship since D1 is a diabetic, and normally this would not be a topic for humour. The teasing continues with challenging and countering moves, until the team’s laughter. Humour creates strong interpersonal bonding among team members (Thomson, 2016) but it also occurs to disguise serious issues that may be at stake, such as D1’s diabetic condition and whether she can consume foods high in sugar (Eggins & Slade, 1997). L2 may well be exploring this concern through humour. In bringing the exchange to a close, L2 takes the focus away from D1, making herself the object of the joke, and thereby defusing the possible tension in the
exchange which could be perceived as too personally intrusive.

Exchange 5.13

<table>
<thead>
<tr>
<th>Speech/Move function</th>
<th>Turn/Move</th>
<th>Speaker</th>
<th>Talk</th>
<th>Subject</th>
<th>Finite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Give fact</td>
<td>1a</td>
<td>D1</td>
<td>[LAUGHTER] well my son is has sort of similar self-interest and my interest ye // because he will say to me when we’re going somewhere ‘did you pack anything in case you need it food’ // and I say ‘anything like what’ ‘I don’t know even’ ‘I think there is a Snickers bar’ ‘you know the Snickers doesn’t really work for me’ ‘it’s the only thing we’ve got left Mum’ yes</td>
<td>my son</td>
<td>has</td>
</tr>
<tr>
<td>Back channel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elaborate</td>
<td>1b</td>
<td>D1</td>
<td>I say</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elaborate</td>
<td>1c</td>
<td>D1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back channel</td>
<td></td>
<td>L2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enhance</td>
<td>1d</td>
<td>D1</td>
<td>so he’s always checking me yes mm that’s quite a challenge ( )</td>
<td>he</td>
<td>’s</td>
</tr>
<tr>
<td>Respond</td>
<td>2</td>
<td>D2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on interactions in Exchange 5.12, D1 relates a similar experience involving herself and her son in Exchange 5.13. In terms of story genre structure, D1’s monologue is a spoken exemplum, with an orientation stage (well my son is has …) followed by an incident stage (the conversation D1 relates between herself and her son) and interpretation stage, where she concludes her monologue with a positive judgement of her son’s behaviour (Martin & Rose, 2008). As is the case in story genres, the people, D1 and her son are in subject position. D2’s response to the exemplum is an evaluation of his behaviour, namely, his concern for his mother’s health being a challenge, and in D2’s estimation, a highly valued action (Martin & White, 2005). D1’s sharing of personal experience with the team further illustrates the close personal relationship among team members.

From these exchange examples, it can be seen that genre elements do enter into meetings, such as reports (Exchange 5.6), procedures (Exchanges 5.7, 5.9, and 5.10), and recounts (Exchange 5.13). However, whether there is an identifiable generic structure for a whole meeting is questionable, given the dynamic and interactional
nature of meetings. Typical stages, at the general level of a beginning, middle, end structure, can be seen in the obligatory elements of meetings, the opening and closing stages. Patterns for the opening stages have been shown in Exchanges 5.9 to 5.13. A closing stage is shown at the end of Table 5.1, where there is a move to casual conversation as the topics for discussion have come to an end, as well as the meeting time allocation. This stage is found in both formal and informal meetings. However, within the more complex middle section, patterns do emerge, as the overall purpose and the topics for discussion and resolution are shared by all participants (Bargiela-Chiappini & Harris, 1997).

Table 5.1 gives a general overview of structural stages in the informal meeting, in particular in the middle sections. Exchanges have been grouped together in terms of both the ideational and textual focus of the exchange, broadly, whether the focus is on the ‘what’ of the negotiation, the content, or the ‘when’, the procedure, and also of importance is ‘who does what when’. Clearly, there are exchanges where these all come together. The opening moves in an exchange or exchange complex are included in the table, together with the team member who carries out this action. The team member or members who dominate each exchange or complex in terms of turn and turn length are also shown. For example, in the first exchange complex, the opening of the meeting, clearly, it is D1 who dominates (58% of the total speaking time). As the meeting unfolds, L1 and L2 have different knowledge responsibilities in the development of content, and this is shown in their opening moves, and their turn taking contribution (for example, in Exchanges 4 to 7, L1’s speaking time is 40% compared to 30% for D1). In Exchanges 8 to 10, L1 needs the discipline lecturers’ expertise to clarify content issues, and therefore, negotiation between D1 and D2 dominates this part of the meeting. The meeting overall shows a collaborative
approach to negotiation as all participants are equally involved in initiating moves as well as contributing to speaking time. The focus on content is found in the first part of the meeting, and in fact takes up more exchanges than procedure. The move to procedure in Exchange 19 is signalled through the ideational and thematic textual content of the opening move ‘sending …. deadlines’. Discussions around procedure, even in terms of the timing of the next meeting, is a logical element as meetings come to a close. In this example, procedure is more concerned with the further development of the content and the allocation of responsibilities for this.

The content of opening and also closing moves, (not shown in Table 5.1), in each exchange or exchange complex signal transitions and boundaries between stages. In the opening moves, the use of ‘so’ ‘alright’ ‘now’ indicate the speaker taking responsibility for a topic change. ‘so’, in particular, is commonly used for this purpose as well as for summarising in topic closing moves (Clifton, 2006; Handford, 2010). These moves can be considered as signalling the stages in the genre, changing the ideational content and organising thematic development with opening moves (can those kinds of things be grouped in a Mac) and then closing the exchange or exchange complex with the textual function of ‘new’ information (so the grouping works for that (Exchange 16: closing move)). Speakers show their genre awareness by making these moves to advance the discussion and achieve the purpose of the meeting.
Table 5.1 Genre structure of informal meeting

<table>
<thead>
<tr>
<th>Exchange focus</th>
<th>Exchange</th>
<th>Opening move</th>
<th>Who</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>L1 so I’ll, shall I get, I’ll get the coffees</td>
<td>D1</td>
<td></td>
</tr>
<tr>
<td>Content</td>
<td>4-7 What and Why</td>
<td>D1 alright maybe the first text was just typos</td>
<td>L1</td>
</tr>
<tr>
<td></td>
<td>8-10 What</td>
<td>L1 this is where we need your help</td>
<td>L1, D1, D2</td>
</tr>
<tr>
<td></td>
<td>11-13 What</td>
<td>L2 yes now the only other major, oh not really as major as that, was a part in my section</td>
<td>L2, D1</td>
</tr>
<tr>
<td></td>
<td>14-16 How</td>
<td>D1 can those kinds of things be grouped in a Mac?</td>
<td>D1</td>
</tr>
<tr>
<td></td>
<td>17-18 What</td>
<td>D2 can I just bring up a small point?</td>
<td>D2, L2, L1</td>
</tr>
<tr>
<td>Procedure</td>
<td>19 When</td>
<td>D1 now the only other thing that I can think of is with regards to sending name some deadlines</td>
<td>D1</td>
</tr>
<tr>
<td></td>
<td>20 What</td>
<td>L2 but we’ve also got appendix</td>
<td>L2, D2</td>
</tr>
<tr>
<td></td>
<td>21 Who</td>
<td>D2 that’s another thing I’m always confused about who’s writing the welcome page</td>
<td>D2</td>
</tr>
<tr>
<td></td>
<td>22 What and Who</td>
<td>L1 so we’ve really got overall structure, title, methods and conclusion …</td>
<td>L1</td>
</tr>
<tr>
<td></td>
<td>23-24 When</td>
<td>L1 so if she wants some dates</td>
<td>L2</td>
</tr>
<tr>
<td></td>
<td>25-28 When and What</td>
<td>D2 I was going to ask …. /I was going to ask is it possible to do the methods first?</td>
<td>D1</td>
</tr>
<tr>
<td></td>
<td>27 Closing casual conversation</td>
<td>L2 you can watch my sunset, all of mine out of all my window L1 wow D2 beautiful D1 does that come from Mac? L2 L1 yes D1 that’s nice much nicer than anything you can get === L2 ===oh windows D1 terrible L1 unreal</td>
<td></td>
</tr>
</tbody>
</table>

5.9 Discussion and Conclusion

This paper has aimed to illuminate the negotiations around sharing and building knowledge in project teams in a higher education context where online learning resources are being developed. The focus in the research has been on naturally occurring discourse as the basis for negotiation. This kind of analysis is challenging as naturally occurring conversation is by its nature messy and all of the nuances of both
linguistic and non-linguistic communication cannot be easily captured, as well as the multimodal nature of interaction. The detailed linguistic analysis used in this paper has shown how the choice of subject foregrounds the interplay between what is being negotiated and those involved in the negotiation, the ideational and interpersonal meanings. In this way, participants’ roles and identities are linked to the kinds of knowledge they are negotiating.

Participants have shared knowledge differentially, each coming from their own discipline or professional perspective as well as their own topic areas of responsibility in the project. This kind of knowledge sharing can lead to knowledge building in the intersections of interdisciplinary space. One such space is the concept of the hypothesis and its explanation which involves the coming together of academic literacy knowledge and discipline knowledge in the ‘third space’ (Briguglio, 2014). In this example, knowledge is co-constructed, despite tensions, through complementary communication. Another example involves the visual presentation of the hierarchical classification of both knowledge and pedagogy in the diagram for the online module for writing the laboratory report introduction. The diagram captures the complexity of the learning design in an efficient way, and hence provides a model for further curriculum applications. The limit to knowledge building is illustrated in Exchanges 8 to 10 in Table 5.1, where quiz feedback is dependent on the negotiation of physiology knowledge about stimulus response in the sciatic nerve of a cane toad. Although the outcome of this discussion is important for the wording of the feedback, only discipline participants gain knowledge directly from this exchange. Others may gain indirectly from observing the interaction and how discipline concepts can be explained in a more accessible way.
Patterns of knowledge building tend to be circular, repetitive and cyclical as participants negotiate, dispute, and reach consensus. These complex patterns tend to be found in the central stages of meetings, especially those parts that focus on content rather than procedure, although content can be recycled into procedure. Despite the fluid nature of meeting negotiations and stages, participants are aware of the meeting genre and the need to complete the task through waves of topic opening and closing moves. The clearly identifiable stages of the meeting genre are the openings and closings and they vary in terms of formality. The spoken exchanges in this study have exemplified the importance of a knowledge negotiation as essentially a social process with an emphasis on collaboration to achieve consensus. Further research into the discourse of exchanges in the content focus of design meetings is necessary to reveal how knowledge building and sharing occurs and how this is facilitated by interpersonal communication.

The findings in this study are limited in terms of the small set of data which could be analysed in detail. Also, the composition of the team did not vary in terms of ethnicity, language background or gender and therefore the influences of these aspects on negotiation could not be explored. The researcher was embedded in the team and this could have influenced team behaviour. However, this was counteracted by the normal practice of regularly recording meetings. The researcher’s interpretations could also be perceived as less objective than an independent observer. Despite these limitations, this paper has highlighted aspects of knowledge negotiation across discipline and professional boundaries and the potential for knowledge building in these interactions. As interdisciplinary and interprofessional team projects become part of curricula, discipline staff will need to support students in developing strategies for successful knowledge negotiation. The contribution of this study has been to make
explicit some of the ways in which this can be achieved and importantly, awareness and use of these negotiation strategies can lead to improved team project outcomes.

5.10 Concluding comments to Chapter 5

This chapter, based on a published paper, has investigated the practices of the design team as they negotiate the process of designing the online learning materials for FLERT. The team’s interactions have been analysed using an SFL approach to conversational analysis to reveal key exchanges in the sharing and building of knowledge. These have been termed negotiating, disputing and explaining knowledge. Where there is debate about design, circular and repetitive patterns occur before consensus is reached. Collaboration is supported by the interpersonal meanings in exchanges. Stages in the design meeting have also been proposed. Opening and closing stages are more easily identified as is the movement from discussion about content topics to that of planning development procedures. However, the crucial stages where the design of the learning resources is being negotiated are more fluid and require further research with a larger corpus.

Chapter 6 continues the EDR story with a focus on the outcomes of design processes, the designed product.

Chapter references


CHAPTER 6

DESIGN PRODUCTS

6.1 Introduction to Chapter 6

This is the second of the published papers in this thesis, a chapter in an edited publication. However, this thesis chapter, although similar in many ways to the published version, represents an earlier version and a different presentation of the content. In terms of the narrative journey of the thesis within an EDR framework, this chapter analyses the designed products, the outcomes of design processes.

Chronologically, this chapter moves back in time to before the design of FLERT, as well as forwards to an expansion of the FLERT design to other disciplines in the Write reports in Science and Engineering website (WRiSE). It presents an analysis of the composition of the products of design over a nine-year period, specifically the online programs for supporting students in writing the laboratory reports genre in their disciplines. A multimodal analysis of the designed products is presented to illustrate the evolution of design over time. Student and staff evaluations of the programs are also discussed with particular reference to feedback on program design.

6.2 Publication


Note: this chapter is an earlier version of this publication and therefore differs from the published version.
6.3 Moving online to teach academic writing in science and engineering: theory and practice

6.4 Introduction

Our approach to teaching academic writing in science and engineering disciplines at undergraduate level has been informed by a Systemic Functional Linguistics (SFL) theory of language and genre-based literacy pedagogy. We have used this foundation to develop teaching materials and approaches to scaffold student understandings of the genre, discourse and grammar of discipline based writing tasks (Jones, 2004). Over a nine-year period, these materials and approaches have gradually been “redesigned” (Kress, 2003; New London Group, 2000) into interactive, multimodal, online learning modules, replacing face-to-face pedagogy with digital pedagogy (Drury, 2004; Mort & Drury, 2012).

SFL and genre pedagogy can inform the “redesign” of materials and approaches for teaching academic writing online. In addition, research in social semiotics and multimodal meaning making can contribute to the development of a digital pedagogy for academic writing. However, a key question is how students use online resources to create their own learning journey to develop successful discipline based writing, their own “personalised curricula” (Kress, 2003, 2007). In monitoring these journeys, designer/teachers (or “rhetors” (Kress, 2010, p. 26)) can further develop effective online curricula for academic writing.

Genre-based literacy pedagogy in the SFL tradition provides a rich classroom based model for developing students’ writing (Martin & Rose, 2008; Rose & Martin, 2012). The pedagogy moves through a cycle to build students’ knowledge of both the field (setting context, see Figure 6.1) and the genre. The cycle comprises genre deconstruction, joint construction and independent construction. The teacher uses
models of the genre to illustrate structure and language features before supporting students in their own writing process, whether in groups or independently. The nuanced scaffolding of knowledge by the teacher is described by Martin (1999, p. 135) as “guidance through interaction in the context of shared experience”. Through this process students themselves gain mastery of the genre and can further their fellow students’ understandings as well as critique or ‘play’ with the genre (Figure 6.1).

Figure 6.1 A genre-based teaching and learning model (Martin, 1999, p. 131)

This rich genre pedagogy has been developed in the school situation and has not been fully adapted to the university context, where arguably, an approach more appropriate to discipline practices and curricula is needed. Nevertheless, genre pedagogy has been used to apprentice students into the genres of their disciplines, most frequently through modelling and deconstruction of example discipline genres. Although we have moved from a face-to-face pedagogy to an online teaching and
learning environment, the purpose of our pedagogy has remained the same. As teacher-designers our pedagogical aim has been to develop students’ understandings and knowledge of the assessment genres in their field of study. The subject matter of our field, or our curriculum, is genres as the products of discipline practices, their purpose, structure and language. In terms of genre pedagogy, the constraints of embedding our teaching into discipline curricula have meant that our focus has been largely on the deconstruction phase of the pedagogy, in this case, the deconstruction of genres in science and engineering, in particular the report genre, a key genre in these disciplines. An online approach has been developed due to the challenge of embedding genre pedagogy in crowded science and engineering curricula and, in addition, to enable more students to access the resources and work through them at their own pace and according to their needs. However, science and engineering disciplines are noted for students who are reluctant to write and motivating such students to engage in learning must be taken into consideration in the design of an online learning environment (Skinner, Mort, Drury, Calvo, & Molina, 2012).

This chapter will explore the cycle of design and redesign over a nine-year period of a genre pedagogy for academic writing in science and engineering, focussing in particular on the laboratory report genre. The aim is to use a social semiotic framework based on the SFL tradition using both the metafunctional meaning making principles (Halliday, 1994) and the rhetorical principles of multimodal communication (Bezemer & Kress, 2008) as a way to explore the theory and practice behind the evolution of the design of a digital pedagogy. Design begins with the move from a face-to-face pedagogy through key iterations of an online pedagogy. Additionally, the role of learners in using and transforming the online resources for their own needs and in this way contributing to further design will be discussed.
6.5 The context of design

6.5.1 A design team and the cycle of design

Even before the advent of online learning environments, a collaborative team approach has been used to teach academic writing in the disciplines (Jones, 2004). In this approach discipline staff and language and learning specialists have worked together to design face-to-face teaching approaches and print-based materials. This team has expanded as teaching has moved online to include other experts such as elearning specialists, graphic designers and programmers. In addition, student and expert users have been included in the development of prototypes. Finally, end user feedback has also been incorporated into later designs. Although educational design proceeds in a linear way through time, it involves participants in a cycle of design, development, implementation and evaluation (McKenney & Reeves, 2012). In the development of an online pedagogy for science and engineering genres, teacher-designers (namely discipline staff and language and learning specialists) have collaborated with other team members to create the learning potential of the online programs (Figure 6.2). Clearly, the design of the learning potential is based on the extensive teaching experience of the teacher-designers who are aware of students’ problems in their writing of discipline genres both in terms of content and language. It is also important for teacher-designers to find out about students’ perceptions of their areas of difficulty by carrying out a needs analysis through interviews or formal or informal focus groups. This is also emphasized in the ‘setting context’ phase of genre pedagogy where teachers assess what students already know in order to build new knowledge. For example, second year students in physiology identified the introduction and discussion of a laboratory report as the most challenging where they have to integrate theory and the outcomes of the experiment:
connecting the theory in the intro. to the aim of the experiment and the theory in the discussion... we have to think more to write this [discussion], develop our own argument

This is echoed by teacher comments on students’ areas of difficulty:

*not clearly relating theory to results e.g. writing about mechanisms described in the textbook which are irrelevant as an explanation*

These kinds of interactions with students also allow for their suggestions for improving their learning to be incorporated into the design where feasible, for example, the above group of students suggested that good and bad text examples would help them to see what was expected as well as the activity of identifying problems with poor examples and remedying them.

The design process for science and engineering genres has involved the adaptation of genre theory and pedagogy to an online environment incorporating aspects of multimodal design within a social semiotic framework as well as the theory and practice of online learning. Both technology and funding have placed limitations on this process. However, only after student users have engaged with the program and transformed it for their learning, providing evaluative feedback on the design along the way, can their learning be assessed and aspects of the program redesigned to enhance further learning (Figure 6.2). In other words, as Kress emphasises, this is “a pedagogy which acknowledges and values the (semiotic) work of students and yet does not give up the importance of authoritative knowledge” (Kress, 2007, p. 37)
Figure 6.2 The cycle of design for learning

6.6 Design principles

The move from the classroom to an online medium involves significant redesign of pedagogic resources in terms of the learning materials and tasks and the contributions of participants in the learning situation. This “recontextualisation” of these resources from face-to-face to online is a “re-presentation” of the current materials, tasks and activities in a manner suited or “apt” for the new environment and enhanced by new affordances (Bezemer & Kress, 2008). A social semiotic approach within the SFL tradition can provide a basis for analysing and developing design. In this approach, the pedagogic resources available to teacher-designers can be categorized into three kinds of functions for making meanings, termed metafunctions, namely, ideational, interpersonal and textual. Briefly, ideational meanings comprise the content or subject matter of the site, interpersonal meanings the social relations
created through interaction with this content and textual meanings provide a unifying structure for the site. This metafunctional approach can be complemented by the four rhetorical/semiotic principles of multimodal communication provided by Bezemer and Kress (2008). These are the selection of the meaning making materials or modes, their arrangement, their foregrounding and the social relations they create. In this chapter, I am following Kress’s definition of mode as “a socially shaped and culturally given semiotic resource for making meaning. Image, writing, layout, music, gesture, speech, moving image, soundtrack and 3D objects are examples of modes used in representation and communication” (Kress, 2010, p. 79). In contrast, the term mode as used in the SFL ‘context of situation’ focuses on the role of language in “the channelling of communication” (Martin & Rose, 2008, p. 14). A multimodal approach “extend[s] the social interpretation of language and its meaning to the whole range of representational and communicational modes or semiotic resources for making meaning that are employed in a culture” (Jewitt, 2009, p. 1).

6.6.1 Re-presenting content

In general, the ideational content of our pedagogy whether face to face or online remains the same in terms of teaching materials and to some extent the teaching activities or tasks that the teacher sets students to undertake. As the New London Group (2000, p. 22) has suggested “Designing always involves the transformation of Available Designs ; it always involves making new use of old materials”. The written paper-based learning materials from the classroom context still remain in a written mode on screen and also retain some elements of their arrangement, sequence, layout and foregrounding, for example, the use of capitals and bold for the headings of each section of a laboratory report genre and within each section a sequence of explanations, examples and exercises in the areas of content, structure and language
(Drury, 1997). However, in transforming these materials from a page to a screen environment, new modal selections and modal combinations or ensembles have become available as well as the necessity of new modal arrangements for a screen environment.

Most at risk in moving genre pedagogy online are the metatextual meanings provided through the face to face communication of scaffolding. In this context, both teacher and students interact in spoken dialogue, accompanied by other modes of meaning making such as body language, gesture, movement, etc. and handwritten ‘notes/texts’ and illustrations, for example on a whiteboard, provided by both teacher and students. All these largely spoken meanings, for example, explanations, guidance and feedback, have now to be disseminated within different modes using the medium of the screen, the computer and the software available. This process termed “transduction” (Bezemer & Kress, 2008) impacts most on the spoken mode of scaffolding, a dynamically unfolding, nuanced mode which is transduced into a largely written mode on screen.

In an online environment, the screen becomes a unit for meaning making. This imposes constraints on what can be seen at any one time. The evolution of our screen design can be seen in the sample screens in Figures 6.3 to 6.5. Each presents an aspect of the deconstruction of a stage in a laboratory report. The earliest report writing program, (Figure 6.3), was developed using Authorware in 1999/2000 to support first year students writing a laboratory report in biology. A later program redesigned this using a template design based largely on Dreamweaver and this meant other programs for science and engineering report genres could also be offered online as shown in Figure 6.4, a screen from a 2004/5 program for a second-year short report in biochemistry. The latest program incorporated redesigns for all the previous report
writing programs and brought them together in one online site, WRiSE (Write reports in Science and Engineering) and a screen from one of the modules in this site is shown in Figure 6.5, a third year short scientific report in molecular biology designed in 2009 using HTML and Flash.

In all three figures, clearly the written mode has to be used to present the core ideational content, the structural stages and their functions of a section of a laboratory report. However, in Figure 6.3, the written mode is dominant whereas in Figure 6.5, the visual plays a much greater role in communicating this content. In all three figures, the written mode is combined with three other modes, namely layout, colour and to a lesser extent typography and these modal ensembles form the basis for the learning design. The modal arrangement or layout of the core ideational content occupies the most salient position in the centre of each screen. This layout is an abstract spatial representation of the analysis of a section of a laboratory report into its compositional stages, stages that are in numerical sequence, suggesting a linear unfolding in time as the report text is written and read. In this way, the figures are examples of the realisation of a “temporal analytical process” (Kress & Van Leeuwen, 2006, p. 94). Linear framing of the content is used to create unity and coherence, most strongly in Figure 6.3, where an orange coloured linear, rectangular frame separates the numbered stages and their functions from each other and a bolder orange line forming the top of the rectangle separates the stages from the introductory explanatory text block.
In contrast, in Figure 6.4, the discussion stages are framed primarily through using different colour saturation for each rectangular block of text, yellow for the explanation and instructions and orange for the stages with a weaker white linear frame between each stage, indicating the closer arrangement among them. However, a stronger black, vertical, linear frame separates the content from the menu items on the left-hand side of the screen and most importantly, a horizontal, linear frame, below the presentation of the stages, is used to indicate the place at the base of the screen for examples of each stage. This arrangement places the example, a “real” text below the abstract analysis of the stages of a typical text, the “ideal” that students are aiming for (Kress & Van Leeuwen, 2006). The layout potential is expanded in this way, but it depends on students activating hypertext links embedded in each stage. Then they can simultaneously view linked examples of each stage, a key aspect of scaffolding their understanding.
DISCUSSION: Structure

The staging of the discussion is not always straightforward and the order in which you sequence the information depends on the aim of the experiment and the kind of results you obtained. Your discussion is an argument about how you see your results. Use the questions in the Content section and the stages mentioned here to help you to develop your argument in a logical way. Remember that not all of the questions or the stages will be relevant to every experiment.

One guideline for staging the discussion is shown here based on extracts from the discussion in one of the cholesterol reports. Although this is a good guideline, remember it is only a guideline and you need to adapt it to each experiment you carry out.

Click on the stages to see an example.

Stage 1: Relate your results to the aims of the experiment.
Stage 2: Summarise your results (can combine with Stage 1).
Stage 3: Explain your results. Discuss the validity and accuracy of your results. Explain inconsistent or unexpected results.
Stage 4: Identify problems in experimental technique and suggest improvements (can combine with Stage 3).
Stage 5: State the significance or implications of your experimental findings and areas of future research.

Consumption of a high cholesterol diet did not significantly increase blood cholesterol concentration over a 12 week period (Figure 1). Similarly, over the same period, consumption of a low cholesterol diet did not significantly reduce plasma cholesterol concentration.

Figure 6.4 Screen from writing a short report in biochemistry showing the structural stages of the discussion section of a report

The arrangement of the stages of a discussion is dramatically different in Figure 6.5 as a visual mode takes precedence over a written mode. The stages are no longer listed in a numerically, strictly linear way within a rectangular frame. Rather they are grouped, each with its own coloured semi-rectangular frame, within an ‘hourglass’ frame, shaped to reflect the general to specific to general ideational meanings of the development of this section of a report. This framing comprised of a weightier grey line makes meaning in itself. The semi-linear grouping aims to show a more flexible, sequential development of the stages, namely some stages as fixed, typically in first and last position and some stages occupying more variable and recurrent positions. These repeated stages are indicated by the expansion of their semi-rectangular frame and their recurrent nature is further indicated using arrows as vectors (Kress & Van Leeuwen, 2006). This visual arrangement attempts to illustrate the complexity and circular nature of writing the stages in a discussion at this level in an undergraduate degree. Furthermore, the whole arrangement can be animated to show the dynamic,
unfolding nature of the text if the student chooses this option. Numbering of the stages is still retained on the left-hand side of the screen alongside a vertical arrow illustrating the temporal development of the text, as well as the movement from general to specific and back to general. Whether each stage is general or specific is revealed through rolling over hyperlinks in each stage, for example, the Explain results stage, a repeated stage, is linked on roll over to the number 4, a specific stage. Layout is expanded via pop-up windows which are activated through hyperlinks in each stage. These windows appear alongside their relevant stage and contain question prompts about the kind of information contained in each stage and an example text. (See Figure 6.5.) This design aims to mimic the face to face, step by step, scaffolding of the classroom through the progressive presentation of the core ideational content. However, students are free to skip these steps by activating the ‘Show all examples’ icon at the bottom of the screen. In this case, the whole text example appears on a subsequent screen together with its stages and their colour coding. In this design, linear framing is almost absent, although a weak dotted grey line, separates the introductory explanation text from the instructional text and the stages of the discussion.
The staging of the discussion is not always straightforward and the order in which you sequence the information depends on the aim of the experiment and the kind of results you obtained. Your discussion is an argument about how you see your results. If you have a number of results to discuss, the sequence of stages may need to be repeated for each result and it is helpful to give each sequence its own sub-heading. For this kind of discussion, you may need to begin with a more general stage that gives brief background information, reminding your reader of the aim of your experiment, the method employed, relevant previous history, or theory. In the same way, you will need a concluding stage to summarise the significance of the experiment as a whole.

One example of staging the Discussion is shown here based on an extract from a student report on the purification and analysis of plasmid DNA containing an insert of unknown size and orientation. When you have played the animation, click on the stages in the diagram to see which questions are answered in each stage and an example of that stage.

Note the movement from general to specific and back to general.

The main aim of this experiment was to use a combination of restriction digests of plasmids from both blue and white colonies, with subsequent agarose gel electrophoresis to determine the size and orientation of an unknown EcoRI insert from the bacteriophage λ genome (48.5 kb) in a pBluescript IISK + vector.

The λ fragment present in the white colonies has been identified as being 4878 bp in size and is inserted in orientation 2 (Fig. 4), with the two BamHI sites close together. A simple restriction map of the recombinant plasmid has also been derived (Fig. 5).

Figure 6.5: Screen from writing a short scientific paper in molecular biology showing the structural stages of the discussion section of a paper and the content in the pop-up window when students click on the Relate to aim stage.

The use of colour as a part of the modal ensemble for creating ideational
meanings increases over the various design iterations of the report writing programs. In Figure 6.3, the use of colour is minimal but nevertheless, the choice of red font for the numbered stages of the introduction foregrounds and adds salience to this list. Red font also clearly contrasts with the black pebbled background and the white font used to explain the function of each stage. In Figure 6.4, background colours are used to differentiate between the functions of each text block, a less saturated, pure yellow for the explanation and instruction text and a brighter orange to add salience to the stages and their functions. These text block colours contrast with the overall white background colour. Typography choices are also used to distinguish the explanation and instruction text in black font from the more salient, bold, black font emphasizing the stage numbers and a bold red font, their functions.

The choice of different colours for each stage of the discussion in Figure 6.5 contrasts strongly with the previous screen designs which used repetition of font colour to create cohesion among the stages and their functions. However, since these different pastel colours have a similar degree of saturation and purity, this creates cohesion among them (van Leeuwen, 2011). Furthermore, the choice of different colours can be said to emphasize the difference in function of each stage which is reinforced when the stage colour is used to link to the questions in the pop-up windows. In contrast, the arrow vectors in the diagram have the same function and therefore share the same colour. In Figures 6.4 and 6.5, the explanation text in written mode, distinguished from the instruction text in Figure 6.5 via font colour, creates related but different meanings from the presentation of the stages. In particular, the interaction of the written text and the largely visual display of the location of the stages in Figure 6.5 allows for the “multiplication” of meanings (Lemke, 1998; Unsworth & Cleirigh, 2009).
6.6.2 Organising content

A number of modes and modal ensembles have been selected to help users to understand how the website content is organised, how to navigate through the website and where they are in the website. The modal composition of banners, headings, subheadings, icons and menu items together aim to create coherence both within and across the different screens of the website. These modes, like all modes, convey ideational, interpersonal and textual meanings, but their predominant function is textual, in organizing site content as a meaningful whole.

The mode of colour plays a key role in foregrounding location and navigation information so that users can easily create their own learning pathways. Colour is once again used in an increasingly sophisticated manner from Figures 6.3 to 6.5. In Figure 6.3, different colours are combined in a seemingly arbitrary manner with typography, bold, upper or lower case, to create headings and sub-headings to signal the section of the laboratory report genre and within this section, the kind of content that is presented. In contrast, Figures 6.4 and 6.5 suggest a more motivated use of colour combined with typography as well as layout. In Figure 6.4, the same colour is used for headings and sub-headings but typography is used to distinguish between them, upper case to draw attention to the discussion section of the laboratory report genre and capitalized lower case to signal the specific content. Both are located at the top of the screen. In Figure 6.5 the affordances of one colour, green, are used in a more sophisticated way to create cohesion between the title of the laboratory report, the section in the report and the content in this section. Different green hues are not only used for headings and sub-headings but also as contrasting banner colours as background to the typography for these headings and sub-headings.
A menu is essential for helping users to understand the composition of a website and menu design is critical in supporting this. In each laboratory report program, the layout of the menu items comprises a vertical list on the left hand side of the screen, the position for locating “given” or ‘already known’ information (Kress & Van Leeuwen, 2006). In Figure 6.4, the main elements of this list foregrounded through bold typography make up the typical sections or generic stages of a laboratory report reinforcing the macro level structure of a report and its arrangement into parts. The lower levels in the menu hierarchy are clearly indicated through changes in typography, predominantly smaller font size and choice of bold/not bold (Figure 6.4). In the case of Figures 6.3 and 6.5, the menu items indicate the organisation of content within a section of a laboratory report, although students can access the higher levels of the hierarchy through the item ‘menu’ in Figure 6.3 and through a horizontal listing of other sections of the laboratory report at the base of the screen in Figure 6.5 (not shown in Figure 6.5). Icons such as arrows can be used on their own (Figure 6.3) or combined with colour and written labels (Figure 6.4) to create cohesion among screens within a laboratory report section and suggest to users that there is a meaning relationship among screens in a given section and that moving in a more linear way at this stage will increase understanding of the content. However, students need to know how many screens are involved and where they are up to. Screen numbering is used in Figure 6.3 although this is labelled as ‘Page’, an indication of how close this design was to the original paper-based materials. In Figure 6.5 a simple numbering system, together with the word ‘Next’ supports students’ linear movement through a section of the website (not shown in Figure 6.5).

A banner in Figures 6.4 and 6.5 is highly effective in unifying a website or a module in a website by creating a distinctive and coherent identity for the content.
which is repeated on each screen. These banners combine a number of modes, writing, image and colour. In both figures, the image for the banner is further used as the basis for creating cohesion through a unifying colour scheme for headings and subheadings and for menu items in Figure 6.4.

6.6.3 Creating social relations

Students are invited to engage in a more personal way with the content on the screen through a number of modal combinations. At the macro level of the whole online program, image and banner as seen in Figures 6.4 and 6.5 invite users to identify with their discipline and hence with the program. Images were chosen by discipline lecturers as symbolic of their discipline, the extract from Leonardo da Vinci’s notebook for the short report in biochemistry and the image of the structure of green fluorescent protein for the short scientific paper in molecular biology. These images are located at the top left-hand corner of the screen and are extended vertically in Figure 6.4 and horizontally in Figure 6.5 to form banners. Aspects of these images are repeated in the banner but the main form of extension is through different levels of colour saturation (van Leeuwen, 2011). Such image and colour laden banners aim to claim users attention so that they will be motivated to interact with the website content to develop their knowledge and understanding of communicating in the field.

The on screen written mode largely replaces the spoken classroom mode in providing explanations about the ideational content and guidance on how to interact with this. Although the relationship is still that of student and computer as teacher, students are addressed in a personal way using the pronoun ‘you’ in explanations while directives using the imperative form instruct students about how to interact with the ideational content. Directives are continued in the presentation of this content, the stages of the laboratory report across all 3 examples. However, when more detail about
each stage is progressively revealed through interaction with each stage as in Figure 6.5, the interrogative form is used as well as personal pronouns. This encourages students to interact by answering the questions posed as they relate to their own laboratory report. Then students can reveal an example of the stage by clicking on an icon. This sequential unfolding of content through the students’ interactions with the screen is used to scaffold understanding and is carried out in two interactions for each stage in Figure 6.4 compared with four in Figure 6.5. In addition, the use of colour in Figure 6.5 is a key mode both in connecting stages, with their associated questions and examples and in encouraging students to make this connection in their own understanding.

Exercises followed by feedback provide a further way for students to interact with the site and, as in the classroom situation, are a way for students to check their understanding of the content that has been presented, typically on earlier screens. However, students are free to choose whether to do the exercises or not as well as to bypass the scaffolded checking of their answers and merely reveal the answers. Advances in technology have enabled the number of screens devoted to exercises to be reduced. For example, if students clicked on the exercise icon in Figure 6.4, they would have then been offered ten exercises on subsequent screens either radio button or check box, with feedback appearing in the frame at the bottom of the screen. In contrast, in Figure 6.5, there is one radio button exercise, consisting of five questions on the same screen and feedback appears in a pop-up window adjacent to each question. Clearly, online exercises are limited, and, in the same way, feedback cannot anticipate and respond to all students’ problems or questions as in the classroom situation. However, online exercises allow for more examples of the genre or genre stage to be made available for students either as good or poor examples, where
feedback can identify why examples are inappropriate or how they can be improved. Also, if the online program is fully integrated into discipline curricula in a blended way, social relations around the content of the program can be built on as the following comment shows:

*The other day I had a normally unruly class of 2nd year Chem Eng. students enthralled in a cohesion exercise from the WRiSE site.*

### 6.7 User practice and evaluation: impact on design

#### 6.7.1 Cycles of design, use and evaluation

The success of a website design can only be gauged from how it is used and, in our context, whether learning has taken place as a result of user interactions with the website. Learners create their own pathways through the site to gain knowledge about how to write a laboratory report, typically while in the process of writing an assignment in their discipline. In other words they “fashion their own knowledge, from information supplied by the makers of the site” (Kress, 2005, p. 10) and “design[s] a coherent complex sign that corresponds to the needs that she or he has” (Kress, 2005, p. 18).

In the cycle of design and redesign, user evaluation and feedback are essential for improving design for learning. In all our design iterations, student users and our team of discipline and elearning staff, together with expert users have provided both input and feedback. Overall, our digital pedagogy has been positively evaluated by users from the very first design. Students have reported that different aspects of the programs, such as example texts, explanations, exercises etc. have improved their learning of laboratory report genres and this has also contributed to improved performance measured through assessment grades. Each design iteration has shown a trend of improved performance for student users compared with non-users with the
WRiSE site user report marks significantly higher than those of non-users \((t_{323}) = -2.96, p = .01\) (Drury, 2001; Drury, O'Carroll, & Langrish, 2006; Mort & Drury, 2012).

Ideally, students and expert users should be involved at the prototype stage of the design so that their insights can be included in the final version. However, this is not always easy to accomplish given development deadlines and the need to encourage and reward time-poor student volunteers. In addition, the development of effective research instruments to actually assess student learning from online environments as opposed to students’ perception of their learning is a challenge. Also, performance data on genre writing in the disciplines cannot be attributed solely to the intervention of an online program to support such writing. However, over the nine-year period of collecting questionnaire, focus group and performance data, in general, we can conclude that students who have used the programs have learned from the various iterations. Over this period, we have generally used similar questionnaires to provide data on the effectiveness of the design of the programs in such areas as user friendliness, screen layout, navigation, instructions etc. as well as student perceptions of their learning from different aspects of the program and their pathways through the program. Both quantitative and qualitative questionnaire data have been collected, complemented by focus groups. Pre- and post-tests using exercises from the programs have also been used as well as the collection of performance data on the genres students have been writing supported by the online resources (Drury, 2001; Drury & Muir, 2014; Drury et al., 2006).

Quantitative data for the iterations of the above programs have been reported extensively but qualitative data less so. This kind of data can provide more nuanced insights into the relationship between learning design and learning. Open-ended
comments on student and staff questionnaires as well as focus group and interview data will be discussed in two main areas, namely,

- learner engagement and learner pathways,
- perceptions of learning from design.

6.7.2 Learner engagement and learner pathways

It is clear that students will only use an online program for writing in their discipline area if it is relevant and realistic (Mort & Drury, 2012). This means that the pedagogical content, information, explanations, exercises etc. needs to be based on examples of authentic genres written by students. These can be used not only to exemplify the structure and language of a genre instance, but they also give some indication of expected levels of performance. From the beginning, we have consistently used authentic student writing to exemplify report structure and language as well as to provide content for exercises. This has led to high approval ratings even for the early website designs. For example, evaluation of the biology report writing program found that 80% of users (n = 40) rated the program highly for explanations and usefulness of exercises and feedback, as well as user friendliness, navigation and clarity of instructions (Drury, 2001).

Student comments not only refer to the usefulness of example reports but also reveal how the arrangement of the example with the analysis of its structure can aid learning:

*those examples or the example and then the structure next to it, I think was great*

*I tried to follow the content of the examples given i.e. what was written in what order*

Students have consistently asked for both more and complete example reports.
For example, evaluation of the chemical engineering laboratory report program using the template design illustrated in Figure 6.4 found that 66% of users (n=91) requested more example texts (Drury et al., 2006).

example reports were the most helpful to know what to put in

Including a ‘whole’ report has proved challenging due to the limitations of screen size and the fact that scrolling means that only part of the report is visible at any one time. However, learners not only want complete report examples but also the accompanying analysis in a more visual form:

full examples of reports and better structural layout and diagrams of differing forms of report as different subjects want different things in forms of report

a data base of text examples would be great

Although authentic reports help to engage students in the website, this content must also be aligned with the curriculum and in particular immediately relevant to the assessments students will be writing:

I think it might be the weighting of the paper [why students don’t use the website] It’s only 8%... your final exam is worth 7 or 8 times that

In addition students need to see that the website is fully integrated into their unit of study and an essential part of their curriculum validated by their discipline lecturers, not an optional extra (Skinner et al., 2012).

lecturer xxxx doesn’t stress it [the website] at all, he may offhandedly mention it but lecturer yyyyy is really behind it, he pushes a lot
A further incentive for students to use the website for learning about report writing is to bring together in one site both writing and discipline content. The WRiSE website does this by including modules on understanding discipline concepts or the specific discipline content for a report that students are writing:

_the list of suggested concepts for intro and discussion specific to the muscle prac [was most useful]_

Student pathways through the websites strongly indicate a needs-based approach. The preferred way of moving through each website iteration has been to move from screen to screen, scanning explanations and exercises and then choosing particular explanations and exercises to work through in detail (approximately 50% to 70% of survey samples). Smaller proportions of students reported moving in a linear way from screen to screen through a whole section, reading explanations, and doing exercises or checking their understanding through an entry quiz and then working through a section if they needed to. In addition, the most popular parts of the websites related to structuring sections of the report:

_I learned how to structure the report what types of information to put in the relevant sections._

Comments on using the language parts were not so frequent and possibly underused by native speakers of English:

_I now understand the tense requirement for the discussion sections better but still confused_

_Language is a turn-off but when you look through it’s really quite useful_
More insightful comments showing deeper learning were also infrequent:

*helped me to think more clearly and concisely about what a scientific report should be*

Although, in general, students used the website according to their needs, those with specific questions about report writing often did not find what they wanted on the website, in particular the websites represented by Figure 6.4. This view was also shared by discipline staff:

*It was hard to find information on legends search function would help*

*A lot of relevant, useful and important information is buried in examples and feedback – so it’s hard to find* (staff comment)

### 6.7.3 Perceptions of learning from design

Student comments can also reveal whether their learning is associated with particular aspects of the program designs. For example, comments related to the use of colour:

*Seeing those different colours is what helped me the most …*

*it had a sample introduction and then it highlighted each component of each part of the introduction that you needed, which was really good.*

Other comments are related to layout and the use of visual diagrams:

*the explanation beside each section on the discussion provides us with a clue about how the structure of the discussion should be*

*the diagrams of content of each section .. the flow diagrams and how much should be written*
while others refer to the content contained in the written mode:

*explanations of how to write introduction title discussion and conclusion*

*showing errors and giving examples that are good*

However, responses also highlighted the tensions involved in designing an online pedagogy for improving writing in science and engineering disciplines as listed below:

- balancing the amount of written text on screen (examples, explanations etc.) without
- reducing the complexity of the genres students are expected to write:

*hard to read text on screen, more diagrams and point form layout would help students to go through more quickly to find what they are looking for*

- finding a way to present a more generic approach to genre writing while at the same time keeping a discipline specific focus:
  *make a shorter more direct program*

- a section on frequently asked questions or misconceptions

- overcoming modularisation so that students can see how all the parts of a report fit together:
probably better to have all info for each section on one screen with an example at the bottom. A printable version would have also been useful

- choosing language features to focus on for success in the genre and teaching students an appropriate metalanguage to be able to use these features:

  *This analysis of information structure is too detailed for my students;*

- determining the level of detail, the richness of the site so that it is sufficiently comprehensive but not exhaustive:

  *So if there was a page that said an introduction must have this, this, this, this ... let’s have summary introduction page or something like that.*

These comments emphasize the importance of this kind of feedback for subsequent program design but also give some indication of the challenges for teacher/designers as they balance competing demands within contextual constraints.

**6.8 Conclusion**

As more teaching and learning moves online, it is essential to develop a principled approach to designing curricula in a medium which is very different from traditional, face-to-face classroom interactions but is inevitably influenced by these. Although the expectation is that students will develop their own online curricula, this does not mean they will ‘teach’ themselves. Rather, teacher-designers have an even greater responsibility to make explicit the content that needs to be learned through a conscious and informed choice among the available pedagogical resources, the multiple modes, for making meaning in an online environment. These decisions can be informed by principles developed in a social semiotic approach to meaning making
and, in the case of teaching academic writing, genre and genre pedagogy in the SFL tradition. However, as in the classroom situation where teachers can monitor whether learning is taking place and if so, how and why, in an online environment, it is also essential to close the loop and assess the how, why, when and where of learning. To do this effectively is not only a matter of collecting performance data, although this certainly is useful in itself, but a much more time and resource consuming exercise of data collection on learning from design. The development of more effective online learning environments for today’s diverse student population depends on this process.

Perhaps the last word should be left to one of our student informants.

_I think most students don’t realize how important [writing] is because it’s hard. I personally tried really hard ... not for the mark ... but I want to become a good engineer and to become a good engineer you need to learn how to write reports and that’s why I tried really hard... I like the solid foundations of how to write a report and I’ve never learnt properly how to do it ... I’ve started on a really long journey on how to write a report properly. And I don’t think it’s a waste of time. [WRISE] helped me._

6.9 Concluding comments to Chapter 6

The next two chapter, Chapters 7 and 8 continue the narrative journey of the EDR project and return to the FLERT program and its evaluation. Although Chapter 6 has provided some insights into evaluation, Chapters 7 and 8 provide the detail, Chapter 7 focusing on quantitative evaluation and Chapter 8 on qualitative.

Chapter references


CHAPTER 7

FLERT IMPLEMENTATION AND EVALUATION

7.1 Introduction to Chapter 7

This Chapter presents a jointly published paper on the evaluation of FLERT. The paper has been reformatted for inclusion in this thesis, but otherwise adheres to the original. This chapter and the next continue the thesis narrative into the implementation and evaluation phases of an EDR project, in this case the FLERT program. The focus in this chapter is on quantitative data analysis. However, since the chapter is based on a published paper, background introductory material is included. This means there is some repetition of the theoretical and pedagogical approaches presented earlier in Chapters 2, 3 and 6. This is the last of the published chapters in this thesis. Chapter 8 continues the narrative journey with the analysis of qualitative data.

7.2 Publication


7.3 Using an e-learning environment for developing science students' written communication: the case of writing laboratory reports in Physiology.

Abstract

The laboratory report is a core assessment task in undergraduate science curricula that challenges students to concisely report laboratory activities using appropriate, discipline-specific genre conventions as well as integrating readings into their writing. In a crowded curriculum with a diverse student population, an online
approach was developed to address supporting students in their writing in the discipline of physiology. A collaborative team comprising discipline staff, language and learning specialists and IT pedagogical designers came together to design, develop and implement the online report writing resource known as FLERT (Flexible Electronic Report writing Tool). FLERT is comprised of two interactive components: a literacy component and a discipline-specific component. Both are structured in a format similar to that of a laboratory report. While writing, students can move between report sections in FLERT as they perceive the need. This paper reports on the collaborative design and development approach of the team, the implementation process and evaluation of FLERT. Overall, users found both components of FLERT user-friendly and easy to navigate. Students rated the site strongly in terms of their increased understanding and confidence in report writing and content understanding. Students who used FLERT had significantly higher report marks than non-users.

7.4 Introduction

The expectation of employers and government is that science graduates will have developed high levels of written communication within their degree programs (Australian Government Department of Education Employment and Workplace Relations (DEEWR), 2011; Australian Learning and Teaching Council (ALTC), 2011; Business Council of Australia (BCA), 2011; Graduate Careers Australia, 2014). However, developing science students’ writing skills within their discipline context continues to present challenges. Science curricula are typically content rich with little time to address issues of developing students’ science writing alongside their increasing knowledge and understanding of content. Science discipline staff may also feel they are ill-equipped to support students in developing their writing skills or that this is not their role. Given the diverse educational and language backgrounds of incoming students, it is not surprising that many students struggle with writing and it is
clear that even English-speaking background students would benefit from interventions to support the development of their writing skills for science.

A key assessment genre across the undergraduate years is the laboratory report. Although new ways of communicating science are evolving both within university science curricula and in the professions (Australian Learning and Teaching Council (ALTC), 2011), the laboratory report remains a critical genre for students to master. Given the challenge of providing writing support in the face-to-face science curriculum outlined above, an online learning environment is a strategic way to develop students' report writing since they can access the learning resources in a flexible way according to their needs. Combining such an environment with resources to support students’ understanding of discipline content alongside the report genre used to communicate this content is a contextualised way of addressing writing issues. This approach means that students can access a comprehensive and relevant suite of resources, which enhance and make explicit their awareness of writing reports in their discipline. At the same time, the online resources can provide discipline staff with new opportunities for communicating with their students and support them in writing the laboratory report genre. The FLERT online learning environment has been developed to provide these online resources for second year students writing laboratory reports in physiology. This paper will report on the language theory and pedagogy which underpins the online writing resources, the collaborative approach to design and the implementation and evaluation processes and outcomes.

7.5 Teaching writing in the sciences: theory and practice

Teaching writing in the disciplines is informed by a wide range of research and practice in the area of ‘Writing to Learn’ and ‘Learning to Write’. The ‘Writing to learn’ approach is based on the belief that writing is a way of exploring how to know
and learn (Scardamalia & Bereiter, 2006). In this way, writers can engage in many kinds of writing activity, from personal to creative to discipline-based writing in order to gain a deeper understanding of disciplinary concepts and ways of thinking (Reynolds, Thaiss, Katkin, & Thompson, 2012; Rivard, 1994). This approach to writing emphasises the process of writing as a way of exploring ideas and developing thinking strategies and is often associated with the pedagogy of process writing and writing across the curriculum (WAC). In contrast, the ‘Learning to write’ approach emphasizes the contextual and purpose driven nature of writing and, in the university context, the discipline-based aspects of writing and is most often associated with writing in the disciplines pedagogy (Moskovitz & Kellogg, 2011). However, although a distinction is made between these approaches, in practice, both pedagogies are used to engage students in learning about disciplinary content and about writing processes and products (Keys, 1999; McLeod & Maimon, 2000; Thaiss, 2001). One of the most influential teaching approaches in the Learning to Write tradition is genre pedagogy. Genre pedagogy draws on theories of language in context where language choices create and achieve the goal of the genre (Johns, 2002). Traditions of research and practice in this area have developed in the fields of new rhetoric (Berkenkotter & Huckin, 1995; Miller, 1984), discourse analysis (Swales, 1990), academic literacies (Lea & Street, 1998) and systemic functional linguistics (SFL) (Martin & Rose, 2008).

Our approach to teaching writing in the sciences draws on the Sydney School of SFL and its associated genre based literacy pedagogy (Johns, 2002; Martin, 1999). This pedagogy brings together language and content as well as the process and product of writing in a particular genre in the discipline context. The teaching/learning cycle makes the genre explicit, first, through deconstruction of specific examples while at the same time building students’ field knowledge as well as their knowledge of
language. This phase is followed by scaffolded practice where students and teachers jointly construct a genre example before the final phase of independent construction. A final option is to take a critical approach to the genre and provide an alternative to achieve a similar disciplinary purpose (Figure 7.1).

![A genre-based teaching and learning model (Martin, 1999, p. 131)](image)

Figure 7.1 A genre-based teaching and learning model (Martin, 1999, p. 131)

A genre-based approach to teaching science writing apprentices students into the disciplinary practices and purposes associated with particular genres and genre sequences. It provides a developmental and scaffolded approach to support student writing (Zimbardi, Bugarcic, Colthorpe, Good, & Lluka, 2013). At the same time, the structure and language of scientific argument is made explicit in the context of a whole of genre approach through the use of relevant examples. Genre pedagogy has also been adapted to online learning environments for teaching science writing (Drury, 2004; Ellis, 2004)

### 7.6 The Design Approach

An effective curriculum, whether face-to-face or online, involves all stakeholders in the process of design. At Sydney University there have been long-
standing collaborations between discipline academics in science and engineering, and language and literacy specialists, in the integration of communication skills into curricula (Taylor & Drury, 2007). With developments in online pedagogy, these initiatives have resulted in online learning environments for teaching writing within science and engineering disciplines (Drury, O'Carroll, & Langrish, 2006). Such approaches are by their nature team-based where discipline staff, language and learning specialists, and e-learning and software specialists work together to design and develop online learning resources. The strength of this team-based approach is the different skills and knowledge that participants bring to their interactions in the design process. In this way, team members engaged in a ‘community of practice’ (Wenger, McDermott, & Snyder, 2002), learning collaboratively and sharing expertise to achieve the project outcome.

7.6.1 The FLERT program

The aim of FLERT was to support students in writing their laboratory reports in second year physiology by providing online resources to address both writing and discipline content. Discipline staff and physiology students had already identified the particular challenge of writing laboratory reports, especially introductions and discussions, and these concerns had been addressed to some extent in face-to-face tutorials and through the trial of a draft feedback cycle for report writing. When the opportunity arose to apply for e-learning support to develop an online approach, physiology staff and language and learning specialists submitted a joint proposal to develop a comprehensive and systematic set of resources to address writing and content issues in the area of report writing, which students could access according to their needs. From the outset, the design was driven by the need to address student needs, both in terms of writing and understanding content. FLERT brings together
learning materials for both report writing and understanding concepts in discipline content through the design of two core modules, ‘Help with Report Writing’ and ‘Help with Understanding Content’. To further reinforce the integration of writing and content through design, image and colour were used in a screen banner to represent the discipline of physiology throughout the site (Figure 7.2).

### 7.6.2 Developing the Help with Report Writing module
This module is designed around the typical sections of the laboratory report genre. In each section, the structure and language choices that fulfil the aims of that section are explained and exemplified, and students can check their understanding through exercises and feedback. Authentic student texts rather than lecturer models have been used for examples and exercises as these are the kinds of writing students can relate to and aim for. Lecturer commentary on the examples, which identifies their strengths and weaknesses, is included in the module. Each report section drafted by language and learning specialists went through a review by discipline specialists before redesign into an online format by the e-learning specialist. The redesign process enabled the properties provided by a computer-based medium of instruction to be used to highlight genre features. The use of visuals, colour and font together with animations and hyperlinks can scaffold students’ understandings of the structure and language of a particular laboratory report section (Figure 7.2).

The constraints of the computer screen meant that a complete laboratory report example could only be shown by scrolling, with the added disadvantage that the beginning of the report would disappear off screen as students moved through the report. To address this design issue and avoid scrolling, a separate ‘Overall Structure’ section was included to show how each part of the report contributes to the whole. In addition, each section begins with an entry quiz where students can check their current
understanding of writing the section and then decide on whether to continue or go to another section. Although information is presented in a linear, screen by screen way, moving from explanation to example to exercise, students can choose their own learning pathway through the site according to their needs.
Figure 7.2 Screen example from Help with Report Writing

This screen shot shows the Physiology image with the module banner and a hyperlinked example of the Relate to Aim stage of the discussion which appears alongside this stage when students click on this stage.
7.6.3 Developing the Help with Understanding Content module

This part of FLERT was designed to improve student understanding of the concepts and discipline content of laboratory activities and reports. Because the laboratory topics change during the second-year curriculum, this part of the site had to be based on a user-friendly software that discipline academics could learn to use so that they could easily change the module to align with the report students were currently writing. The software chosen, Question Tools (http://www.questiontools.org), enabled discipline staff to create interactive exercises to address content issues students were struggling with, particularly in the introduction, results and discussion sections (Figure 7.3).

![Figure 7.3 Screen example from Help with Understanding Content module](image-url)
The overarching questions addressed in this paper are:

i) do students improve their learning of report writing through the use of FLERT?

ii) what are students’ perceptions of their learning by the use of FLERT?; and

iii) how easy is it to use FLERT?

7.7 Methods for Trialling and Evaluation of FLERT

7.7.1 Participants

FLERT was progressively trialled and evaluated over 18 months at a large, research-focused university. During this period, second year Science students enrolled a physiology course self-selected to whether to use FLERT or not. This allowed for a comparison between users and non-users in the form of a quasi-experimental research design.

After its development, FLERT was trialled and evaluated over two semesters. Students in these semesters are referred to as Cohort 1 (Co1). Based on student and staff feedback, changes were made and then FLERT was integrated into the second-year physiology curriculum. At the time of its integration, a second evaluation was undertaken. Students participating in this evaluation are referred to as Cohort 2 (Co2).

Student participants were invited to take part in the project by completing questionnaires, pre- and post-tests focused on report writing skills, participating in focus groups, contributing to think-aloud protocols and allowing observation of their interaction with the program. In addition, students were asked for permission to have their report marks recorded and their interactions with the website tracked. Staff also completed formal surveys, as well as providing informal feedback. This paper reports
only on quantitative data from the student questionnaires, pre- and post-tests, report marks and website tracking.

7.7.2 Trial and Implementation of FLERT

The introduction of FLERT to students differed between the two cohorts. Co1 was introduced to FLERT by an explanation about the resource presented in class by their tutor. Co2 was introduced to FLERT through a hands-on introduction in a tutorial where they individually engaged with one of the online exercises. Initially when trialling FLERT at the beginning of the academic year, Co1 completed a questionnaire on their past writing experiences and, in particular, their difficulties with report writing. At the same time, they undertook a paper-based pre-test which was composed of the literacy component of FLERT. They then went on to write their first assessed lab report without the use of the FLERT. Later in semester, FLERT was made available to students before they wrote their second lab report. At this time, they undertook the post-test assessment focusing on the literacy component. After submission of their lab reports, students completed a questionnaire evaluating FLERT. Based on student feedback, changes were made and at the beginning of the following academic year, FLERT was made available to Co2 before their first assessed lab report. After their reports were submitted, these students completed an evaluation questionnaire. Lab report grades were collected from the two student cohorts. Tracking data for student use of FLERT was also recorded.

7.7.3 Instruments

Survey instruments consisted of questionnaires which included both closed and open-ended questions. These questionnaires were based on those developed and administered in previous years for evaluation of discipline based online programs for supporting lab report writing in science and engineering (Drury et al., 2006). In total, 5
questionnaires were administered, four to Co1 and the fifth to Co2. The aim of the first 3 questionnaires (Q1, Q2 and Q3) was to track student learning of report writing across the first semester which included writing without FLERT and after the introduction of FLERT. The fourth questionnaire was the focus of another research project and will not be reported here (Muir, Drury, & Carroll, 2007). The aim of the fifth questionnaire was to evaluate student use of FLERT after full implementation and completion of the project. (Note: in Chapter 4 and Chapter 8 and the Appendix of this thesis, the fifth questionnaire is referred to as Questionnaire 4.)

The first questionnaire (Q1), ‘Previous Writing Experience’ was a base-line, one-page survey, containing 3 sections; the first on students’ demographic backgrounds; the second on their writing history and the third on their self-evaluation of their written communication skills. The second questionnaire (Q2), ‘Writing the Nerve Report’, elicited information on students’ evaluation of their report writing skills.

The third questionnaire (Q3), ‘Writing the Cardiovascular (CV) Report’, a two-page survey, consisted of 5 sections. Only the first section, on students’ preparation for writing, applied to all students as well as a question on whether they had used FLERT and if not, why not. The last sections elicited information from student users of FLERT in terms of the parts of the program they used, how they moved through the program and their perceptions of learning from the program. There were 3 open-ended questions which asked students to comment on the program’s design. The fifth questionnaire (the fourth in this thesis) was administered to Co2, ‘Evaluation of the FLERT Online Program’, comprised 7 sections, 3 sections for all students to answer and four for those who had used FLERT. The first three sections elicited demographic data, data on writing history, preparation for writing the report and self-evaluation of
skills for report writing, as well as reasons for not using FLERT. These sections used many of the same questions as those in Q3 so that comparisons could be made across the cohorts. The questions for users of FLERT were broadly similar to those of Q3 and asked student to identify the parts of the program they had used, how they moved through the program and their perceptions of the influence on their learning of various aspects of the program. In addition, students were invited to comment further through answering 6 open ended questions as well as adding their own comments.

Pre- and post-tests based on the structure and language aspect of laboratory report writing had been used in past project evaluations. In this project, 5 questions, 2 multiple choice, 2 ‘Yes/No’ questions and one gap-filling exercise comprised the pre- and post-tests. These questions targeted the introduction, hypothesis, results and discussion sections of a report (Appendix 2). Software tracking was used to identify how many times students accessed FLERT and also the length of time on the program.

7.7.4 Data analysis

Data were analysed using descriptive statistical analysis, correlation, t-tests and chi-squared tests using SPSS. Values of p<0.05 were considered statistically significant.

7.8 Outcomes and Discussion

The analysis of quantitative student data will be reported and discussed under the following themes; student demographics and writing history, the characteristics and performance of student users versus non-users and finally the perceptions of and evaluations by users.
7.8.1 Student demographics and writing experience

Participants in the two cohorts were similar demographically and had similar tertiary writing experiences (Table 7.1). The majority of students (86%) in both cohorts were between 18 and 22 years of age. Most students spoke English as their first language. Other than English, the most frequent first language spoken was Chinese (nominated as Chinese, Mandarin or Cantonese).

In terms of their writing experience at university, most students in both cohorts had written summaries, short answers, lab reports and essays, with a slightly higher proportion of the second cohort having written essays (86%) as opposed to the first (72%). Similar proportions of students reported being quite confident or very confident in their writing (Table 7.1).

Table 7.1 Student demographics, writing history and self-reported confidence in writing.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Cohort 1 (n=205)</th>
<th>Cohort 2 (n=163)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>76% females 24% males</td>
<td>74% females 26% males</td>
</tr>
<tr>
<td>Spoke English as first language</td>
<td>68%</td>
<td>55%</td>
</tr>
<tr>
<td>Self-rated English fluency as a native/near native speaker</td>
<td>89%</td>
<td>80%</td>
</tr>
<tr>
<td>International students</td>
<td>11%</td>
<td>12%</td>
</tr>
<tr>
<td>Had written texts &gt; 9 pages</td>
<td>57%</td>
<td>55%</td>
</tr>
<tr>
<td>Confident or very confident in their writing ability</td>
<td>66%</td>
<td>68%</td>
</tr>
</tbody>
</table>

7.8.2 Students’ perceptions of their areas of difficulty in report writing

The outcomes from an earlier study of students’ perceptions of their areas of difficulty in report writing were used in the design process for FLERT (Muir & Drury, 2006), as well as data from the two questionnaires (Q1 and Q2) completed by Co1 before having access to FLERT. The areas identified by students as being most
difficult included comparing information from different sources, proposing further experiments, constructing logical arguments, interpreting results, writing hypotheses, writing/organizing introductions and discussions, writing conclusions and time management.

Not surprisingly, the main area which students found challenging relates to writing the discussion and conclusion sections of a report where they have to interpret results, develop an argument, link ideas in a logical way and incorporate information from multiple sources. These areas require a high order of critical thinking, science understanding and communication skills.

Data were collected via questionnaires completed in class. There were no significant differences for any of the parameters between the two cohorts.

7.8.3 The characteristics of student users versus non-users

In Co1, 63.9% of students used FLERT to prepare either their second or third laboratory report or both; while 59.5% of students in Co2 used FLERT. Although the introduction of FLERT to the two cohorts differed, it appears that this had little impact on student use. The reasons students provided for not using FLERT are summarised in Table 7.2.
Table 7.2 Students’ reasons for not using FLERT.

<table>
<thead>
<tr>
<th>Reason for non-use</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did not have time</td>
<td>29.5</td>
</tr>
<tr>
<td>Did not need it</td>
<td>27.4</td>
</tr>
<tr>
<td>Did not know about it</td>
<td>17.9</td>
</tr>
<tr>
<td>Used different resources</td>
<td>3.2</td>
</tr>
<tr>
<td>Technical difficulties</td>
<td>2.1</td>
</tr>
<tr>
<td>Forgot about FLERT</td>
<td>2.1</td>
</tr>
<tr>
<td>No reason</td>
<td>16.8</td>
</tr>
</tbody>
</table>

The total percentage of students from both cohorts that did not use FLERT was 39.4%. The two most common reasons given for not using FLERT were that students thought they did not have time to use FLERT (29.5%) and that they did not need FLERT (27.4%). Technical difficulties (2.1%) and simply not remembering the resource was available (2.1%) were the least common reasons noted.

For both cohorts, there was no difference between users and non-users in terms of gender and language background. With regard to writing history, in both cohorts users and non-users did not differ in terms of either the length or types of academic text they had written. However, for Co1, a composite score of the different types of texts produced indicated that on average, users had produced 3.24 (SD = 1.05, n = 131) different types of texts while non-users had produced 3.75 (SD = 1.33, n = 75). An independent samples t-test indicated that non-users had produced significantly more text types than users (t (123.21) = 2.85, p = 0.01).

On average, users in Co1 tended to be significantly less confident in their writing tasks (M = 2.42, SD = 0.64) than non-users (M = 2.11, SD = 0.58; t (135.08) = -3.34, p = 0.01) and rated themselves as less competent in writing skills (M = 2.58, SD
than non-users (M = 2.20, SD = 0.77); t (165.44) = -3.32, p = 0.01). None of these significant differences were observed between users and non-users in Co2.

In terms of students’ perceptions of their areas of difficulty in writing, non-users in Co1 rated themselves as significantly better in terms of understanding referencing principles, t (203) = -2.18, p < 0.05), selecting relevant information from readings, t (203) = -3.07, p < 0.01, constructing a logical and clear argument, t (203) = -3.07, p < 0.01, expressing relationships between different pieces of information in writing, t (201) = -2.76, p < 0.01) and using formal academic writing style, t (203) = -2.78, p < 0.01) and accurate sentence level grammar, t (203) = -2.78, p < 0.01). No significant differences were observed in Co2 between users and non-users in these parameters.

In Co2, there was a significant association between web site use and the number of written assignments produced in the previous year. Significantly more users had completed fewer assignments (0-3) in the previous year than non-users, χ² = 4.00, n = 25, p = 0.04.

Although there were no significant differences in language and demographic backgrounds, Co1 users tended to rate themselves as less confident and competent in their writing tasks and non-users tended to have had more writing experience. Since FLERT was created to be used by students according to their needs, the data suggest that, in fact, FLERT was successfully targeting students who may well have been less confident and less experienced in their writing.

### 7.8.4 The performance of student users versus non-users

Pre- and post-test data (Co1 only) indicated that the average score of participants increased from 25.12 (SD = 3.9) to 27.71 (SD = 3.8) from a total of 37. The number of students who participated in the pre-test was 178 compared to 72 who
undertook the post-test, 69 of whom had used FLERT. A paired-samples t-test showed that the difference between pre-test user scores (M = 25.44, SD = 3.853) and post-test user scores (M = 27.71, SD = 3.88) was significant, t (68) = -4.63, p = 0.0001.

With Co1, report marks were recorded on two occasions, before they had used FLERT (the Nerve report) and after using FLERT (the CV report). There was no significant difference in the average mark between users and non-users for either of the two reports. Tracking data showed a significant positive correlation between website hits and report marks, r = .22, n = 118, p < 0.05, suggesting that users who accessed the site more often had better report marks than those who had used it less often. Since we did not create categories for frequency of use, we do not know whether infrequent users obtained poorer report marks on average than non-users.

For Co2, comparisons were made between the report marks for users and non-users. Overall, those who used FLERT had a significantly higher report mark (M = 74.71, SD = 13.02) than non-users (M = 68.15, SD = 13.21), t (118) = 2.15, p = 0.03. Since FLERT was introduced to students early in the semester, before their first assignment, to some extent the difference in marks between users and non-users may be attributed to the FLERT intervention.

Approximately two thirds of users from both cohorts spent up to an hour per report on the website. Those from the Co2 spent more time and a chi-square test of independence indicated that there was an association between cohort and time spent, \( \chi^2 = 16.63, n = 144, p < 0.01 \). The implementation strategy for FLERT was different between the two cohorts with Co2 having engaged in class with the program while Co1 received an overview by their tutors. It may be the case that implementation strategy for Co2 was more effective than that used for the earlier cohort.

Overall, taking into account the combined data on performance and considering
that in general, those using FLERT in both cohorts tended to have less writing confidence and experience, it can be concluded that using FLERT had a positive impact on report marks.

### 7.8.5. User evaluations and perceptions of FLERT on learning

User preferred pathways through the website were either to move from screen to screen, scanning explanations and exercises and then choosing particular sections to work through in detail (49%) or to move from screen to screen through a whole section, reading explanations and doing exercises (37%). The most used sections of both the *Help with Report Writing* module and the *Help with Understanding Content* module by both cohorts were those relating to the introduction and discussion sections of the report. Students’ heavy use of these sections correlates with findings from an early study by the authors (Muir & Drury, 2006) where students identified these two report sections as being the most challenging to write.

Users in both cohorts were asked to evaluate the user-interface in the *Help with Report Writing* module and the *Help with Understanding Content* module by rating four statements, (working through the site was easy; the navigation buttons were easy to find; the instructions were easy to follow and the screen design was user friendly) using a Likert scale. Overall, users found both interfaces user-friendly and easy to navigate (Figure 7.4).
Figure 7.4 FLERT ease of use. Comparison of cohort ratings (mean ± SD) for ease of use of Help with Report Writing (A) and ease of use of Help with Understanding Content (B)

Likert scale: 1 = strongly agree, 5 = strongly disagree. Cohort 1: Blue Cohort 2: Red

Users were asked to evaluate the effect of the Help with Report Writing module on their understanding of the structure and language of report writing and confidence in report writing using a Likert scale. Although both cohorts rated the site strongly in terms of increased understanding and confidence, Co2 rating for confidence in understanding report structure was significantly more positive than Co1 (Figure 7.5).

Both cohorts rated the model student reports provided as the most helpful for understanding report structure, followed by diagrams (Co2 only) and animations. Exercises were rated higher in terms of understanding structure compared with
understanding report language. This pattern was repeated in terms of confidence where students indicated that the module had improved their confidence in understanding report structure more than report language.

Users were asked to evaluate the effect of the Help with Understanding Content module on their improved understanding of the concepts and content of the report they were writing and their confidence about the content in the report using a Likert scale. Once again, both cohorts rated the site strongly in terms of their increased understanding and confidence, with Co2 ratings tending to be more positive than Co1 (Figure 7.6). Co2 ratings were significantly different from Co1 in the areas of hypothesis writing, identifying independent and dependent variables and the helpfulness of feedback.

Overall the highest ratings were those relating to understanding the content for the introduction and features of the introduction such as identifying independent and
dependent variables and writing the hypothesis. Examples and exercises for understanding scientific concepts (Co1 only) and feedback on exercises were not rated as highly. The Co2 rating for understanding content for the discussion was not so highly rated as that for the introduction. Similar to confidence ratings for the Report Writing module, students’ ratings of their improved confidence were the lowest of all ratings. Overall students were strongly positive about their perceived learning from using FLERT with more than 50% of Co1 students and almost three quarters of Co2 students strongly agreeing or agreeing with the rating statements for improved understanding and confidence from using the Help with Report Writing module. Their perceived learning from the Help with Understanding Content module was also positive with substantially more than 50% of Co1 students and more than three quarters of Co2 students strongly agreeing or agreeing with the rating statements for improved understanding and confidence.

The examples and exercises helped me understand the scientific concepts
Feedback on exercises helped me to understand the correct answer
Helped me to identify the independent and dependent variables
Helped me to understand content necessary for the introduction
Helped me to understand content necessary for the discussion
I am now more confident about the content in the report
Helped me write the hypotheses

Figure 7.6 Comparison of cohort ratings (mean ± SD) of improved understanding of report writing content and confidence in report writing content for different aspects of the Help with Understanding Content module
Likert scale: 1 = strongly agree, 5 = strongly disagree. Cohort 1: Blue Cohort 2: Red
*p < 0.05.

The difference in ratings between the two cohorts may be attributed to the different implementation strategies for FLERT as noted earlier as well as teaching staff.
being more familiar and confident with using the tool in their teaching.

**Beyond FLERT**

FLERT was the prototype for an Australian Learning and Teaching Council cross-institutional project for the development of a report writing website for the sciences and engineering, the Write Reports in Science and Engineering (WRiSE) site. ([http://learningcentre.usyd.edu.au/wrise/](http://learningcentre.usyd.edu.au/wrise/) (Drury & Jones, 2009)).

**7.9 Conclusions**

The FLERT online learning environment has adapted a widely used and effective genre pedagogy to enhance the development of students’ written communication in terms of literacy and discipline understanding. The particular strength of this pedagogy is how it firmly embeds science communication, in this case laboratory report writing, within its discipline context. The data suggest that the use of FLERT contributed to improvements in student learning in the writing of laboratory reports in Physiology and the understanding of physiology concepts required for successful report writing. In addition, FLERT has for the most part been accessed by those students with less writing experience and confidence and has brought about improvements in their performance. Student users have not been differentiated from non-users in terms of language background or other demographic criteria. This suggests that FLERT is not perceived by students to be only for those students with English as an additional language unlike many writing programs. The results also indicate that the more students make use of the resource, the greater their improvement in performance marks. Students’ perceptions of their learning also strongly support the performance data and have indicated which aspects of FLERT they have found most helpful. In particular, report examples and diagrams were rated highly in the Help with Report Writing module while information on specific aspects of content such as independent and dependent variables and hypothesis writing were most highly rated in
the Help with Understanding Content module. The higher ratings and performance of
users in Co2 indicate that design and implementation aspects had been improved and
the effectiveness of the modules increased.

Acknowledgements
The authors gratefully acknowledge financial support from the office of the Deputy
Vice-Chancellor (Education), University of Sydney, through an eLearning Strategic
Development grant, Dr Miriam Frommer for discipline-specific content development
and project review, Natassia Goode for statistical analyses, Dr Janet Jones for language
and learning content design and development, Ms Gosia Mendrela and Helen Wozniak
for pedagogical IT design and development and the 2nd year physiology students for
their participation.

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CHAPTER 8

LEARNING FROM USERS: QUALITATIVE DATA

8.1 Introduction

As presented in Chapter 4, a multi- and mixed methods research design allows for both quantitative and qualitative data to be collected so that a more complete picture can be gained to answer the research questions posed. This Chapter presents an analysis of the qualitative data gained alongside the quantitative data and then proceeds to integrate the data strands. The overarching research question for this Chapter is whether student learning of report writing in physiology is enhanced by their interactions with the online program, FLERT and specifically, what aspects of the program design are most valued by students for their learning and how do these support their learning.

The program design can be viewed from a number of perspectives. Firstly, it consists of learning materials or content for report writing and for Physiology topics. Secondly, there is a pedagogy behind the choice of materials, their sequencing and the learning approaches they contain. In particular, the Teaching/Learning Cycle (TLC) genre pedagogy in the SFL tradition has been used to inform the report writing part of FLERT. Lastly, the learning materials and pedagogy are presented in an online medium, an interconnected series of screens where designers need to decide on aspects such as the navigation choices presented to users, the modes and the arrangement and combination of modes for content, interactivity and feedback. At the same time designers need to ensure that the program is coherent and there is cohesion among its parts. Bearing this in mind, the overall aim of this section is to analyse students’ experiences as they interact with the program to gain insight into how they make meaning from these different aspects of program design and apply this to their
8.2 Methodology and Methods

Qualitative data can be described and analysed from a number of theoretical perspectives. Most approaches draw on grounded theory where participants’ written or spoken responses, narratives, dialogues etc. are firstly analysed according to the language they use and then classified and ‘coded’ into more abstract themes or categories based on patterns identified in the data by the researcher. The researcher can approach the data inductively, with a focus on the words, phrases and ideas in the data, in order to develop general descriptions and explanations and make it possible to build theory. Or the researcher can approach the data deductively, such that research questions and/or a theoretical framework guide the thematic analysis, with the aim of confirming hypotheses or extending theory. In reality, many researchers use both approaches and move back and forth between a more abstract theoretical framework and the concrete data (Creswell & Plano Clark, 2011).

A related approach in the field of Applied Linguistics is discourse analysis. This approach applies linguistic tools in a systematic way to identify themes in the language of the data. The actual choice of words and grammatical structures and the relationships among them are investigated according to the particular discourse analysis method chosen. It is argued that following this method provides a more objective approach to the analysis and development of themes as it is supported by an underlying theory of how language is used in context. In this research, discourse analysis based on SFL is used, as described in Chapter 4.

A range of methods and procedures were used to collect the data in this study as illustrated in Chapter 4, Tables 4.1 and 4.2 and summarised in more detail in terms of qualitative data in Table 8.1. Note that Cohort 1 students were those taking part in Stage 2 of the research and involved in formative evaluation of FLERT whereas
Cohort 2 students, a new cohort, were those involved in Stage 3 who provided summative evaluation of FLERT as a completed website.

Table 8.1 Summary of qualitative methods, participants and data

<table>
<thead>
<tr>
<th>Method</th>
<th>Participants</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation of FLERT</td>
<td>Cohort 1 volunteers (n = 10 participants)</td>
<td>Field notes, transcripts of student audio recordings, student open-ended comments on questionnaires</td>
</tr>
<tr>
<td>trial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Focus group</td>
<td>Cohort 1 volunteers</td>
<td>Summary of focus group and discussion</td>
</tr>
<tr>
<td>Tutorial discussion</td>
<td>Cohort 1</td>
<td></td>
</tr>
<tr>
<td>Reflective recounts</td>
<td>Cohort 1 volunteers</td>
<td>Transcripts of audio recordings of students writing a lab report with the program</td>
</tr>
<tr>
<td>Questionnaires</td>
<td>Cohort 1 (n=33, 67% of users)</td>
<td>Responses to open-ended questions on FLERT</td>
</tr>
<tr>
<td>Questionnaires</td>
<td>Cohort 2 (n=63, 53% of users)</td>
<td>Responses to open-ended questions on FLERT</td>
</tr>
</tbody>
</table>

During Stage 2, the FLERT development phase, a one-off observation trial of one section of the modules was held with a small number of paired participants (Table 8.1). This trial was a structured event where participants followed instructions to access specific parts of the modules to carry out certain activities and while doing so recorded their interactions. The same group of participants contributed reflective recount data while preparing a report with the online program. They also contributed to focus groups during the implementation of the program. Tutorial discussions with groups of cohort 1 students were also held during this early implementation phase. Both cohort 1 and 2 students completed open-ended questions in questionnaires and this yielded the most data.

In the first part of this Chapter, 8.3, the open-ended questionnaire data is analysed. Then, in 8.4 and 8.5 the analysis of student interactions and reflective
recounts is presented to highlight how students engaged with FLERT while working through set parts of the program and while writing their laboratory report for assessment. Although focus group data and tutorial discussions were recorded and analysed, they are not discussed in this Chapter as they supported what is reported here and did not provide new insights. The Chapter concludes with an overview of outcomes from both quantitative and qualitative data analysis (8.6).

8.3 Qualitative data from questionnaires

Students who used FLERT in the first cohort provided qualitative data responding to three open-ended questions on the third questionnaire, *Writing the Cardiovascular (CV) report*. One of the questions asked for suggestions for design changes as this questionnaire was administered in Stage 2 of the project, the formative stage. Students from both cohorts were asked what they thought was most and least helpful about FLERT. Those in the second cohort were asked to explain whether using the FLERT modules had changed the way they wrote their report or what they put in the report and if so how and why. Further questions asked what FLERT had taught students about writing in Physiology and what they thought would help them improve their report writing.

8.3.1 Analysis of student comments: focus on learning materials

The open-ended written responses were initially analysed using an inductive approach to coding responses, followed by the identification of emerging categories as themes in the data. Combining the open-ended data from both cohorts, students responded to the questions, *What do you think is most helpful/least helpful in FLERT?* The content of students’ responses to the question about what was most helpful were primarily parts or aspects of the FLERT learning materials. Often responses consisted of the specific aspect as a single word or a short phrase such as:
examples; example section; the structure; content, other responses elaborated on what was specified, such as:

explanations of how to write introduction, title, discussion and conclusion

or stated why a particular part of the learning materials was chosen:

exercises that gave you an idea of what to put into each section of the report

Other less frequent comments were related to the pedagogical design, such as:

flexibility – you can choose whichever part you are not sure of and do it until you understand it fully;

how it guides you through the prac report;

the use of past reports students had written and lecturers’ comments

Evaluative comments were also less frequent as in fact the evaluation of most/least helpful was stated in the question itself. However some students, added comments such as I thought it was really good and helpful, or I basically found the whole of FLERT very useful, or moderately helpful.

A breakdown of feedback related to the aspects of the program identified by students as most helpful is shown in Table 8.2., (and also included as an example in Chapter 4, Table 4.4).
Table 8.2 Breakdown of student feedback on aspects of FLERT stated as most helpful

<table>
<thead>
<tr>
<th>Parts of FLERT (most helpful)</th>
<th>Cohort 1 (n=33)</th>
<th>Cohort 2 (n=63)</th>
<th>Example responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Help with understanding content</td>
<td>2</td>
<td>16</td>
<td>the list of suggested concepts for intro and discussion</td>
</tr>
<tr>
<td>Help with report writing</td>
<td>31</td>
<td>44</td>
<td>the report part</td>
</tr>
<tr>
<td>Examples</td>
<td>11</td>
<td>21</td>
<td>the example given for writing each section of the report</td>
</tr>
<tr>
<td>Explanations</td>
<td>3</td>
<td>8</td>
<td>explanations beside each section</td>
</tr>
<tr>
<td>Exercises</td>
<td>4</td>
<td>5</td>
<td>quiz exercises</td>
</tr>
<tr>
<td>Diagrams</td>
<td>2</td>
<td>2</td>
<td>the diagrams of content of each section</td>
</tr>
<tr>
<td>References</td>
<td></td>
<td>2</td>
<td>reference list example</td>
</tr>
<tr>
<td>Feedback</td>
<td>1</td>
<td></td>
<td>feedback on exercises</td>
</tr>
<tr>
<td>Structure/ Sections of report</td>
<td>10</td>
<td>16</td>
<td>what to include in each section</td>
</tr>
<tr>
<td>Language</td>
<td></td>
<td>3</td>
<td>tutorial about scientific language as opposed to the words you use in stories</td>
</tr>
</tbody>
</table>

In response to the question as to what was least helpful, responses also mentioned specific aspects or parts of the learning materials, although this was not such a dominant theme as in responses to the former question. Sometimes the response consisted of a word or phrase, for example:

- *scientific language*
- *introduction quizzes*

or an aspect followed by an evaluative reason:

- *animation annoying and time consuming*

Another related theme was what was missing from the learning materials:

- *specific details on how to label figures*

or what needed to be expanded:

- *more examples would be good*

Comments also identified characteristics of the design of the learning materials.
relating to their breadth and depth such as:

*it was too simple I knew everything it told me I needed more in-depth information*

or, in contrast,

*very detailed information;*

*it was very long. I didn’t have time to go through everything*

Problems with technical aspects and navigation design features were also identified, such as:

*the clicking and dragging didn’t work;*

*there are too many buttons, too many links within links;*

*not being able to print off an example*

Evaluative comments, both negative and positive, were a more frequent theme in these responses and although this question invited students to comment on what was least helpful, some students (n = 9, almost 20%) responded with comments such as, *none* or *nothing* or *can’t think of anything* or with positive comments, for example:

*I think it was all useful information*

*Can’t think of anything. I believe they were all great and helped me a lot.*

A breakdown of feedback related to the aspects of the program identified by students as least helpful is shown in Table 8.3.
Table 8.3 Breakdown of student feedback on aspects of FLERT stated as least helpful

<table>
<thead>
<tr>
<th>Parts of FLERT (least helpful)</th>
<th>Cohort 1 (n=18)</th>
<th>Cohort 2 (n=30)</th>
<th>Example responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buttons</td>
<td>3</td>
<td>1</td>
<td>the sliding button part was confusing ... having to flick between the texts and explanations</td>
</tr>
<tr>
<td>Links/Navigation</td>
<td>1</td>
<td>1</td>
<td>too many links within links</td>
</tr>
<tr>
<td>Technical problems</td>
<td>2</td>
<td>2</td>
<td>the Java takes up a lot of time for the computer to load</td>
</tr>
<tr>
<td>Facility for printing</td>
<td>1</td>
<td></td>
<td>not being able to print off an example</td>
</tr>
<tr>
<td>Size/Level of detail</td>
<td>6</td>
<td>3</td>
<td>1. very detailed information 2. may have gone on too long 3. more in depth information</td>
</tr>
<tr>
<td>Help with report writing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examples</td>
<td>2</td>
<td>4</td>
<td>student examples</td>
</tr>
<tr>
<td>Explanations</td>
<td>5</td>
<td>1</td>
<td>long winded explanations</td>
</tr>
<tr>
<td>Animations</td>
<td>1</td>
<td>1</td>
<td>animation annoying</td>
</tr>
<tr>
<td>Exercises</td>
<td>1</td>
<td>6</td>
<td>quizzes</td>
</tr>
<tr>
<td>Language</td>
<td>2</td>
<td>1</td>
<td>use of scientific language was not clearly stated</td>
</tr>
</tbody>
</table>

Comparing the two tables, many more responses identified helpful parts of the learning materials as opposed to unhelpful. Most comments were on parts of the Help with report writing module, although more comments were made on the Help with understanding content module by the second cohort, reflecting the fact that this part of the website was more developed for implementation for the second cohort. Both cohorts overwhelmingly identified the examples as the most helpful part of the Help with report writing module, followed by explanations and exercises. Additionally, it appears the advice and guidance on report structure was evaluated as more useful than that on language.

This initial analysis of student responses suggests that students have a clear understanding of the parts of the program in terms of the learning materials that make up the program and, to some extent, the ways in which these are presented. They
recognise that the pedagogy comprises examples, exercises and explanations about report structure and language and that these can be presented in diagrams or animations. A possible student ‘site map’ or learning map of the program is illustrated in Figure 8.1.

![Diagram of FLERT pedagogy](image)

**Figure 8.1 Students’ understandings of the composition of FLERT**

### 8.3.2 Analysis of student comments: focus on pedagogy

Although this initial coding of the responses has highlighted the main theme as aspects or parts of the learning materials that students valued the most, a more detailed linguistic analysis can provide information on the attributes of these which prompted the students’ responses. From a design point of view, this is crucial information as it can point to specific qualities of the learning materials which students found helpful and in some cases why this was helpful. An SFL linguistic analysis as described in Chapter 4 is a useful approach here as it can identify how the program parts or aspects students have chosen are modified or qualified and what extra meanings are conveyed. For example, the analysis can identify what in particular about the examples or
explanations was most helpful. The linguistic structure where program parts are named
is typically the nominal group or noun group where extra meanings are found both
before (Premodifier) and after (Postmodifier) the main noun (the Head noun), which is
usually the program part students have identified as most helpful. See for example
Table 8.4.

Table 8.4 Structure of the nominal group with examples of student comments

<table>
<thead>
<tr>
<th>Premodifier</th>
<th>Head noun</th>
<th>Postmodifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>The student</td>
<td>examples</td>
<td></td>
</tr>
<tr>
<td>Words</td>
<td></td>
<td>that should be included</td>
</tr>
</tbody>
</table>

Focussing first of all on the premodifiers, the structures which occur before the
Head noun, these are typically adjectives that assign classification or evaluative
meanings. Classification examples (underlined) identified which module, section or
part of the website, students found most helpful, the cardiovascular module, report
section, content section. Additionally, students specified the kind, type or category of
the learning materials which they found most helpful, such as, the student examples,
correct examples, report examples; or the entry quizzes; or the lecturer feedback; or
step by step instructions or the flow diagrams. The majority of these descriptors before
the head noun have a classifying function, there are very few evaluative meanings, just
two examples in the data (underlined) detailed instructions; pretty clear explanations.

The postmodifying qualifying structures that are found after the Head noun
occur more frequently in the data and comprise prepositional phrases or defining
relative clauses or a combination of these qualifying structures (Table 8.5).
Table 8.5 Examples of student comments with post modifying structures

<table>
<thead>
<tr>
<th>Head noun</th>
<th>Post modifier</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prepositional phrase</td>
</tr>
<tr>
<td>explanation</td>
<td>of each section</td>
</tr>
<tr>
<td>past reports</td>
<td>[that] students had written</td>
</tr>
<tr>
<td>exercises</td>
<td>that gave you an idea of what to put into each section of the report</td>
</tr>
</tbody>
</table>

Post modifying structures convey three kinds of meanings, namely:

- more specific details which make up the content of the part of the program mentioned,
- its location
- or its purpose.

Most of the prepositional phrases provide more specific details about the part or aspect of the program, typically beginning with the prepositions, ‘of’, ‘on’ and ‘about’ where ‘of’ is the most frequently used preposition. Examples include the following: (post modifier is underlined in all examples)

- explanation of each section
- examples of what to include in sections of the report
- diagrams of content of each section
- the tutorial about scientific language
- the sample paragraph on each section
- instructions on how to write it
More useful in terms of design are those prepositional phrases which provide information on location beginning with ‘beside, ‘in’ or ‘with’. These indicate what was useful in terms of the juxtaposition of information. Examples include:

- *step by step instructions with pointers*
- *the explanation beside each section of the discussion*
- *example reports with the suggested improvements from lecturers/tutors*
- *the examples in the different sections*

There are fewer examples of prepositional phrases of purpose which identify how students used a particular part or aspect of the program. All of these begin with ‘for’. Examples include:

- *the example for writing each section of the report*
- *the list of suggested concepts for intro and discussion specific to the muscle prac*

Other qualifier structures, namely defining relative clauses, provide similar information, such as specific details, *examples that are good, words that should be included, past reports [that] students had written*

Often a combination of qualifying structures provides the most information, and particularly useful information about the design and why students found certain aspects helpful. Examples include:

- *explanations accompanying the examples pointing out what was correct and wrong*
- *exercises that gave you an idea of what to put into each section of the report*
Another way in which students provided relevant design information in their feedback is when they used a clause structure, often beginning with a ‘wh’ word or a present participle to describe a particular part of the program instead of simply naming a part. By using these structures, students can include more details about what they thought was most helpful and why. For example:

what to include in each section [was most helpful]

which points to include in intro (background info) and discussion [was most helpful]

how much should be written [was most helpful]

what and what not to include in the report [was most helpful]

how it guides you through the prac report [was most helpful]

which things to put in which particular section of the report

In terms of what was least helpful, further information on program parts or aspects was not provided. This was unfortunate from a teacher-designer perspective as without specific details, issues could not be addressed. In the few cases where further information was provided, students specified what the problem was, for example:

the clicking and dragging into sentences didn’t work

Students also showed their awareness of design constraints:

all the buttons and long winded explanations but I guess that can’t be helped

This more detailed analysis shows that students recognise the attributes of the learning materials, such as, the fact that the examples are student examples but also the pedagogy behind these materials. Genre pedagogy in the FLERT Help with Report Writing module focuses on the deconstruction of the genre of the laboratory report in Physiology using authentic, discipline-based, student text examples. Deconstruction of
these text examples makes explicit the structure and language of the genre and shows how it achieves its purpose in the discipline context. Students construct their knowledge of the genre through their interactions with the ‘computer as teacher’. This could be in interpreted as a kind of ‘joint construction’. Strictly speaking, in genre pedagogy in the face-to-face context, joint construction refers to the practice of the teacher and students co-constructing a written text after students have gained a thorough knowledge of the genre in the deconstruction stage. In the development of FLERT, this practice was not attempted online although other projects have attempted to do so. (See Chapter 3 for a more detailed discussion of the stages of the teaching learning cycle (TLC) for genre pedagogy in the SFL tradition including online joint construction.) The final stage of genre pedagogy is independent construction, where students write their own report, an assessment task, alongside FLERT. Examples of students’ perceptions of genre pedagogy are shown in Table 8.6. More insights which students provide on the final stage, independent construction, are discussed later in this Chapter in the analysis of interactional data and reflective recounts.
### Table 8.6 Student comments illustrating awareness of the laboratory report genre

<table>
<thead>
<tr>
<th>Genres pedagogy</th>
<th>FLERT design</th>
<th>Example student comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deconstruction</td>
<td>Building field</td>
<td>providing clear guidelines to report writing in Physiology</td>
</tr>
<tr>
<td>Modelling the genre</td>
<td>• Authentic student reports as examples with lecturer feedback</td>
<td>the use of past reports students had written and lecturer’s comments</td>
</tr>
<tr>
<td></td>
<td>• Generic structure exemplified</td>
<td>assessing example reports to work out what belongs in a section of a report and in what sequence</td>
</tr>
<tr>
<td></td>
<td>• Discourse and language features exemplified</td>
<td>now I know that certain tenses should be used in the discussion and other tenses aren’t</td>
</tr>
<tr>
<td></td>
<td>• Metalanguage introduced and exemplified</td>
<td>how a proper report should flow from section to section and within sections from paragraph to paragraph</td>
</tr>
<tr>
<td>Joint construction</td>
<td>• Scaffolding through interaction</td>
<td>step by step instructions with pointers</td>
</tr>
<tr>
<td></td>
<td>• Feedback on exercises</td>
<td>the quizzes keep you on the right track</td>
</tr>
</tbody>
</table>

#### 8.3.3 Analysis of student comments: focus on learning experience

In their responses, students express meanings about how they experienced FLERT, how they engaged with it or how FLERT prompted them to engage. From a linguistic perspective, the process or the ‘verb’ in traditional grammar terms, is the core meaning of their experience and other meanings, such as the participants in the process or the circumstances surrounding it are attached to this core meaning. Using an SFL approach to the analysis of process types allows for a more nuanced analysis of meanings where the process is not simply seen as an action or ‘doing’ word. An SFL
process analysis (or transitivity analysis), divides processes into those of doing and happening (material processes), those of sensing (mental processes), those of being or having (relational processes) or those of saying, expressing, (verbal processes). Typically, an SFL process analysis only considers finite processes, that is, those that are limited by subject and tense or modality, for example: FLERT reinforced my understanding. However, since many of the responses consist of non-finite processes, in order to capture the full intent of the impact of FLERT, processes in the grammatical form of present or past participles or infinitives are also included in this analysis.

Processes ascribed to FLERT and what FLERT does or says suggest that students perceive FLERT as acting on their learning, for example, in terms of processes of ‘giving’ or ‘providing’ but also ‘telling’ or ‘pointing out’. For instance:

giving examples that are good

providing clear guidelines to report writing

the diagrams pointing out what should be included

In most examples, FLERT, the participant or ‘actor’ that brings about the process, is omitted completely or elided from the response or, if present, referred to with the pronoun ‘it’. In addition, the student, the person benefiting from these processes is also left unstated. However, in some examples, FLERT is given a much stronger role as a causative external agent that initiates or brings about changes in students’ behaviour as in the following examples:

[FLERT] made you actively read concepts

[FLERT] reinforced my understanding = (FLERT made me understand better)

it [FLERT] keeps you on the right track
Further examination of how students experienced FLERT, especially in terms of the changes they made in their report based on their use of the program is provided by the responses of the second cohort to a two part question. The first part asked whether they had made changes to how they wrote their report or what they put in their report if they used the modules. The second part asked students to explain how and why they had made changes, if they had done so. A summary of the number and kind of response is provided in Table 8.7. It is clear that students made the most changes based on their interactions with the Help with Understanding Content module. To some extent this is is be expected, since the experimental background and content would be new to them whereas they would already have some knowledge and experience of report writing as second year undergraduate students. Nevertheless a majority of students did make changes of some kind to their report based on the Help with Report Writing module.

Table 8.7 Responses to the question on whether students had made changes to parts of their report based on their interactions with FLERT

<table>
<thead>
<tr>
<th>Responses</th>
<th>YES (%) Changes made</th>
<th>NO (%) Changes not made</th>
<th>Qualified response (%) (e.g. slightly)</th>
<th>Qualified response (%) (e.g. not really)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Help with Report Writing</td>
<td>50</td>
<td>18</td>
<td>25</td>
<td>7</td>
</tr>
<tr>
<td>(n= 56)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Help with Report Content</td>
<td>80</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(n=47)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In examining the content of affirmative responses, three aspects are important, firstly, who or what is making changes, secondly, the processes used in making changes and thirdly what was changed. Most students identified themselves as the participant carrying out the changes, although this was not included in many responses (Help with Report Writing n = 40 (22 elided or ommitted) Help with Understanding Content n = 21 (10 elided or ommitted). As expected, most of the processes students
used to describe the changes they made are material or ‘doing’ processes rather than mental ‘knowing/sensing’ processes or relational ‘having or being’ processes or verbal ‘saying’ processes. A summary of examples of student comments is provided in Table 8.8.

Table 8.8 Examples of the process types students used to describe the changes they made to their laboratory report after interacting with FLERT

<table>
<thead>
<tr>
<th>Who</th>
<th>Process (material)</th>
<th>What</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>adjusted tense</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>changed the tenses of words in certain sections</td>
<td></td>
</tr>
<tr>
<td>[I]</td>
<td>followed instructions</td>
<td></td>
</tr>
<tr>
<td>[I]</td>
<td>included dependent and independent variables</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>changed the title of my report to be descriptive</td>
<td></td>
</tr>
<tr>
<td>[I]</td>
<td>took note of the concepts to be included in each section</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Who</th>
<th>Process (mental)</th>
<th>What</th>
</tr>
</thead>
<tbody>
<tr>
<td>[I]</td>
<td>knew which irrelevant information to remove</td>
<td></td>
</tr>
<tr>
<td>[I]</td>
<td>knew which parts went into which area of the report</td>
<td></td>
</tr>
<tr>
<td>[I]</td>
<td>understand Physiology’s rule on report writing</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>understand more what to put in each section</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Who</th>
<th>Process (relational)</th>
<th>What</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>had a better idea of what to write</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Who</th>
<th>Process (verbal)</th>
<th>What</th>
</tr>
</thead>
<tbody>
<tr>
<td>We</td>
<td>had to talk about both passive and active force</td>
<td></td>
</tr>
</tbody>
</table>

These examples illustrate that students’ material processes motivated by FLERT are commonly about making changes or following program guidelines; mental and relational processes about their increased knowledge or understanding and verbal
processes about what they needed to ‘talk’ about or actually write. Their changes cover both discipline content (dependent and independent variables) and changes to their report writing both at the level of structure (parts went into which area of the report) and language (the tenses of words in certain sections).

Students also made the program, or parts of the program, the participant in bringing about changes they made (Help with Report Writing = 9, (18%) (3 elided or omitted) and Help with Understanding Content = 10 (47%) (1 elided or omitted) (Table 8.9).
Table 8.9 Examples of how students perceived FLERT acted on their learning

<table>
<thead>
<tr>
<th>What</th>
<th>Process</th>
<th>Who</th>
<th>What</th>
</tr>
</thead>
<tbody>
<tr>
<td>[it]</td>
<td>just reinforced</td>
<td>me</td>
<td>ideas I had in mind</td>
</tr>
<tr>
<td>[it]</td>
<td>just made</td>
<td>me</td>
<td>more confident</td>
</tr>
<tr>
<td>[it]</td>
<td>helped [format]</td>
<td>me [format]</td>
<td>it</td>
</tr>
<tr>
<td>it</td>
<td>gave</td>
<td>me</td>
<td>ideas to write my report</td>
</tr>
<tr>
<td>it</td>
<td>made [discover]</td>
<td>me [discover]</td>
<td>the mistakes I usually make in previous reports</td>
</tr>
<tr>
<td>it</td>
<td>clarifies</td>
<td>me</td>
<td>the info I already know</td>
</tr>
<tr>
<td>it</td>
<td>helped [order]</td>
<td>me [order]</td>
<td>the progression of ideas and concepts in my report</td>
</tr>
<tr>
<td>it</td>
<td>gave/provided</td>
<td>me</td>
<td>what to write and include</td>
</tr>
<tr>
<td>[it]</td>
<td>gave</td>
<td>me</td>
<td>more direction in the specific areas I was expected to discuss</td>
</tr>
<tr>
<td>it</td>
<td>clarified</td>
<td>me</td>
<td>the concepts to include in the introduction and discussion section</td>
</tr>
<tr>
<td>this section [understanding content]</td>
<td>broke down</td>
<td>me</td>
<td>the quite daunting report into much smaller subsections that I could focus on</td>
</tr>
<tr>
<td>report content</td>
<td>made [select]</td>
<td>me [select]</td>
<td>the most relevant information</td>
</tr>
<tr>
<td>it</td>
<td>helped [to decide]</td>
<td>me [to decide]</td>
<td>on format and how little/much detail to put in</td>
</tr>
<tr>
<td>it</td>
<td>helped [organise]</td>
<td>me [to organise]</td>
<td>my report making it succinct</td>
</tr>
</tbody>
</table>

In these student responses, FLERT is the causitive agent directly influencing students’ behaviour to make changes in their report writing. These comments indicate that students experience FLERT as a ‘teacher’ with processes that are typically associated with teacher behaviour, such as: guiding, helping, clarifying, providing models, guidelines and instructions. FLERT is the external agent and its suite of explanations, example texts and interactive exercises prompt students to make changes.
in their writing. This is strong evidence of the power of a computer program to effect change in student behaviour, in this case, to develop students’ knowledge about writing a laboratory report for a particular discipline experiment and to support students in making changes in their writing based on their increased understanding of the laboratory report genre. Student engagement with FLERT had a direct impact on their writing process. However, this does not mean that students interacted with FLERT without reflection. This is revealed in their recorded conversations while interacting with the program and their reflective recounts.

8.4 Qualitative data from student interactions with FLERT

Student conversations while interacting with the program were recorded during the observational trial, the formative stage of the FLERT project, Stage 2. Students interacted with a prototype version of the program, typically in pairs under laboratory conditions and followed set tasks. Their conversations were recorded while carrying out these tasks. An example of one of these interactions is included (Extract 8.1). This illustrates how students reflect on FLERT in a critical way and relate the advice on the structural stages of a discussion to the actual discipline content. Students are aware of the tension between the rhetorical purpose and topic during the writing process. Part of the screen students are commenting on is shown in Figure 8.2. Extract 8.1 is analysed as an exchange using the SFL speech function or move system network illustrated in Chapter 5.
Figure 8.2 Screenshot of the typical genre structural stages (schematic structure) in an example discussion stage of a Physiology report
Extract 8.1 Exchange analysis of dialogue between student A and student B concerning the structural stages illustrated in Figure 8.2 (negative evaluations of FLERT in red; positive in blue)

<table>
<thead>
<tr>
<th>Speech/Move Function</th>
<th>Turn/Move</th>
<th>Speaker</th>
<th>Talk</th>
<th>Subject</th>
<th>Finite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand fact</td>
<td>1</td>
<td>B</td>
<td>what’s this thing, the whole cycle?</td>
<td>this thing ‘s</td>
<td></td>
</tr>
<tr>
<td>Respond</td>
<td>2a</td>
<td>A</td>
<td>you have to explain your results</td>
<td>you have to</td>
<td></td>
</tr>
<tr>
<td>Extend</td>
<td>2b</td>
<td></td>
<td>//and discuss the limitations of each result that you explain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enhance</td>
<td>2c</td>
<td></td>
<td>//that’s what I found ...</td>
<td>that ‘s</td>
<td></td>
</tr>
<tr>
<td>Confirm</td>
<td>3a-e</td>
<td>B</td>
<td>explain results// refer to the theory //discuss the limitations, // support hypothesis //and go back to each result,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back channel</td>
<td>4</td>
<td>A</td>
<td>yeh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check</td>
<td>5</td>
<td>B</td>
<td>really</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Give opinion</td>
<td>6a</td>
<td>A</td>
<td>the thing I found hard about the cardiovascular lab report we just did was because everything was all interconnected,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enhance</td>
<td>6b</td>
<td></td>
<td>// so you couldn’t just explain one set of results</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back channel</td>
<td>7</td>
<td>B</td>
<td>yeh</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Give fact</td>
<td>8</td>
<td>A</td>
<td>you had to explain everything in one go</td>
<td>you had to</td>
<td></td>
</tr>
<tr>
<td>Counter/Give opinion</td>
<td>9a</td>
<td>B</td>
<td>I find a lot of people, in my group in pharmacology for instance</td>
<td>I find</td>
<td></td>
</tr>
<tr>
<td>Extend</td>
<td>9b</td>
<td></td>
<td>// they didn’t really know this...</td>
<td>they didn’t</td>
<td></td>
</tr>
<tr>
<td>Counter</td>
<td>10</td>
<td>A</td>
<td>yeh see I don’t know ===</td>
<td>I don’t</td>
<td></td>
</tr>
<tr>
<td>Enhance</td>
<td>9c</td>
<td>B</td>
<td>//that’s actually quite good, the whole cycle thing.</td>
<td>that ‘s</td>
<td></td>
</tr>
<tr>
<td>Elaborate</td>
<td>9d</td>
<td></td>
<td>a lot of people don’t get that</td>
<td>a lot of... don’t</td>
<td></td>
</tr>
<tr>
<td>Challenge</td>
<td>11a</td>
<td>A</td>
<td>except the cycle doesn’t work</td>
<td>the cycle doesn’t</td>
<td></td>
</tr>
<tr>
<td>Enhance</td>
<td>11b</td>
<td></td>
<td>// if you’ve got something that is so interconnected</td>
<td>you ‘ve</td>
<td></td>
</tr>
<tr>
<td>Demand fact</td>
<td>12</td>
<td>B</td>
<td>which part of the assignment?</td>
<td>{it} {is}</td>
<td></td>
</tr>
<tr>
<td>Respond</td>
<td>13a</td>
<td>A</td>
<td>you had to talk about heart rate and stroke volume and the factors influencing it ...</td>
<td>you had to</td>
<td></td>
</tr>
<tr>
<td>Elaborate</td>
<td>13b</td>
<td></td>
<td>// so when you go to talk about why the heart rate and the stroke volume changes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enhance</td>
<td>13c</td>
<td></td>
<td>//they’re all interconnected</td>
<td>they ‘re</td>
<td></td>
</tr>
<tr>
<td>Counter</td>
<td>14a</td>
<td>B</td>
<td>yeh I don’t know ===</td>
<td>I don’t</td>
<td></td>
</tr>
<tr>
<td>Elaborate</td>
<td>14b-c</td>
<td></td>
<td>// it’s just ...yeh // that would help a lot of people</td>
<td>it ‘s that would</td>
<td></td>
</tr>
<tr>
<td>Elaborate</td>
<td>14d</td>
<td></td>
<td>// I do that already</td>
<td>I do</td>
<td></td>
</tr>
<tr>
<td>Elaborate</td>
<td>14e</td>
<td></td>
<td>//but I mean ...</td>
<td>I mean</td>
<td></td>
</tr>
<tr>
<td>Give opinion</td>
<td>15</td>
<td>A</td>
<td>that would help a lot of people that aren’t sure</td>
<td>that would</td>
<td></td>
</tr>
<tr>
<td>Give opinion</td>
<td>16a</td>
<td>B</td>
<td>what I like about this though</td>
<td>what I... {is}</td>
<td></td>
</tr>
<tr>
<td>Elaborate</td>
<td>16b</td>
<td></td>
<td>// it actually gives you a sample</td>
<td>it gives</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>// and then they break it down for you into the bits ... like in terms of that flow chart</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The exchange begins with a focus on the ideational meanings or content in the presentation of the stages in a FLERT discussion example (Figure 8.1). Both speakers interpret the stages as compulsory, as something ‘you have to do’. However, this is challenged both by B’s checking response ‘really’ and by A’s experience of writing the cardiovascular report. B counters A’s experience with their own experience, although they are careful to generalise their opinion to others in their group, possibly to make their contradiction tentative and in preparation for their positive evaluation of the FLERT staging structure. This leads to A’s strong challenge and emphatic evaluative statement, ‘the cycle doesn’t work’, a key move in this exchange where ‘the cycle’ is foregrounded as both the subject and the Theme. However, B’s response is to ask for more evidence for A’s opinion. Despite A providing this evidence, B continues to point out, albeit tentatively, that the FLERT cycle would help a lot of people. A agrees but qualifies B’s statement with ‘people that aren’t sure’ suggesting that both of them are not part of this group. Having achieved some agreement from A, B completes the exchange by a positive evaluation of the FLERT staging cycle, identifying the examples and the scaffolding of the stages as helpful design elements.

This extract shows that FLERT acts as a prompt for reflection and knowledge building as students discuss how the FLERT content needs to be adapted for different report topics. The last comment by B is significant as it tells teacher-designers that their multimodal approach to the screen design to convey both the structural parts of the discussion stage (they break it down for you into the bits) and the connections between them (like in terms of that flow chart) have been successful.
8.5 Qualitative data from reflective recounts

Students’ reflective recounts were analysed to reveal how they used FLERT in the independent construction phase of the genre teaching and learning cycle (TLC) when they were writing a laboratory report for assessment. Overall their recounts highlight that the focus of their reflections is on the Physiology content and how to shape this into a laboratory report genre. Comments illustrate the challenge posed by this shaping of disciplinary content into writing:

*It’s midnight. I’ve done everything but the discussion. I’m over the word count so I’ve got to cut it down so much, yeah. I still don’t get the theory too, like I get it but I can’t put it into words because it’s very ambiguous.*

*I’m not too sure if we’re meant to be finding references that support the theory or, like the physiological mechanisms or should we be looking for data where other people have replicated our experiment, and have produced values similar to ours and comment on the similarities and so forth.*

Other comments highlight how students not only use FLERT but also their peers and other resources as they carry out the task of writing their assessed assignment:

*After talking to a few friends and reading the instructions carefully I’ve realised that the data given was not complete and that we are expected to work out [unclear] I’ve worked that out now and am able to do the graph.*

*I find it easiest to google general terms like “posture change on heart rate”, “baroreceptors” “effects on heart rate and pressure” to find some information. I’ve found some really good information for the sort of experiments I’ve carried out and some general information for the introduction.*
The following three example analyses of extracts from students’ recounts have been selected to illustrate how students used FLERT in different ways during their writing process (Extract 8.2, 8.3, 8.4). These extracts move through different phases: firstly, how students are using or not using FLERT, secondly, evaluative comments on FLERT and lastly, self-reflections on their own knowledge or lack of knowledge on different aspects of report writing. Recounts reveal students’ self-reflection on their strengths and weaknesses and how they connect this to why and how they are using FLERT and subsequently, their comments on FLERT and whether it has helped them or not. These extracts also indicate how FLERT is accessed flexibly in different ways and for different purposes. Each extract represents a stage in a reflective recount genre where a particular issue is raised by the student and brought to closure. Student recounts are divided into clauses, Theme and New are identified as exemplified in Chapter 4. The analysis draws on both the cognitive writing process model (Hayes & Flower, 1980) and the genre analysis of phases in a reflective recount (based on Martin & Rose, 2008).
In this extract, an overall positive evaluation of FLERT, the student’s recount moves through phases of how s/he is using FLERT followed by commentary on FLERT and self-reflection. In the beginning phase, the student as Theme (I) provides the general reason for using FLERT (to get an idea of how to write a report) followed by an evaluative comment on the most helpful aspect, the examples, emphasised in Theme position. S/he then moves back into Theme position to describe how s/he has used examples in parts of FLERT (worked through). This is followed by self-reflection on aspects of writing related to parts of FLERT that s/he is confident about and those that s/he is not. The student reveals the reasoning behind using FLERT through the

Extract 8.2 Analysis of a reflective recount using genre analysis and an adaptation of the writing process model

<table>
<thead>
<tr>
<th>Task environment: writing laboratory report with FLERT</th>
<th>Genre stages/ Writing process</th>
<th>Theme and New analysis in numbered clauses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness of using FLERT to carry out task Comment and evaluation of FLERT</td>
<td>Set goal Comment</td>
<td>1. I’m just using the program to, like, just to get an idea of how to write a report</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. so the examples are really good</td>
</tr>
<tr>
<td>Using FLERT to carry out task</td>
<td>Recount</td>
<td>3. I worked through the examples like how to write an introduction and a discussion, especially the discussion.</td>
</tr>
<tr>
<td>Self-reflection on parts of FLERT</td>
<td>Reflect</td>
<td>4. um, I’m all right with grammar and tenses and stuff</td>
</tr>
<tr>
<td>Self-reflection</td>
<td>Identify problem Reflect</td>
<td>5. it’s just the order and scientific language, things like that, what I put in, how I reference</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. because sometimes I over-reference</td>
</tr>
<tr>
<td>Awareness of how FLERT can help Self-reflection Overall comment and evaluation of FLERT</td>
<td>Comment</td>
<td>7. so this program’s pretty good in teaching me that</td>
</tr>
</tbody>
</table>
choice of conjunctions (so, because), also in Theme position. This extract ends with a strong positive comment on FLERT in Theme position (*the program*) and how it is perceived as *teaching*. The extract reveals that in these interactions with FLERT the student comes to realise what they know and do not know about report writing.

*Extract 8.3 Analysis of a reflective recount using genre analysis and an adaptation of the writing process model*

<table>
<thead>
<tr>
<th>Task environment: writing laboratory report with FLERT</th>
<th>Genre stages/ Writing process</th>
<th>Theme and New analysis in numbered clauses</th>
</tr>
</thead>
</table>
| Self-reflection on task expectations and past performance | Identify problem, Reflect | 1. *I know that the discussion is the bulk of the marks for the report*  
2. *and I lost a lot of marks from the discussion in my last report* |
| Self-reflection | Set goal | 3. *so this time I’m going to put some extra effort into it.* |
| Awareness of using FLERT to carry out task | Recount | 4. *I’ve gone back into the FLERT program just to re-clarify what I should put in my discussion* |
| Using FLERT to plan writing | Procedure | 5. *I’ll just write them down on a piece of paper*  
6. *next to each point I’m also going to write some rough dot points on what I’m going to talk about to cover these dot points* |
| Self-reflection on using FLERT | Reflect | 7. *just so I don’t miss out on anything* |

Extract 8.3 begins with a self-reflection phase on both the expectations of the task, in terms of the discussion stage of a laboratory report, as well as past performance. As a consequence, the student decides on a different approach emphasised by a marked Theme (*so this time*). The following clauses describe how the student has used and will use FLERT to address issues in past performance, combining FLERT with their own note-taking strategy. The final phase is a justification for using FLERT for this approach to writing. Although the student does not explicitly comment
on FLERT as in Extract 8.2, it is clear from their description of how they have and will use FLERT that they value the program as a guide for writing the discussion.

*Extract 8.4 Analysis of a reflective recount using genre analysis and an adaptation of the writing process model*

| Task environment: writing laboratory report with FLERT | Genre stages/ Writing process | Theme and New analysis in numbered clauses
|--------------------------------------------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------|
| Awareness of using FLERT to some extent to carry out task | Recount | 1. *I haven’t really used, I mean*
| Comment and evaluation of FLERT | Comment | 2. *I did the exercises in the online tool for the introduction a couple of times over the last few weeks*
| Self-reflection on carrying out task | Identify problem | 3. *um, and they were good in telling me the general overview of how, of what should be in an introduction*
| Comment and evaluation of FLERT | Comment | 4. *but then when it actually comes to writing the background information, um, it’s much more, well it seems much more complicated than, you know, just doing the theoretical background and, yeah*
| Comment and evaluation of FLERT Self-reflection | Comment | 5. *um, I’m not sure that it really provided support in that regard*
| Reflect | 6. *and I don’t know how you would*
| Possible solution | 7. *I guess it’s just practice in writing more and more reports, um,*
| Comment and evaluation of FLERT Self-reflection | Reflect | 8. *um, but yeah, I found the information in there a little bit too basic*
| Reflect | 9. *but, it’s a lot of stuff I already knew from my previous report*
| Self-reflection and overall comment and evaluation of FLERT for task | Reflect | 10. *and I’m not sure it really helped me with the nitty-gritty of actually writing, um, writing the background information in the introduction*

This extract, in contrast to Extracts 8.2 and 8.3, begins with an ambivalent attitude to FLERT and its usefulness, although the final comment on FLERT in this phase is positive. However, the student’s self-reflection and comment on FLERT in the next phase highlights the reason for the ambivalence. This is strongly signalled by
the conjunction (but) in Theme position together with the problem of using FLERT for writing the background stage of the introduction. The next phase is a negative comment on FLERT in terms of supporting the writing of this stage together with self-reflection and realisation that this is difficult and how practice could be a possible solution. The next phase provides a negative comment on FLERT and positive self-evaluation of the student’s own knowledge and this leads to the final evaluative phase where the student realises that FLERT cannot help with this part of the writing process.

Analysis of these extracts provides insight into how students are using FLERT during the writing process, moving between FLERT and their writing, commenting on FLERT’s usefulness at different stages and reflecting on their own knowledge and performance. These extracts highlight the flow of action and reflection in the writing process alongside the learning resources of FLERT. FLERT adds an extra dimension to the process as students compare their knowledge and practices to those exemplified in FLERT and decide on the usefulness or not of the program in supporting them at their current stage of writing.

8.6 Summary: bringing together quantitative and qualitative analysis

Quantitative analysis in Chapter 7, a published paper, has argued that FLERT was able to significantly influence students’ performance in terms of marks for their assessed report if they used the program. However, as in all educational research, other factors besides their interactions with FLERT could have influenced this outcome. Other quantitative analysis revealed students’ perceptions of what they found most helpful: namely the deconstruction of authentic student examples to reveal the genre structure and language of a laboratory report in Physiology. In particular, report examples and explanations of genre structure were valued. Quantitative data also revealed the importance of not only providing help with report writing but also help
with understanding disciplinary content relevant to the report students are writing.

Qualitative data has provided a more nuanced insight into students’ interactions with FLERT. Overall the data have supported the value of deconstructing authentic student examples for students to interact with in explanations and exercises. However, the data have also revealed students’ perceptions of the design features used to display these examples and how they have supported their learning. These kinds of insights have been gained through the collection of different kinds of data and varied approaches to analysis. Analysis reveals that students perceive the medium of the computer and the multimodality of the FLERT program as teaching them about how to write their report.

However, FLERT is more than a collection of well-designed learning resources, it is a stimulus for knowledge building and reflection. As students interact with the program, it provides a mirror for them to compare their own skills and knowledge with what is displayed in the program. This leads to changes in their writing, but those changes do not slavishly follow FLERT, as if it provided a formula for report writing. Students recognise that FLERT needs to be adapted to the purpose and disciplinary field of a new experimental topic.

This Chapter has focussed on qualitative data and also commented on both the contribution of quantitative and qualitative data to understanding student learning from FLERT. The final chapter - Chapter 9 - builds on this and provides an overall summary of the research and its contributions to knowledge in the field. It provides general and local design principles for teaching academic writing online. It also reflects on limitations of the research and makes some suggestions about directions for future research and development.
Chapter references


CHAPTER 9
SUMMARY AND CONCLUSIONS

9.1 Introduction

This chapter brings together the main outcomes of the thesis in the areas of EDR which it has addressed. Contributions cover team interactions for designing online learning materials for Physiology laboratory report writing (FLERT), analysis of evolving designs for report writing genres and evaluation of student learning from the FLERT online learning materials. These investigations have been carried out informed by the theoretical perspective of social semiotic multimodal meaning making within a sociocultural theory of education and a theory of language in use, namely SFL. EDR itself provides a comprehensive framework for this study as it requires an exploration of approaches to designing for learning and learning theory both of which are addressed in this thesis. In addition, EDR encompasses evaluation of learning interventions and aims to develop principles for both the educational designing process and product. This study has provided valuable insights into how online designs for learning are negotiated, how the composition of designed products can be described, analysed and linked to student learning. In Section 9.2, the key outcomes of this research are discussed in terms of the research questions. In addressing each research question, I will discuss the significance of these outcomes, their limitations and opportunities for further research. This will lead on to Section 9.3 where I propose design principles based on this research and in line with the aims of EDR. Section 9.3 is divided into two parts, the first providing general principles for online teaching and learning and the second, principles for teaching academic writing online. The chapter concludes with an overall evaluation of the research contribution (9.4).
9.2 Discussion of key outcomes

9.2.1 Team interactions

This thesis addresses the nature of team interactions in the process of designing learning materials for teaching and learning of Physiology laboratory report writing online, the FLERT program. How does the design team (teacher-designers and elearning designers) negotiate the process of learning design? The theoretical foundations for this investigation are those of SFL (Chapter 2). SFL analytical tools, in particular those of discourse semantics and exchange structure (Chapters 2, 4 and 5) enabled a detailed analysis of how dialogic interactions allow for knowledge exchange and knowledge building across discipline and professional boundaries.

The four guiding research questions focused on the nature of spoken interactions among team members. To address the first question, How is knowledge and experience shared among team members?, the outcomes highlight how knowledge and experience can be negotiated, challenged and explained among team members and this can result in both knowledge sharing and knowledge building. Building new knowledge and practices collaboratively can occur but may be limited to where there are points of alignment in knowledge and practice across discipline boundaries (Chapter 5). The processes of sharing and building knowledge are facilitated by effective interpersonal relationship building and communication strategies, which accompany the exchange of disciplinary knowledge and practices and support openness to crossing discipline boundaries and identities. Knowledge exchange can also be facilitated by artefacts such as draft learning materials and diagrams, (for example, the story-board diagram, (Chapter 5)). These findings answer the second guiding question: What spoken interactions and use of artefacts facilitate this process? Although patterns or genres of team meetings can be identified, especially the meeting
stages of beginning and ending, the nature of exchanging knowledge in design meetings means that there is a certain fluidity around the mid stages of meetings which tends to result in circularity and repetition. The patterns of knowledge exchange and knowledge building also incorporated genres such as reports, procedures and recounts. This addresses the third question: *Do patterns/genres of team practices and knowledge building emerge in design meetings?* The answer to the final question: *How are the outcomes of knowledge building embodied in learning resources?*, is traced through the spoken discourse of team members in the design process concerning features of the designed product to the final version which appears in the online teaching and learning materials (Chapter 5).

This research has provided fresh insight into the process of designing for online learning and highlighted the importance of interpersonal meaning making in supporting communication that builds and shares disciplinary knowledge. These outcomes are based on the detailed analysis of spoken discourse using SFL tools.

Although SFL tools allow for a thorough analysis of spoken discourse, this can be challenging and time consuming. Therefore, this study was limited to a small data set. However, the insights from this study could be built on in later studies and combined with other theoretical approaches such as Legitimation Code Theory (LCT) (Christie & Maton, 2011), which is already used in combination with SFL to investigate knowledge building in educational contexts. This approach can provide an alternative method of analysis which may be able to yield similar insights without the need for an in-depth knowledge of SFL. This could enable larger data sets to be examined to identify what communication strategies support effective team design processes. Research into team-based communication and knowledge sharing and building is important as interdisciplinary research is increasingly carried out both by
9.2.2 The evolution of designed products

This thesis is not only concerned with design processes but also with design of teaching and learning ‘products’ and their evolution. *How does the design of a program for teaching and learning the genre of laboratory report writing evolve online?* The theoretical foundations for this investigation are those of multimodal social semiotics and SFL within a sociocultural theory of learning (Chapter 2). Also of importance are designs for learning, especially those which address the teaching and learning of academic writing (Chapter 3). The learning designs used for the online programs investigated in this thesis are based on genre analysis and genre pedagogy in the SFL tradition (Chapters 2, 3, 6 and 7).

The three research questions guiding this stage of the thesis concern the designed products for teaching the genre of the laboratory report in science and engineering and how these have evolved over time. In addressing the first question, *How is writing pedagogy, specifically genre pedagogy in the SFL tradition, adapted to an online context?,* the outcomes emphasise the parts of the SFL teaching learning cycle that can be adapted to an online environment (Chapter 3 and 7). In particular, the deconstruction stage can be effectively represented in an online context with the multimodal affordances of the computer and the online environment can also provide more examples of the genre. However, the joint construction stage is challenging to use in an online setting and this is understood to be a critical stage for effective genre learning, especially in school contexts (Chapter 3). To some extent, student interactions with online explanations and exercises which are deconstructing the genre can replicate joint construction with the computer providing feedback as ‘teacher’. Independent construction can take place alongside student use of the online learning
materials (Chapter 8). Genre analysis of authentic student writing is important and face-to-face learning materials can form the basis for ‘redesign’ for online learning (Chapter 6).

The choice of the design elements for the online learning materials needs to convey the teaching and learning content, in this case, the learning materials and activities for supporting students to write the genre of the laboratory report in science and engineering. The theoretical framework of multimodal social semiotics and the metafunctional theory of SFL provide a suite of tools for investigating these design elements in a systematic way (Chapters 2, 4, and 6). Different combinations and choices of modes are used to convey the meanings of the learning resources. The dominant mode is the written mode as the learning resources focus on teaching academic writing through directing students to interact with authentic student examples on screen. The display of these written examples is combined with layout, colour and typography. Colour is particularly important in highlighting relevant structure and language features such as the schematic structure in a particular section of a laboratory report example. However, colour also gives cohesion and coherence to the website and colour and visuals motivate student use. Decisions about the arrangement of content on screen or how and what content to reveal through interactions are important in scaffolding students’ understanding (Chapter 2 and Chapter 6). Navigation in terms of the choice of menu items and their location can also be used to convey meaning. These choices can be informed by multimodal theories based on the SFL theory of Given (in some SFL analyses conflated with Theme) and New information. Given on the left of the screen, is a position for what is ‘already known’. In the case of the laboratory report genre, the typical macro genre stages of the report (IMRaD) are familiar to students and they can be used to form the menu.
items, a logical basis for students’ navigation of the website (Chapter 6). These findings answer the second question, *What multimodal elements are chosen to create the online writing pedagogy and how are these combined and arranged?*

Online learning programs reflect the development of the supporting technology over time, offering both affordances and constraints. The online learning programs in this research have become more sophisticated in their use of colour and visual communication to aid meaning making. This has supported improved scaffolding of student understanding of the structure of laboratory reports (Chapter 6 and Chapter 8) and answers the third question, *How have these elements evolved in different iterations of laboratory report writing programs?*

These research outcomes contribute to a more theoretically informed basis for moving into an online environment for teaching and learning. They illustrate how a theoretical approach underpinning face-to-face teaching, genre analysis and genre pedagogy, can be adapted for online learning and how knowledge of how meaning is made through multiple modes and their arrangement can inform design decisions resulting in more effective design products. Designs for learning in TEL have generally not engaged with either theories of language in education or social semiotic multimodal theory. This thesis has attempted to investigate how designs for learning could be enhanced by these theories to provide a broader theoretical approach to learning design, especially relevant for teaching academic writing (Chapter 3). This is clearly important as more teaching and learning in university moves online, often in circumstances where little attention can be given to discussion of theoretical frameworks for online learning.

**9.2.3 Student online learning from a report writing program for Physiology, FLERT**

An important aspect of this research is to establish whether students’ interactions and use of the online program have brought about their learning, namely:
How do users learn from the online learning environment for writing a laboratory report in Physiology (FLERT)? A multi- and mixed methods approach has been used to address this question (Chapter 4).

The three research questions guiding this stage of the study concern students’ performance, their interactions with the website, their perceptions of learning and whether the design of the learning materials and approaches has facilitated their learning. From this study there is strong evidence supporting the influence of students’ interactions with FLERT on their subsequent performance in an assessed laboratory report. In addition, frequency of student use also appears to enhance performance. Importantly, FLERT improved the performance of students who identified as less confident and less experienced in writing (Chapter 7). This answers the first question: *How does the performance of users change after interacting with the program?*

Students valued the example reports in FLERT most highly in terms of their perceived learning and also the sections of the program that addressed report structure rather than language. They accessed the program according to their needs, focussing more on the sections that addressed writing the introduction and discussion sections. The module on *Help with understanding content* was more highly rated than that of *Help with report writing*, suggesting that students’ drew on their prior knowledge of report writing but were not so familiar with the discipline content and concepts of the report they were writing. This finding is also supported by students’ reflective recounts which highlighted their struggles with understanding the content in order to express it in the structure and language of a report. FLERT was perceived by many as “the teacher”, guiding and helping students to make changes to their writing. In their interactions with FLERT they were able to gauge their own strengths and weaknesses in report writing (Chapter 7 and Chapter 8) This answers the question: *How do users interact*
with the program and perceive their learning from the program? Student comments on design features were less easy to identify from their feedback. The use of colour and the layout of the diagrams for the structural stages of the report were mentioned as were the scaffolding features (Chapter 6 and 8). This addressed the last question: What elements of program design do learners perceive support their learning?

These findings are significant as they provide evidence for drawing on effective face-to-face pedagogy to create online learning resources; in this case the SFL genre-based pedagogy behind FLERT. However significant aspects of face-to-face pedagogy cannot be carried out online and it important to address the impact of this if a blended learning approach cannot be implemented. Another valuable outcome of this research is that it has used the theory of social semiotic multimodal design and SFL informed evaluation strategies to investigate how modes and their arrangement can influence student learning. Also, the integration of online support for report writing with support for understanding discipline content can be seen to be a motivating factor in student use of FLERT. However, despite being strongly integrated into the discipline unit of study and aligned with assessment, there were probably a number of students who did not access the program and who could have benefited from using it (Chapter 7). Given the resources used to design and develop FLERT, future programs of this kind may need to explore even closer integration into discipline units of study where students would have to access the program to carry out assessment tasks. This closer integration could also take the form of a blended learning approach to incorporate the joint construction phase of genre pedagogy, possibly, as a draft-feedback cycle where feedback on drafts is linked to the online resources. Simply accessing the program does not bring about learning. Only students’ activities with the program can bring about their learning. This points to the need for more ways to gather
qualitative data on how students use online learning programs. Data analytics can help to some extent in this area. However, the link between the design of the components of the online learning program and student learning can be explored through students’ articulating how these aspects have helped them to learn. Qualitative data collection methods and analysis provide a valuable way to gain such insights.

9.3 Design principles

The last phase of an EDR approach is to propose design principles for both research and practice based on the experience of carrying out a particular EDR project. These principles can focus on the characteristics of the designed learning materials and tasks as well as the procedures and practices involved in creating these (Dohn, Hansen, & Goodyear, forthcoming). The main aim of the design principles I outline below is to provide guidelines and recommendations for design practice. They are both of a general nature and those related to the specific context of teaching academic writing online.

9.3.1 General principles for teaching and learning online

The general principles proposed are important considerations for moving online for teaching and learning based on this research. They include:

- Adapting and using an EDR framework to give structure to the process of moving teaching and learning online, even if acting alone to redesign one’s own teaching and learning for an online environment.
- Reviewing current face-to-face teaching materials and approaches and how they support students in carrying out the assessment tasks in the curriculum. Evaluating their suitability for redesign for online learning.
- Examining designs for learning appropriate to the content of the teaching and learning materials and activities including those that provide insights into multimodal meaning making on screen and
address the role of language in education.

- Involving colleagues, elearning specialists and ALL practitioners to give feedback and support on early design iterations and raise the possibility of design collaborations, especially if teaching online is to prepare students for written assessments.
- Involving students in the feedback process including methods to enable them to articulate how aspects of the design of the teaching and learning materials and their interactions with these have resulted in their learning.
- Disseminating and sharing the practices of designing and the outcomes of the design process across discipline boundaries.
- Addressing issues of the logistics of online learning design (for example, time and resourcing) and the sustainability of the online learning resources so that the content can be redesigned as technology changes.

9.3.2 Design principles for teaching academic writing online

Teaching academic writing online, both in terms of discipline specific programs like FLERT and generic programs such as Help Yourself (Chapter 3), has become increasingly common to address the needs of students from diverse educational and language backgrounds. In this context, developing design principles based on the research in this thesis is an important outcome. They include:

- Designing within an EDR framework and starting with the assessment of student needs, the purpose and context of the program.
- Having a sound theory of language in education and multimodal social semiotics to inform design.
• Adapting SFL language in education approaches to designing online pedagogy for teaching academic writing, for example, genre pedagogy.

• Considering theoretically informed face-to-face teaching of academic writing as the basis for online learning programs.

• Considering a blended learning approach for those aspects of the pedagogy that cannot be carried out online, such as joint construction.

• Collaborating with colleagues, discipline lecturers, elearning specialists in the design process with the possibility of creating an ongoing community of practice for online learning design and development for academic writing.

• Involving students in the designing process, if possible, or in providing formative feedback on interim designs.

• Evaluating student use and perceptions of learning from online resources for teaching academic writing.

• Identifying design components that students perceive bring about their learning.

• Creating programs that are relevant and realistic, aligned with and embedded in discipline curricula where possible so students will be strongly motivated to use these programs to improve their writing.

• Disseminating and sharing practice in online design practices and designed products for academic writing.

• Addressing issues of the logistics of online learning design (for example, time and resourcing) and the sustainability of designed products as technology changes.
9.4 Overall conclusion

By drawing on the experience of designing, developing and testing FLERT, this thesis has provided valuable insights into: the process of designing online teaching and learning, the designed products and student learning from these products. The research has combined some complementary theoretical perspectives in a novel way, showing how they contribute to designing for learning. In particular, it has applied the theory of social semiotic multimodal meaning making in education to the analysis of designed products in order to explore how they influence student learning. Another theoretical perspective, that of SFL has been used both to explore the interactive designing process and also perceptions of student learning. In this way, this thesis has extended the theoretical perspectives, which are underpinned by an EDR process.

In addition, this thesis has added to the body of literature, which argues that well-designed online learning resources aligned with both theory and practice can bring about student learning, both in terms of student performance and perceived learning. This thesis has not set out to compare face-to-face teaching and learning with online teaching and learning and has highlighted the issues involved in transferring well-established face-to-face pedagogy to an online environment. Both learning environments are multimodal but employ multimodality in very different ways to create the conditions for the potential of student learning. There is still much to research into the ways in which students engage in the online environment to bring about their learning. Questions remain about how students’ learning is transformed through their interactions with the meaning making modes of the online environment. What is clear is that students perceive online leaning as part of their broader sociocultural learning environment in their activities around and with online learning programs. In these interactions, the outcomes of this research suggest that students perceive the computer as both “another kind of teacher” and also a source of
scaffolding and examples, useful in facilitating their learning. The seamless integration
of the role of the computer and the teacher in FLERT attests to the success of the team
collaborations in the creation of the learning resources in this program. Perhaps a final
comment can be left to a student. This comment highlights how FLERT supports the
students’ transformation of their thinking into writing through the meanings they have
made from the visual display of the FLERT ‘flow diagram’. This feedback comment is
also important for all designers of online learning resources, a stimulus to reflect on
designing for learning and the multimodal meaning making of the designed products.
Ultimately, it is students who interact with and use these resources and in this way
transform their learning and (re)make the resources their own.

I thought the program [FLERT] was, was really helpful because I could
distinguish what I could put in. Some of the information was um, definitely a lot
helpful um, and I could articulate some of my thoughts a lot better. It still, it
was still quite tough but at least I had one stream of ... to this report um, and I
could just um, have it like a flow diagram from the program but put it in, put it
in words so um, yeah, hopefully, hopefully they like it um. Obviously, it’s not
perfect but um, something to think about.

Chapter references

learning designs to support knowledge transformation. In N. B. Dohn (Ed.),
Designing for situated knowledge transformation. Abingdon: Routledge.
APPENDIX : Questionnaires

QUESTIONNAIRE 1 : PREVIOUS WRITING EXPERIENCE

Student Identity No. : .........................................................

SECTION A: STUDENT BACKGROUND INFORMATION (please tick the appropriate box)
Are you an international student? Yes [ ] No [ ] Age: 18-22 [ ] 22+ [ ]
First language ................................................................. Gender: male [ ]
female [ ]
Fluency in English : native speaker [ ] near native [ ] reasonable [ ] poor [ ]

SECTION B: WRITING HISTORY
1. What is the longest academic text you have written in English? (tick one box)
   1 - 2 pages [ ]
   3 - 4 pages [ ]
   5 - 6 pages [ ]
   7 - 8 pages [ ]
   9 - 10 pages [ ]
   more than 10 pages [ ]

2. What types of text have you produced since you became a student at USyd? (you can tick more than one box)
   Summary [ ]
   Short answer [ ]
   Laboratory report [ ]
   Other report [ ]
   Essay [ ]
   Other (please state) ...........................................................

3. How many written assignments did you complete last year? (tick one box)
   0-3 [ ] 4-8 [ ] 9 - 12 [ ] more than 12 [ ]

4. How confident have you been with your writing tasks? (circle the appropriate number)
   Very confident [ ] Quite confident [ ] Not very confident [ ] Not at all confident [ ]

SECTION C SELF EVALUATION SKILLS
1. Generally, I would rate my skills in written communication as (circle the appropriate number)
   Very competent [ ] Quite competent [ ] Satisfactory [ ] Not very satisfactory [ ] Unsatisfactory [ ]

2. Please rate yourself on the following skills (circle the appropriate number)
   1. Understanding referencing principles.......................... [ ]
   2. Selecting relevant information from my reading............. [ ]
   3. Including information from my reading in my written text.... [ ]
   4. Understanding when to quote and when to summarise or paraphrase... ......................................................... [ ]
   5. Organising the text as a whole....................................... [ ]
<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Constructing a logical and clear argument</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7. Expressing relationships between different pieces of information in writing</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8. Beginning and concluding appropriately</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9. Using formal academic writing style</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10. Using accurate sentence level grammar</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
QUESTIONNAIRE 2 : WRITING THE NERVE REPORT

Student Identity No. : ........................................(please complete if you have consented to take part in the project)

SECTION A: PREPARING TO WRITE YOUR REPORT
1. What resources did you use to write your report? (tick the appropriate box(es)
   - Intermediate Physiology Practical Guide, Department of Physiology [ ]
   - Sherwood, L Human physiology: from cells to systems [ ]
   - Lecture notes [ ]
   - Other (please add) [ ]

2. What kind of plan did you make before writing your report? (tick the appropriate box(es)
   - No plan [ ]
   - Mental plan (i.e. a plan in your head with nothing written down) [ ]
   - Written plan (i.e. main points and sub points written down in a list) [ ]
   - Evolving plan (i.e. a plan that develops as you write with notes written down) [ ]
   - Other type of plan (please explain) [ ]

3. How many drafts did you make of your report? (tick one box)
   - 0 [ ]
   - 1 [ ]
   - 2 [ ]
   - more than 2 [ ]

4. How long did you take to WRITE your report (including drafting/re-drafting time)?
   (tick one box)
   - less than 1 hr [ ]
   - 1-3 hrs [ ]
   - more than 3 hrs [ ]

SECTION B: SELF EVALUATION SKILLS
1. Please rate your performance on the following aspects of preparing and/or writing the report (circle the appropriate number)

   1. Giving myself enough time for the task ..........................................1 2 3 4
   2. Understanding the theory and concepts relating to the electrophysiology of the nerve .................................................................1 2 3 4
   3. Understanding what was expected for writing the report based on instructions and marking criteria on WebCT.................................................1 2 3 4
   4. Knowing exactly how to organise the introduction and discussion .1 2 3 4
   5. Selecting relevant topics/concepts from my resources for my report .................................................................1 2 3 4
   6. Incorporating topics/concepts from my resources in my written text.................................................................1 2 3 4
   7. Writing the Introduction.................................................................1 2 3 4
   8. Writing the aim (s).................................................................1 2 3 4
   9. Writing the hypothesis(es).................................................................1 2 3 4
   10. Interpreting the results.................................................................1 2 3 4
   11. Writing the conclusion.................................................................1 2 3 4
2. I think I will receive the following grade for my report (tick only one box)
1-8 [ ] 9-11 [ ] 12-14 [ ] 15-17 [ ]

SECTION C: REFLECTING ON WRITING
1. What do you think would have helped you to write a better nerve prac report?

2. Did you use any of your first-year writing to help you write your nerve report? If yes, what did you use and how did you use it?
QUESTIONNAIRE 3: WRITING THE CV REPORT

Student Identity No. : ...............................

(please complete if you have consented to take part in the project)

SECTION A: PREPARING TO WRITE YOUR REPORT

1. What resources did you use to write your report? (tick the appropriate box(es)
   a. Intermediate Physiology Practical Guide, Department of Physiology [ ]
   b. Sherwood, L Human physiology: from cells to systems [ ]
   c. Lecture notes [ ]
   d. The online program [ ]
   e. Feedback from the nerve report [ ]
   f. Other (please add) ………..

2. Did you use the online program Report Writing Tool (Help with writing module and Cardiovascular Introduction Exercises module ) (tick the appropriate box)
   Yes [ ] No [ ]
   If, No, why not ? (please explain) ………………………………………………………………………………………………………
   If, Yes, please go on to Sections B, C and D

SECTION B: FEEDBACK ON THE REPORT WRITING TOOL AS A WHOLE

Doing the program

1. Which parts of the program did you go to? (tick the appropriate box)
   a) Entry quizes [ ]
   b) Help with writing Introduction [ ]
   d) Help with writing Results [ ]
   e) Help with writing Discussion [ ]
   f) CV Introduction Exercises [ ]

2. Approximately how long did you spend on the program?
   30 - 60mins [ ] 1 - 3hrs [ ] > 3 hrs [ ] other (please indicate) [......................]

3. What was your preferred way of moving through the exercises and explanations in a section Please tick the method(s) that best describes your pathway.
   a) did the entry quiz and if I did Ok did not go on to rest of that section [ ]
   b) moved from screen to screen through a whole section, reading explanations and doing exercises. [ ]
   c) moved from screen to screen, scanning explanations and exercises and then chose particular explanation and exercise to work through in detail. [ ]
   d) other (please specify) ……………………………………………………………………………………………………………..
### SECTION C: FEEDBACK ON THE HELP WITH WRITING MODULE

Please respond to the following statements by circling the number that most closely reflects your experience of using the program from 1 – “Strongly agree” to 5 – “Strongly disagree”.

<table>
<thead>
<tr>
<th></th>
<th>Strongly agree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Working through the site was easy</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2. The navigation buttons were easy to find</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3. The instructions at the top of the screens were easy to follow</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4. The screen design was ‘user friendly’</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5. The animations helped me to understand the report structure</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>6. The example reports helped me to understand the report structure</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7. The exercises reinforced my understanding of report structure</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>8. The exercises reinforced my understanding of report language</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>9. The feedback on the exercises helped me to understand the correct answer</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>10. The Help with Writing module helped me to understand the kinds of scientific language (e.g. the language of a hypothesis) appropriate for a report</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>11. After doing the Help with Writing module, I am now more confident about understanding the structure of a report</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>12. After doing the Help with Writing module, I am now more confident about understanding the scientific language to use in a report</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
SECTION D: FEEDBACK ON THE CARDIOVASCULAR INTRODUCTION EXERCISES MODULE

Please respond to the following statements by circling the number that most closely reflects your experience of using the program from 1 – “Strongly agree” to 5 – “Strongly disagree”.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Working through the site was easy</td>
<td>1  2  3  4  5</td>
<td></td>
</tr>
<tr>
<td>2. The navigation buttons were easy to find</td>
<td>1  2  3  4  5</td>
<td></td>
</tr>
<tr>
<td>3. The instructions were easy to follow</td>
<td>1  2  3  4  5</td>
<td></td>
</tr>
<tr>
<td>4. The screen design was ‘user friendly’</td>
<td>1  2  3  4  5</td>
<td></td>
</tr>
<tr>
<td>5. The examples helped me to understand the scientific concepts</td>
<td>1  2  3  4  5</td>
<td></td>
</tr>
<tr>
<td>6. The exercises reinforced my understanding of the scientific concepts</td>
<td>1  2  3  4  5</td>
<td></td>
</tr>
<tr>
<td>7. The feedback on the exercises helped me to understand the correct answer</td>
<td>1  2  3  4  5</td>
<td></td>
</tr>
<tr>
<td>8. The CV Introduction Exercises module helped me to know what type of content to put in my introduction</td>
<td>1  2  3  4  5</td>
<td></td>
</tr>
<tr>
<td>9. The CV Introduction Exercises module helped me to understand the difference between the aims and hypotheses</td>
<td>1  2  3  4  5</td>
<td></td>
</tr>
<tr>
<td>10. The CV Introduction Exercises module helped me to understand independent and dependent variables</td>
<td>1  2  3  4  5</td>
<td></td>
</tr>
<tr>
<td>11. The CV Introduction Exercises module helped me to understand how to use the variables in writing appropriate hypotheses</td>
<td>1  2  3  4  5</td>
<td></td>
</tr>
<tr>
<td>12. After doing the CV Introduction Exercises module, I am now more confident about what content to put in an introduction</td>
<td>1  2  3  4  5</td>
<td></td>
</tr>
</tbody>
</table>

16. What do you think is most helpful in the report writing tool as a whole?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

17. What do you think is least helpful?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

18. If you were the designer, what changes would you make now?

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
SECTION A: STUDENT BACKGROUND INFORMATION (please tick the appropriate box)
Are you an international student? Yes [ ] No [ ] Age: 18-22 [ ] 22+ [ ]
Gender: male [ ] female [ ]
First language .................................................
Fluency in English: native speaker [ ] near native [ ] reasonable [ ] poor [ ]

SECTION B: WRITING HISTORY
1. What is the longest academic text you have written in English? (tick one box)
   1 - 2 pages[ ] 3 - 4 pages[ ] 5 - 6 pages[ ] 7 - 8 pages[ ] 9 - 10 pages[ ]
   more than 10 pages[ ]
2. What types of text have you produced since you became a student at USyd? (you can tick more
   than one box)
   Summary [ ] Short answer [ ] Laboratory report [ ] Essay [ ]
   Other report [ ] Other (please state) ..............................................................................
3. How many written assignments did you complete last year? (tick one box)
   0-3 [ ] 4-8 [ ] 9 - 12 [ ] more than 12 [ ]
4. How confident have you been with your writing tasks? (tick one box)
   Very confident [ ] Quite confident [ ] Not very confident [ ] Not at all confident [ ]

SECTION C: PREPARING TO WRITE YOUR REPORT
1. What resources did you use to write your report? (tick the appropriate box(es))
   a. Intermediate Physiology Practical Guide, Department of Physiology [ ]
   b. Sherwood, L Human physiology: from cells to systems [ ]
   c. Lecture notes [ ]
   d. The online Help with Report Writing [ ]
   e. The online Help with Report Content [ ]
   f. Feedback from first year reports [ ]
   i. Other (please add) ...........................................................................................................
**SECTION D : SELF EVALUATION SKILLS**

1. Please rate your performance on the following aspects of preparing and/or writing your report (Circle the appropriate number.)

<table>
<thead>
<tr>
<th></th>
<th>excellent</th>
<th>good</th>
<th>only fair</th>
<th>poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Giving myself enough time for the task</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. Understanding the theory and concepts behind the practical</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. Understanding what was expected in writing the report based on instructions and marking criteria on WebCT</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. Knowing exactly how to organise the information for the whole report</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. Selecting relevant topics/concepts from my resources for the report</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. Incorporating topics/concepts from my resources in my written text</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. Writing the introduction</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. Writing the aim</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. Writing the hypothesis(es)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. Interpreting the results</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11. Writing the discussion</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12. Writing the conclusion</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

2. I think I will receive the following grade for my report (tick one box)

1-8 [ ] 9-11 [ ] 12-14 [ ] 15-17 [ ] 18-21 [ ]

3. Did you use the online program FLERT? (tick the appropriate box)

If, No, why not? (please explain) .................................................................

If, Yes, please go on to Sections E, F and G

**SECTION E: FEEDBACK ON FLERT AS A WHOLE**

1. Which parts of the program did you use? (tick the appropriate box(es))

Help with report writing

- a) Entry quiz exercises [ ]
- b) Introduction [ ]
- c) Methods [ ]
- d) Results [ ]
- e) Discussion [ ]
- f) Overall Structure [ ]
- g) Conclusion [ ]
- h) Title [ ]
- i) References [ ]

Help with report content

- a) Introduction [ ]
- b) Independent & dependent variables [ ]
- c) Hypothesis writing [ ]
- d) Results [ ]
- e) Discussion [ ]

2. Approximately how long did you spend on the program?

up to 60mins [ ] 1 - 3hrs [ ] > 3 hrs [ ] other (please indicate) ......................
3. What was your preferred way of moving through the exercises and explanations in a section? Please tick the method(s) that best describes your pathway.

a) did the entry quiz and if this was Ok did not go on to rest of that section
b) moved from screen to screen through a whole section, reading explanations and doing exercises.

[ ]

c) moved from screen to screen, scanning explanations and exercises and then chose particular explanation and exercise to work through in detail.

[ ]
d) other (please specify)


SECTION F: FEEDBACK ON THE HELP WITH REPORT WRITING

(Please respond to the following statements by circling the number that most closely reflects your experience of using the program from 1 – “Strongly agree” to 5 – “Strongly disagree”.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Working through the site was easy</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2. The navigation buttons were easy to find</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3. The instructions at the top of the screens were easy to follow</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4. The screen design was ‘user friendly’</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5. The diagrams helped me to understand the report structure</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>6. The animations helped me to understand the report structure</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7. The example reports helped me to understand the report structure</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>8. The exercises reinforced my understanding of report structure</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>9. The exercises reinforced my understanding of report language</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>10. The feedback on the exercises helped me to understand the correct answer</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>11. The Help with Report Writing module helped me to understand the kinds of scientific language (e.g. the language of a hypothesis) appropriate for a report</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>12. After doing the Help with Report Writing module, I am now more confident about understanding the structure of a report</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>13. After doing the Help with Report Writing module, I am now more confident about understanding the scientific language to use in a report</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>
### SECTION G: FEEDBACK ON THE HELP WITH REPORT CONTENT

(Please respond to the following statements by circling the number that most closely reflects your experience of using the program from 1 – “Strongly agree” to 5 – “Strongly disagree”.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly agree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Working through the site was easy</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2. The navigation buttons were easy to find</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3. The instructions were easy to follow</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4. The screen design was ‘user friendly’</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5. The feedback on the exercises helped me to understand the correct answer.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>6. The Help with Report Content module helped me to identify content necessary for the Introduction.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7. The Help with Report Content module helped me to identify content necessary for the Discussion.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>8. The Help with Report Content module helped me to identify what the independent and dependent variables were for this experiment.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>9. The Help with Report Content module helped me to write the hypotheses.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>10. After doing the Help with Report Content module, I am now more confident about what content to put in my report.</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

1. If you used the Help with Report Writing module, did you change the way you wrote your report or what you put in your report? If yes, how?

2. If you used the Help with Report Content module, did you change the way you wrote your report or what you put in your report? If yes, how?

3. What do you think is most helpful in FLERT as a whole?

4. What do you think is least helpful?

5. What have all the online resources taught you about writing in Physiology?

6. What do you think would help you to improve your report writing?
APPENDIX 2 : Pre- Post-test Activity

Please note:
1. This is not an assessment task - there will be no marks given for this activity

2. This activity will help you identify your strengths and weaknesses in writing parts of a report in Physiology and should help you to write a better report for assessment.

Student No. ……………………………………………………………………………………..
(please write your number if you signed the consent form)

Write all your answers on this paper and hand it in to your tutor or to Helen Drury from the Learning Centre. It will take about 10 minutes to complete this activity.

QUESTIONS ON THE INTRODUCTION SECTION OF A REPORT

Question 1
In general, the information or the content in your Introduction answers a number of questions about your experiment. Which of the following questions do you think would be answered in an Introduction. Tick the appropriate boxes.

<table>
<thead>
<tr>
<th>(a) What is the theory on this subject?</th>
</tr>
</thead>
<tbody>
<tr>
<td>(b) Why did you get the results you got? (You have to explain inconsistent or unexpected results.)</td>
</tr>
<tr>
<td>(c) How does your experiment relate to theory?</td>
</tr>
<tr>
<td>(d) What is the subject of your report?</td>
</tr>
<tr>
<td>(e) How are the data collected and presented?</td>
</tr>
<tr>
<td>(f) What is the aim or objective of your experiment?</td>
</tr>
<tr>
<td>(g) What hypothesis (es) is/are being tested?</td>
</tr>
</tbody>
</table>
Question 2

Which of the following sentences are appropriate for an hypothesis statement for the stimulus-response relation experiment (Electrophysiology of the Nerve practical)? Tick the appropriate boxes.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Determine if a compound action potential produces the all-or nothing pattern of firing shown in single nerve fibres.</td>
<td></td>
</tr>
<tr>
<td>b) As the distance increases the latency will increase.</td>
<td></td>
</tr>
<tr>
<td>c) Another issue is whether the shape of the nerve compound action potential stimulus-response curve conflicts with the all-or-none law. In fact it should not.</td>
<td></td>
</tr>
<tr>
<td>d) Increasing the level of stimulus in the sciatic nerve of the Queensland cane toad increases the amplitude of the compound action potential</td>
<td></td>
</tr>
<tr>
<td>e) The amplitude reaches a maximum and does not increase further with an increase in stimuli.</td>
<td></td>
</tr>
</tbody>
</table>

**QUESTIONS ON THE RESULTS SECTION OF A REPORT**

Question 3

Consider the following figure which shows the results from an experiment which aimed to measure the conduction velocity in a nerve. Look at the improvements listed below it. Indicate whether you think these improvements should be applied to the figure by ticking either yes or no.

Figure Time of CAP for distance of Sciatic nerve

<table>
<thead>
<tr>
<th></th>
<th>yes</th>
<th>no</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) The figure title should be rewritten as follows: Figure 2: Conduction velocity in the sciatic nerve of the Queensland cane toad.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) In this figure, there should be only one line.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) There should be no title written on the body of the figure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
d) Axes labels should not begin with lower case letters, not capitals.

e) The equation $y = 0.027x + 2.2$ should be removed from the body of the figure.

f) The y equation and the value for $R^2$ should be written on the body of the figure.

g) The figure title should be placed underneath the figure.

**QUESTIONS ON THE DISCUSSION SECTION OF A REPORT**

**Question 4**

Decide whether the extracts from a student’s report on the effects of Xylocaine, a locally applied anaesthetic, on the nerve response should be in the Discussion section. Tick either the yes or no box.

(a) The results indicate that Xylocaine acts as a blockade of the peak compound action potential. **yes** **no**

(b) Three drops of 2% Xylocaine solution from a syringe needle were applied to a small piece of filter paper placed on the nerve mid-way between the stimulating and recording electrodes **yes** **no**

(c) Xylocaine is a local anaesthetic. **yes** **no**

(d) The hypothesis predicting the neural blockade action of Xylocaine was upheld. **yes** **no**

(e) Topical application of Xylocaine will decrease the peak amplitude of the monophasic compound action potential. **yes** **no**

(f) Figure 1 shows that, over a five-minute period, the peak monophasic compound action potential response attenuated on average, at a rate of 17% per minute, rising to 25% at the end of the five minute trial. **yes** **no**

(g) A broader range of test conditions is required to validate the observation of the action of Xylocaine on the cane toad sciatic nerve. **yes** **no**
Question 5

Read the following extract from a Discussion section of a report on ‘Period of Reduced Excitability following an Action Potential in the Sciatic Nerve of a Queensland Cane Toad’ and decide which of the 3 choices in the columns on the right should fill the gaps (****) in the text. Tick the box of your choice.

At 0.9ms, a response of the nerve ******** recorded (Figure 1) at stimuli strengths above maximal (i.e. supramaximal) suggesting that some fibres within the nerve ******** in their relative refractory period. Below 0.85ms, the most excitable fibre’s Na channels ******** still inactive (absolute refractory period) even with supramaximal stimulation.

The maximum frequency of firing of a fibre in this nerve ******** 1100Hz (Table 1). As large myelinated axons ******** at 2500Hz, results ******** this nerve to be of middle diameter, or unmyelinated.

Limitations within this experiment ******** from overuse or drying out of the single nerve, while crushing the nerve ******** alter the responses obtained, and therefore the results recorded. This causes problems of starting again on a new nerve. These discrepancies ******** overcome by closer attention to the nerve.

The ability for a nerve fibre to propagate a second AP ******** on the absolute refractory period. This period ******** responsible for the unidirectional propagation of APs along a nerve.

<table>
<thead>
<tr>
<th>Choice 1</th>
<th>Choice 2</th>
<th>Choice 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ was</td>
<td>□ were</td>
<td>□ has been</td>
</tr>
<tr>
<td>□ are</td>
<td>□ were</td>
<td>□ have been</td>
</tr>
<tr>
<td>□ have been</td>
<td>□ were</td>
<td>□ was</td>
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<td>□ was</td>
<td>□ is</td>
<td>□ has been</td>
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<tr>
<td>□ fire</td>
<td>□ fired</td>
<td>□ are fired</td>
</tr>
<tr>
<td>□ suggested</td>
<td>□ are suggested</td>
<td>□ suggest</td>
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<tr>
<td>□ resulted</td>
<td>□ result</td>
<td>□ may</td>
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<tr>
<td>□ must</td>
<td>□ may</td>
<td>□ will</td>
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<td>□ are</td>
<td>□ were</td>
<td>□ could be</td>
</tr>
<tr>
<td>□ depended</td>
<td>□ is depended</td>
<td>□ depends</td>
</tr>
<tr>
<td>□ was</td>
<td>□ is</td>
<td>□ has been</td>
</tr>
</tbody>
</table>
APPENDIX 3 : Focus group protocol example

Protocol for focus group held after Questionnaire 2, *Writing the nerve report*

1. Welcome to participants

2. Introduction: what I’d like for us to talk about today is some of the ratings students gave on the questionnaire for preparing and writing their nerve report. I’d like us to discuss why some students rated their performance on these aspects as ‘only fair’ or ‘poor’.

3. (on the visualiser for discussion)

Percentage of students rating their performance as ‘only fair’ or ‘poor’ on the following aspects of preparing and/or writing their nerve report (numbered according to the questionnaire)

Only fair or poor

1. Giving myself enough time for the task 32%

3. Understanding what was expected for writing the report based on instructions and marking criteria on the Web 24%

4. Knowing exactly how to **organise** the introduction and discussion 28%

5. Selecting relevant topics/concepts from my resources for my report 24%

9. Writing the hypothesis(es) 20%

10. Interpreting the results 28%

11. Writing the conclusion 36%

4. **Now let’s reflect on your writing of the nerve report.** What do you think would have helped you to write a better nerve prac report?
APPENDIX 4 : Ethics Committee Documents

Ethics Committee Approval Document

The University of Sydney

NSW 2006 Australia

Human Research Ethics Committee
www.usyd.edu.au/ethics/human
Manager:
Gail Briddy
Telephone: (02) 9351 4811
Facsimile: (02) 9351 6706
Email: gbriddy@usyd.edu.au
Rooms L4.14 & L4.13 Main Quadrangle A14

Human Secretariat
Telephone: (02) 9351 5000
(02) 9351 5008
(02) 9351 4474
Facsimile: (02) 9351 6210
Email: melbarrett@usyd.edu.au
bitemper@usyd.edu.au

7 December 2005

Ms H Drury
Learning Centre
Student Services
Education Building – A35
The University of Sydney

Dear Ms Drury

Thank you for your correspondence dated 23 November 2005 addressing comments made to you by the Committee. After considering the additional information, the Executive Committee approved your protocol entitled “A flexible electronic report-writing tool (FLERT) in Physiology: Investigating its development and evaluating student learning”

Details of the approval are as follows:

Ref No.: 12-2005/2/8665
Approval Period: December 2005 to December 2006
Completion Date of Project: 31 December 2007
Authorised Personnel: Ms H Drury
Ms J Jones

To comply with the National Statement on Ethical Conduct in Research Involving Humans, and in line with the Human Research Ethics Committee (HREC) requirements this approval is for a 12-month period. At the end of the approval period, the HREC will approve extensions for a further 12-month, subject to a satisfactory annual report. The HREC will forward to you an Annual Progress Report form, at the end of each 12-month period. Your report will be due on 31 December 2005.

Conditions of Approval Applicable to all Projects

(1) Modifications to the protocol cannot proceed until such approval is obtained in writing. (Refer to the website www.usyd.edu.au/ethics/human under ‘Forms and Guides’ for a Modification Form).

(2) The confidentiality and anonymity of all research subjects is maintained at all times, except as required by law.
(3) All research subjects are provided with a Participant Information Sheet and Consent Form, unless otherwise agreed by the Committee.

(4) The Participant Information Sheet and Consent Form are to be on University of Sydney letterhead and include the full title of the research project and telephone contacts for the researchers, unless otherwise agreed by the Committee.

(5) The following statement must appear on the bottom of the Participant Information Sheet. Any person with concerns or complaints about the conduct of a research study can contact the Manager, Ethics Administration, University of Sydney, on (02) 9351 4811.

(6) The standard University policy concerning storage of data and tapes should be followed. While temporary storage of data or tapes at the researcher's home or an off-campus site is acceptable during the active transcription phase of the project, permanent storage should be at a secure, University controlled site for a minimum of seven years.

(7) A report and a copy of any published material should be provided at the completion of the Project.

Yours sincerely

Associate Professor J D Watson
Chairman
Human Research Ethics Committee

Encl.
- Participant Information Statement
- Student Participant Information Statement
- Team Member Participant Consent Form
- Student Participant Consent Form – Completing Questionnaire and Allowing Copying of Reports and Recording of Marks
- Student Participant Consent Form – Interview/Focus Group/Think-Aloud Protocol/Tracking of Interactions with the Computer
- Questionnaire
- Recruitment Advertisement

cc Ms Janet Jones, Learning Centre, Education Building – A35, University of Sydney
## Project Completion Report

### THE UNIVERSITY OF SYDNEY
HUMAN RESEARCH ETHICS COMMITTEE
COMPLETION REPORT FORM

**RESEARCHERS MUST COMPLETE ALL SECTIONS**

<table>
<thead>
<tr>
<th>Project Number</th>
<th>Project title</th>
<th>Approval Date</th>
<th>Completion Date</th>
</tr>
</thead>
</table>

#### SECTION 1

<table>
<thead>
<tr>
<th><strong>Researchers current contact details</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chief Investigator</strong></td>
</tr>
<tr>
<td><strong>Name:</strong> Helen Drury</td>
</tr>
<tr>
<td><strong>Department or Full postal address:</strong> Learning Centre, Education Building A35</td>
</tr>
<tr>
<td><strong>Phone 1:</strong> 9351 3853</td>
</tr>
<tr>
<td><strong>Email:</strong> <a href="mailto:h.drury@usyd.edu.au">h.drury@usyd.edu.au</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Co-investigator</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name:</strong> Janet Jones</td>
</tr>
<tr>
<td><strong>Department or Full postal address:</strong> Learning Centre, Education Building A35</td>
</tr>
<tr>
<td><strong>Phone 1:</strong> 9351 3853</td>
</tr>
<tr>
<td><strong>Email:</strong> <a href="mailto:j.jones@usyd.edu.au">j.jones@usyd.edu.au</a></td>
</tr>
</tbody>
</table>

Please copy, paste and complete table for additional researchers.

<table>
<thead>
<tr>
<th><strong>Number of Subjects</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>550</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Location where the project was conducted</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Sydney, Discipline of Physiology</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Please advise if any publications resulted from this study.</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistical analysis of data from this study was finalised in December 2008. Publications will follow in 2009/10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Was the approval subject to certain conditions? Have these conditions been met?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>If not, please give details.</td>
</tr>
<tr>
<td>Yes, the conditions have been met</td>
</tr>
</tbody>
</table>

316
**SECTION 2**

Please provide brief details on the outcomes or benefits resulting from the research and any further avenues of research, which may have opened up as a result. The Committee is particularly interested in your comments on ethical issues.

The development of FLERT has been instrumental in the project team gaining a prestigious ALTC competitive grant to create an online learning environment for report writing in sciences and engineering which will be launched in Semester 1, 2009. The FLERT program has been the prototype for this online learning environment and this research has informed the design process. The insights gained from this study have informed the approach to evaluation of student learning of report writing in the online learning environment which will be carried out in 2009.

------------------

**Chief Investigator**

16/1/2009

Date

Dr Janet Jones (on leave until the end of January 2009)

Co-Investigator
RECRUITMENT ADVERTISEMENT

DEPARTMENT OF PHYSIOLOGY AND THE LEARNING CENTRE: JOINT PROJECT

What are we doing?
Developing an online program to help you write your 2nd year laboratory report

When will this happen:
Week, Semester 1, 2006

What will the program look like:
It will contain explanations, examples and interactive exercises on the content, structure and language of each part of the laboratory report and also extra materials to help you understand the concepts behind the report you will have to write.

We have already developed programs for biology, biochemistry and chemical engineering.

Student comments:
"exercises were very good - gave practical examples"
"it is a good program - we 'd like another one for professional report writing"
"a great program"  "It helped me a lot"

What we would like you to do:
volunteer to be part of our evaluation project

Project Title: Development and evaluation of FLERT (A flexible electronic report-writing tool (FLERT) in Physiology)

What does this involve:
1. Giving your consent for us to photocopy your lab report and record your marks
2. Fill in a 2 page questionnaire after you have used the program
3. Take part in a focus group or interview or tell us how you wrote your report using the program
Participation Information Statements and Consent Forms

The University of Sydney

Learning Centre
Student Services

UNIVERSITY OF SYDNEY
HUMAN ETHICS COMMITTEE
APPROVED
DATE: \Dec 05

TEAM MEMBER PARTICIPANT INFORMATION STATEMENT

Research Project Title: Development and evaluation of FLERT (A flexible electronic report-writing tool (FLERT) in Physiology)

This study will investigate the development of an online program (FLERT) to support student learning of report writing in second year Physiology. This program is being developed by a team involving subject area specialists, language and learning specialists, programmers and student users. The purpose of the study is to identify key factors in the creation of an effective user-centred learning environment by recording and analysing interactions among team members. In addition, the learning experiences of students using prototypes and the completed program will be recorded and analysed to assess what and how students have learned from the program.

This study is being conducted by Helen Drury and Janet Jones, lecturers at the Learning Centre, The University of Sydney.

The study will involve:

- Both audio and video recordings of collaborative meetings among team members. These recordings are necessary as it would be impossible to note every aspect - both verbal and visual - of the interactions among team members with on-going program designs without these media. These recordings will be used for research purposes only and once data is analysed, they will be stored in locked cabinets at the Learning Centre. Only anonymous transcripts from these recordings will be presented as part of the dissemination of project outcomes.
- Collection of documents including emails and minutes of meetings and design documents.
- Audio and/or video recordings, researcher observation, software tracking and think-aloud records of student team members’ interactions with the program. Audio and/or video recordings will allow for a complete record of student interactions with the computer program. Recordings will only be used for research purposes and will be stored in locked cabinets at the Learning Centre once data is analysed. They will play no part in any presentation arising from the dissemination of research outcomes.
- Interviews with team members.

If you decide to take part in this study as a team member, the amount of time you will need to devote to the project is as follows:

- Team members who consent to be part of the project will need to give up approximately 2 hours of their time for interviews over the duration of the project. Student team members will be recompensed for their time.

1 of 2
- Student team members who consent to be part of the project will need to give up approximately 5 hours of their time, approximately 2 hours for recorded interactions with the program and 3 hours over a 4 week period to record their experiences of writing their report as think-aloud protocols. Students will receive movie or book tokens for their participation.

In order to carry out this research project, we will be asking for your consent (see separate form) to carry out these investigations and collect this data. This information is confidential. Any report based on the findings of this research will not contain information about you as an individual.

Please note that taking part in any way in this project is entirely voluntary. You can choose not to take part in this study or withdraw from the study at any time, without affecting your relationship with the researcher(s) now or in the future.

Thank you for your cooperation.

Helen Drury, Lecturer, Learning Centre 9351 3853

Any person with concerns or complaints about the conduct of a research study can contact the Manager for Ethics Administration, University of Sydney on (02) 9351 4811.

UNIVERSITY OF SYDNEY
HUMAN ETHICS COMMITTEE
APPROVED
DATE: 1 Dec 05

2 of 2
Research Project Title: Development and evaluation of FLERT (A flexible electronic report-writing tool (FLERT) in Physiology)

In semester 1, 2006, the Department of Physiology in collaboration with the Learning Centre and the Flexible Online Learning Team, Sydney University will be introducing an online program for writing a laboratory report in Physiology. In order to assess the effectiveness of this program, lecturers from the Learning Centre will be carrying out a number of different evaluations. These include:

- a questionnaire to gain feedback on your use of the program and how you learned from the program
- focus group and interviews with a small number of student volunteers for gaining more in depth information on their use of the program and their learning
- think-aloud protocols with a small number of student volunteers to gain insights into how they went about writing their report using the program
- software tracking of student interactions with the program
- audio and/or video recordings and researcher observation of a small number of student volunteers’ interactions with the program.

We will also be analysing your report assignment and recording your report marks to assess your ability to write a report in Physiology after you have had a chance to use the web-based program.

In order to do this, we will be asking for your consent (on separate forms) to carry out these evaluations and to provide us with your student number with each evaluation. We are requesting this because it will be helpful to correlate your questionnaire responses with your report outcomes. This information and your responses to the questionnaire are confidential. Once your student number has been matched with your test and report outcomes and questionnaire responses, we will assign a new number to each student and discard your student number so that your identity will be completely protected. Your completed questionnaires will not be made available to your lecturers or other staff members from your course. Any report based on the findings of this research will not contain information about you as an individual.

Please note that taking part in any way in this project is entirely voluntary. You can choose not to take part in this study or withdraw at any time.
Completing the questionnaire will take about 10 to 20 mins and time will be set aside in one of your tutorials to do this. Students who wish to take part in a focus group and/or interview will need to set aside about 30 mins of their time. Students who wish to take part in the recordings of their interactions with the computer program and the think-aloud protocols will need to set aside approximately 5 hours of their time, approximately 2 hours for recorded interactions with the program and approximately 3 hrs over a 4 week period to record their think-aloud protocols. The time student volunteers give to the project will be rewarded with movie or book tokens.

Thank you for your cooperation. Helen Drury, Lecturer, Learning Centre 9351 3853

Any person with concerns or complaints about the conduct of a research study can contact the Manager for Ethics Administration, University of Sydney on (02) 9351 4811.
TEAM MEMBER PARTICIPANT CONSENT FORM

Research Project Title: Development and evaluation of FLERT (A flexible electronic report-writing tool (FLERT) in Physiology)

This project aims to investigate the development of an online program for report writing in Physiology and to evaluate student learning facilitated by this program. This program has been developed collaboratively with staff and students from the Department of Physiology, the Learning Centre and the Flexible Online Learning Team at the University of Sydney. The development part of this research project consists of recording of collaborative team interactions (both audio and video) and collection of associated documents including emails, design drawings, minutes of meetings which contribute to the completed FLERT program. Development data will be used for program and course improvements and research purposes only.

If you have any questions about this project, please contact Helen Drury at the Learning Centre on 9351 3853.

If you wish to make a complaint about the conduct of the research project, please contact the Manager for Ethics Administration, University of Sydney on (02) 9351 4811.

(please print)

I, ........................................................................................................ (name)
of ..................................................................................................... (address)
have read and understood the above information.

• I am aware of what my participation involves
• I freely choose to participate in this project and consent to audio and/or video recordings of my participation in team meetings and allow documentation to be collected. I understand I can withdraw at any time
• I understand that my contribution is confidential
• I hereby agree to participate

Signature: .........................................................
Date: ............................................................

1 of 1
STUDENT PARTICIPANT CONSENT FORM FOR INTERVIEW/FOCUS GROUP / THINK-ALOUD PROTOCOL / TRACKING OF INTERACTIONS WITH THE COMPUTER

Research Project Title: Development and evaluation of FLERT (A flexible electronic report-writing tool (FLERT) in Physiology)

This project aims to investigate the development of an online program for report writing in Physiology and to evaluate student learning facilitated by this program. This program has been developed collaboratively with staff and students from the Department of Physiology, the Learning Centre and the Flexible Online Learning Team at the University of Sydney. This research project consists of data collection from a questionnaire, assessment of reports written by students, focus group and interview data, think-aloud protocols and tracking and recording of student interactions with the computer (using audio and/or video and/or researcher observation). Development and evaluation data will be used for program and course improvements and research purposes only.

If you have any questions about this project, please contact Helen Drury at the Learning Centre on 9351 3853.

If you wish to make a complaint about the conduct of the research project, please contact the Manager for Ethics Administration, University of Sydney on (02) 9351 4811.

(please print)

1. ................................................................. (name)

of ................................................................. (address)

have read and understood the above information.

• I am aware of what my participation involves
• I freely choose to participate in this interview / focus group / think-aloud protocol / recorded interaction with the computer (using audio and/or video and/or researcher observation) and understand I can withdraw at any time
• I understand that my contribution is confidential
• I hereby agree to participate

Signature: ............................................................. Date: ............................................................

UNIVERSITY OF SYDNEY
HUMAN ETHICS COMMITTEE

APPROVED
DATE: 1 Dec 05

1 of 1
STUDENT PARTICIPANT CONSENT FORM FOR COMPLETING QUESTIONNAIRE AND 
ALLOWING COPYING OF REPORTS AND RECORDING OF MARKS

Research Project Title: Development and evaluation of FLERT (A flexible electronic report-
writing tool (FLERT) in Physiology)

This project aims to investigate the development of an online program for report writing in Physiology and
to evaluate student learning facilitated by this program. This program has been developed collaboratively
with staff and students from the Department of Physiology, the Learning Centre and the Flexible Online
Learning Team at the University of Sydney. This research project consists of data collection from a
questionnaire and assessment of reports written by students, focus group and interview data, think-aloud
protocols and tracking and recording of student interactions with the computer. Development and evaluation
data will be used for program and course improvements and research purposes only.

If you have any questions about this project, please contact Helen Drury at the Learning Centre on
9351 3853.
If you wish to make a complaint about the conduct of the research project, please contact the
Manager for Ethics Administration, University of Sydney on (02) 9351 4811.

(name)
(address)

have read and understood the above information and the Information on the Participant Information Sheet.

- I am aware of what my participation involves
- I freely choose to participate in this project by providing my student identity number, completing a
  questionnaire and allowing my report to be photocopied and my marks recorded. I understand I can
  withdraw at any time
- I understand that my contribution is confidential
- I hereby agree to participate

Student Identity Number: ..........................................................

Signature: ..............................................................................

Date: ....................................................................................

1 of 1