Science, Environment, Engineering and Technology Group
School of Information and Communication Technology
Institute for Integrated and Intelligent Systems
Griffith University

The influence of metropolitan Brisbane middle-school ICT experiences on girls' ICT study and career choices

Submitted in fulfilment of the requirements of the degree of
Doctor of Philosophy

KAYLENE LISA CLAYTON
B.InterComp B.InfTech(Hons)

December, 2007

Not to be reproduced without permission or full reference to the author

ABSTRACT

The under-representation of women entering into Information and Communication Technology (ICT) programs is a long-standing and increasing problem, commonly referred to as the shrinking IT pipeline. Over the past two decades, numerous studies have investigated the low and declining female participation in the ICT educational and vocational pipeline and have identified various factors that may influence female ICT career decisions. Some of the factors identified include national and organisational culture, lack of, or poor quality ICT career information, societal influences, discriminatory work environments, practices and policies, along with the need for appropriate ICT role models. If you add to this mixture the changing and individual needs of the students, the problem becomes increasingly complex. While some studies in this area have contributed by identifying issues and making recommendations for change, some of which have been instituted, many of the efforts have centred on senior secondary school and tertiary students. However, many of the decisions that affect future career choices have already been made by this stage and there is a lack of research exploring Australian primary and lower secondary student ICT experiences and attitudes, prior to their elective subject selections.

This thesis, conducted in the emerging transdisciplinary field of Social Informatics, involves an embedded single case study of metropolitan Brisbane middle-school students. It explored the ICT attitudes and perceptions of Year 4 and Year 8 students, their ICT experiences at home and at school and the influence that these ICT perceptions, attitudes and experiences have on girls' ICT study and career choices. This study drew on literature from a variety of research disciplines including IS and computer science, education and educational psychology, career psychology, psychology, gender science and sociology. The setting for the case study involved three school types, with strong links between the Year 4 and Year 8 levels, including a government (free tuition) coeducational school, a private (tuition charged) female single-sex school and a private (tuition charged) coeducational school.

In total, 58 Year 4 and Year 8 classroom visits took place. The classroom observations lasted from one lesson block (approximately 1 hour) up to a full day, depending on the availability of the students and the type of activities planned. Eleven semi-structured group interviews were held involving 49 Year 4 students and 20 Year 8 students, and individual semi-structured interviews were conducted with six teachers. These interviews generally took place at the end of the respective school term and lasted for approximately thirty minutes each. Information about

© 2007 Kaylene Clayton

classroom ICT artefacts and documents that provided information about curriculum, subject availability and subject selection options were also collected as they became available.

The main findings were that middle-school girls' study and career choices take place in an environment specific to the culture in which the choices are made, in this case the Australian context, and involve social and structural factors and individual attributes. Socioeconomic factors further shaped ICT access, ICT resources and teaching to impact on the middle-school girls' interest in ICT study and careers. The social factors included socialisers such as family and peer groups who act as positive and negative role models and share gender and ICT stereotypes. Parents also offered career advice to the students, but none of the parents encouraged the students to be involved in ICT pathways. The girls were enthusiastic and confident users of ICT, but some of the Year 8 girls were observed downplaying their scholastic ability, possibly to fit in with their peers. The media was also found to influence and reinforce the negative perceptions of gender roles and ICT stereotypes.

Structural factors, including the teacher's interest and training in ICT, the curriculum content and teaching practice, and reliability of ICT resources, had a positive or negative influence on the students' ICT experiences. These experiences were important to the students' motivation to choose ICT study and career paths. The Year 8 Computer Studies classes seemed to be used as a form of electronic babysitting, with the content and delivery given little importance. Moreover, this research confirmed that ICT subjects are regarded as being synonymous with computer literacy, and low-level skills are being taught in these classes. This study also demonstrated how the teachers' ICT interest and enthusiasm influenced the implementation of ICT in their classroom and the enthusiasm of their students. All of the students in this study had access to computers at school and most had at least shared access at home. However, poor quality and unreliable ICT resources had a strong negative impact on the students' desire to engage in ICT study or career paths. These ICT resources differed between schools, with low socioeconomic status schools having unreliable and poorly maintained ICT resources.

Individual attributes, such as personality, aptitude and attitudes; goals and general schemata; subjective task value and interpretations of experience, were identified as being influential to girls' ICT study and career choices. This study demonstrated that, by encouraging peer support and allowing exploration, the teachers increased the girls' confidence and enthusiasm for ICT. Unlike the boys, the girls did not explore the computer, were generally compliant with the rules and concentrated on completing their work. However, the girls' demonstrated compliance with classroom expectations and being careful with resources may discourage tinkering, which has

© 2007 Kaylene Clayton

been linked to increasing ICT interest and preparation for future ICT studies. While the girls were interested in using ICT, they expressed an 'I can, but I don't want to' attitude towards ICT or being involved in the ICT field. Finally, the girls did not enrol in the ICT subjects as they felt that they did not fit the stereotypical image of someone who was interested in ICT.

This research has shown that interest in ICT wanes in the late middle-school years and it is highly probable that most of the students in this study will not pursue an ICT career. As a result of this research, a Model of Girls' ICT Study and Career Choices has been developed to illustrate the factors, and their interrelationships, that influence middle-school girls' study and career choices. Furthermore, a number of recommendations for education authorities, schools and teachers have been proposed to address the problem.

© 2007 Kaylene Clayton

STATEMENT OF ORIGINALITY

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except when due reference is made in the thesis itself.

_____ _____

Kaylene Clayton Date

TABLE OF CONTENTS

CHAPTER 1 INTRODUCTION 1

1.1 INTRODUCTION 1
1.2 STATEMENT OF THE PROBLEM 2
1.3 RESEARCH AIMS AND METHOD 3
1.4 RESEARCH CONTRIBUTIONS 5
1.5 JUSTIFICATION FOR AND SIGNIFICANCE OF THE TOPIC 6
1.5.1 Personal Experiences in the ICT Educational Pipeline 7
1.6 THE QUEENSLAND EDUCATIONAL SYSTEM 8
1.6.1 State-wide Initiatives for Girls and ICT 9
1.7 EXPLANATION OF TERMS 10
1.8 OUTLINE OF THESIS 11
1.9 CONCLUSION 13

CHAPTER 2 LITERATURE REVIEW 14

2.1 INTRODUCTION 14
2.2 CULTURAL CONTEXT 15
2.2.1 Socialisation 17
2.3 SOCIAL FACTORS 18
2.3.1 Family 18
2.3.2 Peer Group 19
2.3.3 Media 20
2.3.4 Role Models 22
2.3.5 Gender Stereotypes 23
2.3.6 ICT Stereotypes 25
2.4 STRUCTURAL FACTORS 27
2.4.1 Teacher 27
2.4.2 School Environment 29
2.4.3 ICT Access and Resources 31
2.4.4 Curriculum 33
2.5 INDIVIDUAL ATTRIBUTES 35
2.5.1 Self-concept of Ability in ICT 35
2.5.2 Interest in ICT 37
2.5.3 Utility of ICT 38
2.6 SOCIOECONOMIC FACTORS 40
2.7 THEORIES AND MODELS FOR ICT RECRUITMENT RESEARCH 41
2.8 CONCLUSION 43

CHAPTER 3 THEORIES AND MODELS FOR STUDY AND CAREER RECRUITMENT 45

3.1 INTRODUCTION 45
3.1.1 Nurture Versus Nature 46
3.2 ECCLES, WIGFIELD, AND COLLEAGUES' EXPECTANCY-VALUE MODEL OF ACHIEVEMENT-RELATED CHOICES 47
3.2.1 Cultural Milieu 49
3.2.2 Socialisers' Beliefs and Behaviours 50
3.2.3 Interpretation of Past Experiences and Aptitudes 52
3.2.4 Child's Goals and General Self-Schemata 53
3.2.5 Subjective Task Value 54
3.2.6 Expectations for Success 56
3.3 GOTTFREDSON'S THEORY OF CIRCUMSCRIPTION, COMPROMISE AND SELF-CREATION .. 56
3.3.1 Circumscription 57

3.3.2 Compromise 61
3.3.3 Self-creation 62
3.4 ADYA AND KAISER'S MODEL OF GIRLS' CAREER CHOICES 64
3.4.1 Social Factors 65
3.4.2 Structural Factors 67
3.4.3 Individual Differences 68
3.5 CONCEPTUAL MODEL FOR GIRLS' ICT STUDY AND CAREER CHOICES 70
3.6 CONCLUSION 72

CHAPTER 4 METHODOLOGY 74

4.1 INTRODUCTION 74
4.2 RESEARCH PARADIGMS IN INFORMATION SYSTEMS 74
4.2.1 Locating This Study 76
4.2.2 Social Informatics 77
4.3 DEVELOPMENT OF RESEARCH QUESTIONS 78
4.4 METHODOLOGY 80
4.4.1 Case Study 81
4.4.2 Data Collection Techniques 83
4.5 CONDUCT OF THE STUDY 88
4.5.1 Selection of Cases 88
4.5.2 Ethical Considerations 93
4.5.3 Data Collection 94
4.5.4 Data Collection in Retrospect 98
4.5.5 Data Analysis and Reporting 100
4.5.6 Judging the Research Approach 106
4.6 CONCLUSION 110

CHAPTER 5 YEAR 4 ICT EXPERIENCES 112

5.1 INTRODUCTION 112
5.1.1 The Year 4 Schools and Participants 112
5.2 CULTURAL CONTEXT 114
5.2.1 Summary of Cultural Context Key Points from the Year 4 Data 116
5.3 SOCIAL FACTORS 116
5.3.1 Family 116
5.3.2 Peer Group 118
5.3.3 Media 119
5.3.4 Role Models 119
5.3.5 Gender Stereotypes and Differences 121
5.3.6 ICT Stereotypes 122
5.3.7 Summary of Social Factor Key Points from the Year 4 Data 124
5.4 STRUCTURAL FACTORS 125
5.4.1 Teacher 125
5.4.2 School ICT Access 127
5.4.3 Home ICT Access 130
5.4.4 School Type 132
5.4.5 ICT Related Resources 132
5.4.6 Curriculum and Teaching 134
5.4.7 Summary of Structural Factor Key Points from the Year 4 Data 137
5.5 INDIVIDUAL ATTRIBUTES 139
5.5.1 Individual Aptitudes, Personality and Attitudes 139
5.5.2 Interpretations of Experiences 141
5.5.3 Goals and General Self-Schemata 142
5.5.4 Subjective Task Value 143
5.5.5 Summary of Individual Attributes Key Points from the Year 4 Data 144

© 2007 Kaylene Clayton

5.6 SOCIOECONOMIC STATUS 145
5.6.1 Summary of Socioeconomic Status Key Points from the Year 4 Data 147
5.7 STUDY AND CAREER CHOICE 147
5.7.1 Orientation to Size and Power 148
5.7.2 Orientation to Sex Roles 148
5.7.3 Orientation to Social Valuation 149
5.7.4 Summary of Study and Career Choice Key Points from the Year 4 Data 149
5.8 CONCLUSION 150

CHAPTER 6 YEAR 8 ICT EXPERIENCES 152

6.1 INTRODUCTION 152
6.1.1 The Year 8 Schools and Participants 152
6.2 CULTURAL CONTEXT 154
6.3 SOCIAL FACTORS 155
6.3.1 Family 155
6.3.2 Peer Group 157
6.3.3 Media 158
6.3.4 Role Models 159
6.3.5 Gender Stereotypes and Differences 160
6.3.6 ICT Stereotypes 162
6.3.7 Summary of Social Factor Key Points from the Year 8 Data 163
6.4 STRUCTURAL FACTORS 164
6.4.1 Teacher 164
6.4.2 School ICT Access 168
6.4.3 Home ICT Access 171
6.4.4 School Type 172
6.4.5 ICT Related Resources 174
6.4.6 Curriculum and Teaching 176
6.4.7 Summary of Structural Factor Key Points from the Year 8 Data 179
6.5 INDIVIDUAL ATTRIBUTES 180
6.5.1 Individual Aptitudes, Personality and Attitudes 180
6.5.2 Interpretations of Experiences 183
6.5.3 Goals and General Self-Schemata 184
6.5.4 Subjective Task Value 185
6.5.5 Summary of Individual Attribute Key Points from the Year 8 Data 187
6.6 SOCIOECONOMIC STATUS 188
6.6.1 Summary of Socioeconomic Status Key Points from the Year 8 Data 190
6.7 STUDY AND CAREER CHOICE 190
6.7.1 Orientation to Size and Power 190
6.7.2 Orientation to Sex Roles 190
6.7.3 Orientation to Social Valuation 191
6.7.4 Orientation to the Internal, Unique Self 192
6.7.5 Summary of Study and Career Choice Key Points from the Year 8 Data 192
6.8 CONCLUSION 193

CHAPTER 7 MODEL OF GIRLS' ICT STUDY AND CAREER CHOICES 195

7.1 INTRODUCTION 195
7.1.1 The Schools and Participants 195
7.1.2 Initial Conceptual Model for Girls' ICT Study and Career Choices 197
7.2 CULTURAL CONTEXT 198
7.3 SOCIAL FACTORS 200
7.3.1 Family 200
7.3.2 Peer Group 201
7.3.3 Media 202

7.3.4 Role Models 203
7.3.5 Gender Stereotypes and Differences 205
7.3.6 ICT Stereotypes 207
7.4 STRUCTURAL FACTORS 209
7.4.1 Teacher 209
7.4.2 School ICT Access 211
7.4.3 Home ICT Access 212
7.4.4 School Type 214
7.4.5 ICT Related Resources 215
7.4.6 Curriculum and Teaching 217
7.5 INDIVIDUAL ATTRIBUTES 220
7.5.1 Individual Aptitudes, Personality and Attitudes 220
7.5.2 Interpretations of Experiences 223
7.5.3 Goals and General Self-Schemata 225
7.5.4 Subjective Task Value 226
7.6 SOCIOECONOMIC STATUS 227
7.7 STUDY AND CAREER CHOICE 229
7.7.1 Orientation to Size and Power 229
7.7.2 Orientation to Sex Roles 229
7.7.3 Orientation to Social Valuation 229
7.7.4 Orientation to the Internal, Unique Self 230
7.8 MODEL OF GIRLS' ICT STUDY AND CAREER CHOICES 231
7.9 CONCLUSION 236

CHAPTER 8 CONCLUSIONS AND IMPLICATIONS 238

8.1 INTRODUCTION 238
8.2 FULFILMENT OF RESEARCH OBJECTIVES 238
8.2.1 The nature of ICT experiences at the Year 4 level 240
8.2.2 The nature of ICT experiences at the Year 8 level 243
8.2.3 Gender differences in ICT experiences and middle-school ICT classrooms 246
8.2.4 Influence of ICT experiences on girls' ICT study and career choices 249
8.3 CONTRIBUTION TO KNOWLEDGE 253
8.4 RECOMMENDATIONS FOR THE TEACHING OF ICT IN SCHOOLS 254
8.4.1 Recommendations for Education Authorities 254
8.4.2 Recommendations for Schools 255
8.4.3 Recommendations for Teachers 255
8.5 STUDY LIMITATIONS 256
8.6 FUTURE RESEARCH 257
8.7 FINAL COMMENTS 258

REFERENCES 260

APPENDIX A INTERVIEW QUESTIONS 272

APPENDIX B CONSENT PACKAGES 276

APPENDIX C TIMELINE OF RESEARCH ACTIVITIES 282

APPENDIX D PINK HILL ICT CURRICULUM 283

LIST OF FIGURES

Figure 3-1 Eccles, Wigfield, and colleagues' Expectancy-value Model of Achievement-related Choices (Wigfield and Eccles, 2000) 48
Figure 3-2 Model of Girls' Career Choices (Adya and Kaiser, 2005) 64
Figure 3-3 Initial conceptual model for the study 70
Figure 7-1 Initial conceptual model for the study 198
Figure 7-2 Model of Girls' ICT Study and Career Choices 231

LIST OF TABLES

Table 1-1 Summary of links between research objectives, research techniques and chapters 4
Table 1-2 Stages of primary and secondary education in Queensland 8
Table 4-1 Summary of links between research objectives, research techniques and chapters 81
Table 4-2 Summary of school demographics 90
Table 4-3 Summary of research participants 94
Table 4-4 Summary of data collection at the government coeducational school 96
Table 4-5 Summary of data collection at the female single-sex school 97
Table 4-6 Thematic framework for the research 103
Table 5-1 Summary of school demographics 113
Table 5-2 Summary of research participants 114
Table 5-3 Summary of school suburb demographics 114
Table 5-4 Summary of skills and activities observed in the Year 4 classrooms 135
Table 6-1 Summary of school demographics 153
Table 6-2 Summary of research participants 154
Table 6-3 Summary of school suburb demographics 154
Table 7-1 Summary of school demographics 196

ACKNOWLEDGMENTS

I am indebted to the participating individuals and organisations who generously gave their time, energy and expertise throughout my research project. Without the cooperation of the schools, students and parents, this study could not have been possible. In particular, I would like to thank Colleen Stieler for her kindness and wise insights into the world of education.

I would also like to publicly thank the many people who have been instrumental in the vision of my future. I could not have arrived at this point without the faith of my friends, my teachers and my family, who have inspired and encouraged me during my studies.

I would like to express my gratitude to my supervisors Associate Professor Liisa von Hellens and Dr Sue Nielsen for their kindness. They are two of the wisest women that I have had the privilege of meeting and working with.

Dr Pat Halloran, thank you for your friendship, enduring support and belief in me throughout my undergraduate and postgraduate years. To the members of the shoe group research meetings – thank you for your encouragement, support, the sharing of your wisdom and the discussion of important diversions in life, like shoes and handbags. I also cannot go past crediting Dr Kerryn Hayman for opening my mind to the world of possibilities and creating the spark that I could go beyond undergraduate studies.

Final thanks must go to my family and I dedicate this thesis to you. Mum and Dad, thank you giving me a broad grounding in life. Jono and Simone, thank you for putting up with a distracted Mum while I worked on this; it has been a juggling act at times.

This thesis would not have been completed without the constant support and understanding of my husband, Jon. You have been the calming and patient influence over me through the tribulations, tantrums, tears and triumphs. Your patience and quiet belief in me over the years is etched into my memory. Always +1.

Something which we think is impossible now is not impossible in another decade.

Constance Baker Motley

Chapter 1 Introduction

1.1 Introduction

This thesis, conducted in the emerging transdisciplinary field of Social Informatics, involves an embedded single case study of Brisbane (the capital city of Queensland, Australia) middle-school students within a classroom setting. It explores the perceptions and attitudes of Year 4 and Year 8 students towards Information and Communication Technology (ICT), their ICT experiences at home and at school and the influence that these ICT perceptions, attitudes and experiences may have on girls' ICT study and career choices. Participant observation and interview data collection methods used in this case study are conducive to the exploration of this topic as they allow insight into the experiences, opinions and perceptions of the students and teachers. Further details of the methodology used are available in Chapter Four.

This thesis is interpretivist in spirit as it seeks to understand reality from the point of view of the participants' constructions. However, the dissertation views social reality as largely preconstructed, that is, social structures and institutions are difficult for individuals to resist or modify and therefore in effect appear to possess causality. Therefore, critical realism has also informed this dissertation. This approach is supported by Walsham (2006, p. 320), who sees "critical realism as one possible philosophical position underpinning interpretive research" and Walliman (2006, p. 20), who states that "different aspects of life lend themselves to different methods of interpretation". Nonetheless, it is not the purpose of this thesis to engage in a debate of the philosophical problems and incommensurability within ontological and epistemological positions.

Over the past two decades, numerous studies have investigated the low and declining female participation in the ICT educational and vocational pipeline (e.g. Adya and Kaiser, 2005; Cohoon and Aspray, 2006; Frenkle, 1990; Gürer and Camp, 2002; Margolis and Fisher, 2002; Trauth, Nielsen, and von Hellens, 2000). Furthermore, while various factors have been identified as contributing to this problem and programs have been set up to address these issues, female enrolments in ICT subjects and involvement in ICT careers continue to decline. However, much of the literature investigating and reporting on this problem deals with senior secondary school and university students, and women working in the ICT industry; there is a distinct lack of literature dealing with middle-school students, especially in the Australian context. By the time students reach the senior secondary stage of education, many of them have

progressively eliminated occupations that they perceive to be incompatible with their self-concept and abilities, and are making compromises because of the availability, or perceived availability, of their preferred occupation (Gottfredson, 2006). ICT educational and vocational paths are frequently rejected, and consequently ICT faculties in Australian universities are in crisis and are resorting to faculty mergers and academic staff redundancies in order to remain viable.

This chapter introduces the research topic by providing a statement of the problem, introducing the broad research question, describing the research aims and contributions and justifying the significance of the topic. Following this, there is a succinct description of the Queensland education system, an overview of some ICT activities the researcher has been involved in with Queensland girls, an explanation of the terms used and a brief outline of the contents of each subsequent chapter of the thesis.

1.2 Statement of the Problem

The under-representation of women entering into ICT programs is a long-standing and increasing problem, commonly referred to as “the shrinking IT (Information Technology) pipeline”. An investigation into the problem of the declining number of females entering ICT study and career paths has been under way for over two decades. However, we are no closer to solving the problem, and the decline of females entering ICT tertiary education is steadily increasing. For example, Australian universities reported that first preferences for ICT degrees were down 22% for 2004 enrolments, with females making up, at most, only 20% of that cohort (Thorp, 2003). Between 2003 and 2004, the number of female university students increased by 1.6%, but there was a corresponding 14.7% drop of women entering IT study (O'Keefe, 2005). This is a trend reflecting across many, if not all, Western countries. For example, Massachusetts Institute of Technology, Rutgers University and Carnegie Mellon University are all reporting similar decreases in enrolments (Frauenheim, 2004).

Previous research has investigated various points of view and factors that may influence female ICT career decisions. Some of the factors identified include: national and organisational culture; lack of, or poor quality ICT career information; societal influences; discriminatory work environments, practices and policies; and the need for appropriate ICT role models (e.g. Gürer and Camp, 2002; Margolis and Fisher, 2002; Trauth et al., 2000). If you add the changing and individual needs of students to this complex mixture, the problem becomes increasingly complex. While these studies have contributed by identifying issues and making recommendations for change, some of which have been instituted, this complex social problem

is worsening. Efforts need to be made to understand the ICT attitudes and perceptions of Australian middle-school students before they make decisions that will affect their future career choices, in order to understand why they are shunning ICT study programs and careers.

1.3 Research Aims and Method

In order to understand the reasons for the declining interest in ICT study and careers, especially for females, this research aims to explore the experiences of Australian middle-school students to identify the factors which influence the choice of ICT study programs in schools and subsequently tertiary institutions. In brief, the problem can be summarised in the overarching question for this study:

> **What is the nature of middle-school ICT experiences in metropolitan Brisbane schools, and what influence do these experiences have on girls' ICT study and career choices?**

To facilitate this research investigation, four sub-questions were developed and appear below:

a) What is the nature of ICT experiences at the Year 4 level?
b) What is the nature of ICT experiences at the Year 8 level?
c) Are the ICT experiences the same for boys and girls, and are there gender differences in the ICT classroom?
d) What influence do these experiences have on girls' ICT study and career choices?

To fulfil this objective and to provide a context for the research and identify key themes and gaps, a critical review of the literature relating to young females and their interest and involvement in ICT study or careers was undertaken. Where possible, the focus of this literature was on school-aged children and research in an Australian context, but a large portion of research in this field has been undertaken outside of Australia. This required the literature review to be expanded to include countries facing similar problems with the recruitment of females into the ICT field. The literature comes from a variety of research disciplines including IS and computer science, education and educational psychology, career psychology, psychology, gender science and sociology, and includes several theories and frameworks from related studies.

The research methodology is not only the structural decisions and procedures of a project, "it is a description of the chosen procedures and rationales (if any) behind them" and the "philosophy and assumptions that underlie the conduct of a research endeavour" (Shoib, Nandhakumar, and

Jones, 2006, p. 137). The methodology chosen for this study is an interpretive case study. The participant observation and interview data collection methods used in this case study allowed insight into experiences, as well as the opinions and perceptions, of the students and teachers. Where available, information about ICT artefacts in the classroom and school environments, and documents that provided information about curriculum, subject availability and subject selection options were also collected. A more detailed elaboration of the stated research question can be found in Section 4.3 of this document, while Table 1-1 links the research objective's questions to the data collection techniques used and the relevant chapter of the thesis.

Research Objective	Techniques	Chapter
Investigate literature to identify key themes related to low female interest in ICT education and careers. • Development of initial conceptual model from literature	Review of relevant literature	Chapters 2 and 3
Investigate the nature of the ICT experiences at the Year 4 level using the key themes identified in the literature review as a guide. • Sub-question a	Observation of classroom activities and environment Teacher interviews Year 4 group interviews	Chapter 5
Investigate the nature of the ICT experiences at the Year 8 level using the key themes identified in the literature review as a guide. • Sub-question b	Observation of classroom activities and environment Teacher interviews Year 8 group interviews	Chapter 6
Investigate whether the experiences are the same for boys and girls and year levels and what influence these experiences have on ICT education and career choice. • Sub-questions c and d	Observation of classroom activities Year 4 and Year 8 group interviews	Chapters 7 and 8

Table 1-1 Summary of links between research objectives, research techniques and chapters

The setting for the case study involves three school types in the Brisbane metropolitan area and focuses on Year 4 and Year 8 students (particularly girls) and their teachers. These school types include: a government (free tuition) coeducational school; a private (tuition charged) female single-sex school; and a private (tuition charged) coeducational school. Schools were chosen that had strong links between the Year 4 and Year 8 levels. This meant finding schools that catered to primary and secondary levels, or alternatively, a primary school that acted as a feeder school to the secondary school. A boundary constraint for the study was imposed to include only those schools within a 26km radius of the Brisbane Central Business District in an attempt to make the selection of schools more manageable and establish a study boundary. Further discussion of how these school types and particular schools were selected can be found in Section 4.5 of this thesis.

© 2007 Kaylene Clayton

Coeducational schools were included in order to observe the interaction of boys and girls in an ICT classroom context and to determine if the girls' ICT experiences were influenced by being in a mixed gender classroom. The female single-sex school type was included in the study to provide an insight into the Australian, female, single-sex, ICT school environment. Furthermore, to take into consideration the possible socioeconomic differences between government and private schools, both government and private coeducational schools were included to gain a more holistic view of the situation.

In total, 58 Year 4 and Year 8 classroom visits took place. The classroom observations lasted from one lesson block (approximately 1 hour) up to a full day, depending on the availability of the students and the type of activities planned. Eleven semi-structured group interviews were held involving 49 Year 4 students and 20 Year 8 students, and individual semi-structured interviews were conducted with six teachers. These interviews generally took place at the end of the respective school term and lasted for approximately thirty minutes each. Information about classroom ICT artefacts and documents that provided information about curriculum, subject availability and subject selection options were also collected as they became available. Details of the methodology used are available in Chapter Four, and Appendix C provides a timeline for the research activities in this study.

1.4 Research Contributions

Iivari, Hirschheim and Klein (1998) believe that the interpretive researcher's role is to "enrich people's understanding of their action". This research seeks to contribute rich insights into the ICT experiences of middle-school students in metropolitan Brisbane schools while addressing the dearth of Australian literature about students' ICT experiences in the middle-school years. It intends to provide a holistic view of the research problem through a fresh examination of the social and structural factors and the clarification of the individual attributes that influence middle-school girls' ICT study and career choices. Furthermore, while the outcomes of this research are specific to the contexts of the participating schools and cannot be widely generalised, a conceptual model can be developed to guide future research in the area.

The culmination of this exploration is the production of the Girls' ICT Study and Career Choices conceptual model (Figure 7-2). It is believed that this model will assist researchers and policy makers to better understand the factors influencing girls' ICT study and career choices, and inform educational practitioners when developing programs aimed at increasing girls' involvement in ICT educational and career pathways. The contributions of this research are described in Section 8.3. Furthermore, recommendations for the ways that educational

authorities, schools and teachers can have a positive influence on middle-school girls' interest in the ICT field, stemming from this research, are provided in Section 8.4.

1.5 Justification for and Significance of the Topic

ICT continues to be increasingly accepted and integrated into everyday life, and current Australian school students have had ICT integrated into their schooling since their pre-school years. Despite the vast acceptance and integration of ICT into Australian society, it has generally not translated into students' desire to create new technologies and be involved in the ICT industry. Students are rejecting tertiary ICT programs and Australian universities are currently in crisis due to low male and female ICT program enrolments. The consequence of the falling ICT enrolments in tertiary institutions is that the ICT industry is facing a chronic shortage of qualified workers for the future. For example, Foreshew (2005) states that, in 2004 to 2005, Australian ICT vacancies grew 42.79% compared to a national vacancies average of 30.96%, and the demand for ICT graduates is increasing. The Australian government has also recognised this issue and responded to the crisis by initiating the partICipaTion Summit in 2005, in an attempt to address the declining interest in ICT careers and education.

Barker and Aspray (2006) believe that there are at least four reasons why increasing female representation in the ICT domain is important. They believe that: it will increase the qualified labour pool available to drive ICT innovation and product development; ICT jobs have favourable working conditions and above average pay; it leads to diversification of the workforce; and applying ICT to solve big problems is critical to the future and the economy. It is also desirable to have designers coming from diverse gender and ethnic backgrounds, as this will improve universal usability by enhancing creativity and production through a rich mix of perspectives and ideas (Schneiderman, 2000). Furthermore, if the ICT industry fails to attract women, it will be potentially losing access to half of the pool of intelligent and innovative professionals (Gürer and Camp, 2002; Jewell and Maltby, 2001).

In international research, many learning environment factors that influence subject choice at the secondary level have been identified, but there have been relatively few Australian studies that investigate this area (Van Der Vyver, Crabb, and Lane, 2004). Furthermore, this study is significant, as most Australian studies investigating ICT enrolments in the past have solely focused on secondary school students, often in their final years of schooling, or tertiary level students. Adya and Kaiser (2005, p. 232) believe that "career genderization occurs early in an adolescent's life, possibly in middle school or the early years of high school". This fits with the aims of the research to explore middle-school student and teacher ICT perceptions and attitudes

prior to elective subject choices. These students also represent the first wave of Australian students who have been exposed to Internet technology from early in their schooling. Adya and Kaiser (2005, p. 251) reinforce this by stating that "research begun in the fourth or fifth grade will capture early formative factors".

1.5.1 Personal Experiences in the ICT Educational Pipeline

My interest in this research project stems from personal experiences in the ICT educational pipeline, and these experiences are acknowledged as being a potential source of bias (see Howcroft and Trauth, 2004, p. 202) as well as providing valuable background information. Through these experiences, I have gained insights into the ICT educational pipeline at the primary, secondary and tertiary levels.

After being introduced to computers in the mid 1990s, I quickly developed a fascination for them and I wanted to learn how to create what I was using. I commenced tertiary study in ICT and witnessed first hand the low levels of female enrolments in ICT programs. I was curious to discover why young women, especially those who have been exposed to ICT since they were very young, were not interested in studying or working in ICT areas.

During this time, I listened to my own children talking about their ICT experiences at school and realised the problem with lack of interest in ICT did not begin at the tertiary level. I have always encouraged my two teenage children in ICT. However, at my son's senior subject selection night, I was shocked to hear his teacher actively discouraging him from enrolling in a senior ICT subject by saying that "it's too difficult" and giving incorrect information about the prerequisites for tertiary ICT study. He is now the highest-ranked final-year student in a technology teaching degree, which involves engineering, robotics and electronics, and holds an industry level certificate in IT. While he has found another pathway into an ICT-related occupation, other similarly discouraged students may not.

My daughter has also spoken about the disengagement and boredom she, and her peers, felt in her compulsory Year 8 Computer Studies class. In Year 9, she chose a subject (Media), portrayed in the subject description as involving Flash programming and web design. Despite achieving well in the subject, she arranged to change to another subject in semester 2 as she felt that it did not meet her needs or match the subject description. My husband also worked as a school network administrator and computer technician for about 10 years. He introduced me to the way ICT is integrated in schools at a technical level, as well as the difficulties experienced.

© 2007 Kaylene Clayton

1.6 The Queensland Educational System

There are a number of distinct stages in the Queensland educational system. The following provides an explanation of the terms that are used throughout this study, and Table 1-2 describes the stages of primary and secondary education in Queensland.

Primary School		**Secondary School**
Prep to Year 7 (approximate ages 4 to 13)		Year 8 to Year 12 (approximate ages 12 to 18)
Junior School Phase	**Middle School Phase**	**Senior School Phase**
Prep to Year 3 (approximate ages 4 to 8)	Years 4 to 9 (approximate ages 8 to 14)	Years 10 to 12 (approximate ages 14 to 18)

Table 1-2 Stages of primary and secondary education in Queensland

At primary school, the students usually stay with the same teacher for the whole day, apart from lessons in specialist areas including Languages Other Than English (LOTE), special education support, or specialist music lessons. Secondary schools are also referred to as high schools and the government secondary school campuses are usually separate from the primary schools. The secondary school students attend classes in different rooms and are taught distinct subject areas by a variety of teachers throughout their school day. Students can generally choose a number of elective subjects from Year 9 onwards. They can also complete trade certificates and work preparation courses, as well as participate in Overall Position (OP) eligible subjects in the Senior School Phase.

The student's OP (1 to 25) and rank in terms of other Year 12 students is determined through a combination of the results of tertiary entrance exams and their OP-eligible subject results in Years 11 and 12. The OP score and rank determine eligibility for tertiary study and the choice of study program. For instance, a high OP (e.g. 1) gives a student the optimal chance of being offered a government-subsidised place in study programs such as law, physiotherapy and veterinary science, or any program that they choose. OP scores assigned to programs do not always reflect their difficulty; it is only a function of the program's popularity. For example, some difficult but unpopular programs, like computer science or software engineering, now have low OP scores (e.g. 18). The OP rating may also fluctuate from year to year.

Primary and secondary schools in Queensland break their school year up into four terms of approximately ten weeks per term. Between terms there is a break of one or two weeks, as well as a six-week summer holiday for junior and middle-school students. The school year begins in late January and finishes in mid-December. Student reports are sent home at the end of the

© 2007 Kaylene Clayton

second and fourth terms. Students attend school Monday to Friday from approximately 9am to 3pm, but there can be minor variations to the start and finish times between schools. Students must now attend school until they complete Year 12, or a Certificate III, or until they are employed for at least 25 hours per week.

Queensland teachers are required to be registered by the Queensland College of Teachers. In order to receive registration, the teacher must have completed a recognised teaching program that meets the level of professional standard required by the Queensland College of Teachers. New teachers are required to have completed either a pre-service teacher education course of at least four years of academic study including at least one year of professional (teacher) studies (for example, a Bachelor of Technology Education), or a graduate course of professional (teacher) studies (for example, a Graduate Diploma of Education – Secondary), or another recognised course of teacher education. The teacher's suitability is also assessed through various background checks and the teacher must possess a positive Working with Children 'blue card'. Teacher registration must be renewed every five years and, as part of the renewal process, the teacher must demonstrate recency of practice and ongoing professional development.

1.6.1 State-wide Initiatives for Girls and ICT

To understand the context in which this study took place, it is helpful to consider other related activities running concurrently. There are a number of ICT activities for girls run in conjunction with Education Queensland aimed at encouraging girls into ICT paths. Examples of these activities include: an annual *Technology Takes You Anywhere* day; the *Girls and ICT Group*; the *Get SET* project and the *Girls Build IT* project. Involvement in these activities helped to inform me about the context and background of the study in relation to teaching professionals and primary and secondary students.

The Brisbane *Technology Takes You Anywhere* days began in 2003 and aim to inform girls, parents, teachers and guidance officers about ICT careers. These annual events have been organised by a combination of ICT industry professionals, teachers from the government and private sectors, and tertiary education representatives. The days involve hands-on activities, demonstrations, role models and competitions and give-aways to inform girls about the opportunities available in ICT career paths. These events have expanded to include annually up to 1500 girls in Years 6 to 12, attending schools in Brisbane and surrounding areas. Involvement with these key stakeholder groups has increased my knowledge of engaging girls in ICT activities, and the restrictions, practical issues and the underlying political and cultural factors influencing educational institutions.

© 2007 Kaylene Clayton

The *Girls and ICT Group* is a group related to the *Technology Takes You Anywhere* committee and acts as a forum to share information about *Girls and ICT* activities that are happening throughout Queensland, interstate and internationally. Interested parties and representatives from industry, the tertiary education sector, government departments, government and private schools and education authorities attend these meetings. A central forum, where information is shared, helps to provide a coordinated approach to encouraging girls into the ICT domain. As part of this group, I assisted in the creation of the *Girls and ICT Framework for Action* document, which outlines future focus areas for girls and ICT activities and indicators for success. By being part of this group, I have been exposed to many initiatives and key stakeholders and their concerns about the ICT educational and vocational pipeline.

The *Get SET* project was initiated by Griffith University as it was recognised that early intervention programs were important to encourage girls into Science, Engineering and Technology (SET) careers. It was jointly funded by the Queensland Government, Education Queensland and Griffith University, and sought to encourage secondary school girls into SET further education and careers through practical activities, role models and industry visits. Research into girls and SET careers was conducted during the project, which gave me further experience in terms of conducting research in the domain and allowed me to interact with teachers and girls in a school setting.

The final initiative I have been involved in that has provided background information for the study is the *Girls Build IT* project. This project involved 32, Year 6 and Year 8 girls and their teachers from various schools. In groups of three (two students and a teacher), each group assembled a computer that was subsequently used at their school. During this project, I had the opportunity to observe female students and their teachers working together on an ICT project. It also provided the opportunity to observe operational activities and requirements in the primary and secondary school system.

1.7 Explanation of Terms

It is a non-trivial exercise to define what ICT involves, as there is a lack of clarity to what constitutes the ICT industry (von Hellens and Nielsen, 2006), due to the rapidly evolving nature of the field. However, Denning (2001) proposed redefining the IT profession into three disciplines: IT-specific disciplines (e.g. computer science, human computer interaction and robotics); IT-intensive disciplines (e.g. bioinformatics, ecommerce and information systems); and IT-supportive occupations (e.g. help desk, database administrator and network technician). The definition of ICT in this study is drawn from Hamelink (1997, p. 3) who says:

> Information and Communication Technologies (ICT) encompass all those technologies that enable the handling of information and facilitate different forms of communication among human actors, between human beings and electronic systems, and among electronic systems.

According to Henslin (1999), childhood is the period from birth to about age 12, and adolescence occurs from about ages 13 to 17. Furthermore, the generation of students who are taking part in this study are known by many names. Generation Y (born approximately 1978 to 1994) is often referred to as Generation Next, the Millennials, the IGeneration, the Net Generation and Generation WHY, amongst others (Sheahan, 2005). They are a lifestyle-centred generation who are early adopters and learners of technology and get bored easily (Sheahan, 2005). In the context of this study, 'girl' is intended to mean a female of preschool or school age, the term "woman" is used at the completion of secondary education, while "female" is used when not referring to a specific age.

In this study, the meaning of attitudes is drawn from the field of social psychology and is taken to mean "a favorable or unfavorable evaluative reaction toward something or someone, exhibited in one's beliefs, feelings, or intended behaviour" (Myers, 2002). When referred to in the research, the researcher does not intend to measure these attitudes in the research, only to identify and explore them. Furthermore, while education as well as personality and elements of self-concept are discussed within this thesis, the researcher does not have a background in education or psychology and does not profess to be an expert in these domains.

1.8 Outline of Thesis

Chapter One lays the foundation to the research and introduces the research topic by providing a statement of the problem, describing the aims of the study, including introducing the broad research question, the research aims and contributions, in addition to the justification for, and the significance of the topic. It provides a brief description of the context of the research and explains the terms used within this thesis.

Chapter Two provides a critical review of the literature related to young females, and their interest and involvement in ICT study or careers, to provide a context for the research and to identify key themes and gaps. This literature was sourced from a variety of research disciplines including IS and computer science, education and educational psychology, career psychology, psychology, gender science and sociology. In order to organise this review of literature, the

chapter is structured into five main areas including cultural, social and structural factors, individual attributes and socioeconomic factors.

Chapter Three provides a brief overview of the nurture versus nature debate and discusses in greater detail the three theories and models introduced at the end of Chapter Two. As with Wolcott (1995, p. 183), I too looked for theoretical frameworks that would "guide and clarify" my observations, data collection and the analysis of the data described in Chapters Six and Seven.

Chapter Four describes and justifies the research methodology and guiding principles used to investigate the research questions, introduced in Section 1.3, and the practical implementation of the methodology. It includes the selection of participants, how and when the data was collected at the three school types, reflections on the data collection process and the data analysis technique.

Chapter Five is the first of the two data analysis and findings chapters. It presents an analysis of the Year 4 student and teacher observational and interview data, from the three schools. These findings are informed by concepts identified in a search of relevant literature discussed in Chapter Two as well as the models and frameworks discussed in Chapter Three. The chapter explores the influence of the cultural context and social and structural factors on ICT study and career choices. It also explores individual attributes which influence ICT study and career choices and delves into the effects of socioeconomic status on the schools and on students' ICT study and career choices.

Chapter Six is the second of the two data analysis and findings chapters and follows the same structure and format as Chapter Five. It presents an analysis of the Year 8 student and teacher observational and interview data, from the three different schools. This data collection was informed by concepts identified in a search of relevant literature discussed in Chapter Two, and the theoretical models and frameworks described and discussed in Chapter Three.

Chapter Seven presents a systematic discussion of the factors identified in the analysis of the data found in Chapters Five and Six, to give an overall picture of the factors influencing ICT career choice of Brisbane middle-school students. For the most part, it follows the structure of Chapters Five and Six, with the addition of a final section, which presents and justifies the new Model for Girls' ICT Study and Career Choices.

© 2007 Kaylene Clayton

Chapter Eight discusses the fulfilment of the research objectives and presents the research contributions, recommendations and the implications of this study. The final sections identify the limitations of the study and provide suggestions for future research directions in this area.

Appendix A provides the pool of questions used for the Year 4 and Year 8 student and teacher interviews. Appendix B contains a sample introductory letter sent to the schools and the consent packages used for the teachers, parents and students. The timeline for the research activities in this project is provided in Appendix C. Appendix D provides the female single-sex school ICT curriculum for Years 1 to 10 as an example of an ICT curriculum.

1.9 Conclusion

This chapter laid the foundation of the thesis which aims to explore the ICT educational experiences of middle-school Brisbane students and the influence that these experiences have on ICT study and career choices. It introduced the research topic by providing a statement of the problem, describing the aims of the study, including introducing the broad research question, the research aims and contributions, in addition to the justification for, and the significance of the topic. It also provided a description of the Queensland education system and some ICT initiatives for Queensland girls, explained the terms used within this thesis and briefly outlined the content of each subsequent chapter of the thesis.

Chapter Two reviews a range of scholarly literature from a number of research disciplines to identify gaps and develop research questions through these gaps. Following this, Chapter Three provides an in-depth overview and discussion of three theories and models that were introduced in Chapter Two. These models and theories are used to inform the data collection and analysis, in order to answer the research questions introduced in Section 1.3. Chapter Four then describes the research methodology, data collection and analysis methods used to investigate the research questions.

© 2007 Kaylene Clayton

Chapter 2 Literature Review

2.1 Introduction

Chapter 1 provided a background to the study, including a brief overview of the problem of dwindling female participation in the ICT field, as well as the motivation for the study. In this chapter, the issues outlined in Chapter One are expanded upon in order to provide a more detailed context for the study. The aim of this chapter is to provide a critical review of the literature, focusing on cultural, social and structural factors, and the individual attributes of people that influence decisions to follow an ICT educational or vocational pathway.

The emphasis of this literature review is on girls and young women in primary, secondary and tertiary education, and the factors that influence their decisions to participate in ICT subjects and courses and ultimately ICT careers. Where possible, the focus of this literature was towards school-aged children and research in an Australian context, but a large portion of research in this field has been undertaken outside of Australia. This required the literature review to be expanded to include countries facing similar problems with the recruitment of females into the ICT field. This chapter explores literature in a diverse range of research disciplines including IS and computer science, education and educational psychology, career psychology, psychology, gender science and sociology.

In order to organise this review of literature, the chapter is structured into five main areas including cultural, social and structural factors, individual attributes and socioeconomic factors. A number of the factors and concepts discussed in the following sections overlap and could be classified in more than one section because of their multiple influences.

Section 2.2 provides information on the cultural context fundamental to the study, including socialisation. Socialisation has been included in this section, rather than in Section 2.3, because socialisation involves the transmission of a society's culture between generations (Abercrombie, Hill, and Turner, 2000). Social factors such as family, peer group, media, role models and gender and ICT stereotypes are discussed in Section 2.3. Media, gender stereotypes and ICT stereotypes have been included in this section because of the role they play in the transmission of images and messages and their influence on individuals (Barker and Aspray, 2006).

© 2007 Kaylene Clayton

Section 2.4 focuses on structural factors including teachers, school environment, ICT access and resources, curriculum and socioeconomic factors. Teachers could also be classed as a social factor because of their influence on socialisation, and their function as a role model to children and other teachers. They are influenced by the socialisation process and have undergone a similar socialisation process to their students. However, because the school assigns teachers to particular classes, they are classified as a structural factor (Adya and Kaiser, 2005). Socioeconomic factors are included in the structural factors section, as children are born into or live in socioeconomic circumstances outside of their control. These socioeconomic circumstances have an influence on the individual, the school the individual attends and ICT resource availability.

Section 2.5 reviews literature concerning individual attributes including self-concept of ICT ability, interest in ICT and the utility of ICT. This is the most nebulous area of literature in this domain and one that requires ongoing investigation. Section 2.6 provides an introduction to three models and theories related to study and career choice that will be discussed in greater detail in Chapter Three.

2.2 Cultural Context

There are a number of dynamics, such as geography, economy, national characteristics, race, ethnicity and cultural factors, all of which must be taken into consideration when investigating the relationship between gender and ICT (Trauth, 2006a). Schein (1984, p.3) provides the following definition of organisational culture.

> Organizational culture is the pattern of basic assumptions that a given group has invented, discovered, or developed in learning to cope with its problems of external adaptation and internal integration, and that have worked well enough to be considered valid, and, therefore, to be taught to new members as the correct way to perceive, think and feel in relation to those problems.

While this view reflects a relatively stable and holistic characteristic set, according to Weisinger and Trauth (2002, p. 309), an alternative view of culture "emphasizes the permeability, fluidity and contentious nature of culture" where "culture does not exist in the minds of people but rather in their behavior".

Cultural values are an integral part of an organisation and are generally intertwined with the cultural standards held by the society from which the organisation is formed. According to Weisinger and Trauth (2002), local culture in an organisation emerges from the union of industry, corporate and national contexts. This results in "unique locally situated work practices

or distinct socially negotiated realities that ultimately impact behavior in these settings" (Weisinger and Trauth, 2002, p. 307). Weisinger and Trauth (2002) also argue that an interplay between certain aspects of the national, organisational and professional contexts impinge on the way that work is performed, and the way the work is carried out in turn helps to reshape and redefine the locale. This interplay produces a locally situated culture within the work environment, in the case of this research the school environment.

The representation of females in ICT is low and declining in various locations around the world including Anglo-Saxon, Scandinavian, and German- and Dutch-speaking countries, the United States and Israel (Eidelman and Hazzan, 2006). However, the Israeli-Arab and Jewish sectors have differing female participation rates in ICT education, with 50% of the female Arab minority sector and only 25% of the female Jewish majority sector studying advanced computer science subjects in high school (Eidelman and Hazzan, 2006). In Australia, Young (2002) affirms that the influence of national culture and families is undoubtedly apparent in relation to females and ICT. This cultural influence shapes perceptions about ICT, such as how ICT is used, and in turn influences the potential entrants to the ICT field (Harris and Wilkinson, 2004). Moreover, when women do chose to enter the ICT field, they tend to participate in different subcultures within the discipline (Harris and Wilkinson, 2004).

The under-representation of women in ICT is not a world-wide phenomenon; there are cultural pockets in the world where women represent a relatively equal proportion of the ICT vocational and educational cohort (Adams, Bauer, and Baichoo, 2003). "In certain countries and cultures, such as Greece, Turkey, Spain, Portugal, Mauritius, Romanic countries (e.g., France and Italy), North African countries, Arabic countries, and South American countries, the representation of women in CS [Computer Science] is high and constant" (Eidelman and Hazzan, 2006, p. 1092). Furthermore, Gharibyan and Gunsaulus (2006) also state that in the Republic of Armenia, females are well represented in computer science, although many of the negative factors which deter women from being involved in ICT are also apparent in Armenia. The difference is that "there is no cultural emphasis on having a job that one loves; instead, there is a determination to have a profession that will guarantee a good living" (Gharibyan and Gunsaulus, 2006, p. 223).

The social status and standard of living provided by employment in the ICT field was also a positive inducement for female Israeli-Arab and Mauritian students. For example, Eidelman and Hazzan (2006) found that Israeli-Arab female students believe that computer science studies can provide them with increased professional opportunities and an associated higher social status. Furthermore, in Mauritius, the words 'nerd' and 'geek' are non-existent in the cultural vocabulary, and ICT is seen as a challenging, fresh and modern path to social advancement

(Adams, Baichoo, and Bauer, 2006). They identified five reasons for the high levels of female representation in ICT in Mauritius including: education is highly valued by Mauritian culture and families; ICT is strongly promoted by the government; high schools are single-sex; it is difficult to change a major once commenced; and the students are motivated and career oriented.

2.2.1 Socialisation

According to Gürer and Camp (2002), the physical development of children is the same until adolescence and their social environments have a huge impact on them. Furthermore, Lee (2002) states that the differences between males and females in relation to technical studies are the likely product of socialisation rather than deep sex differences. “Our gendering experiences begin even before we get to school” (Kimmel, 2004, p. 159) and “the formal educational gendering process begins the moment we enter school, and continues throughout our educational lives” (Kimmel, 2004, p. 161). Society has also perpetuated the myth that subjects such as mathematics, science and computing are inappropriate for girls, even when they have shown exceptional aptitude for these subjects (Camp, 1997).

Attitudes towards ICT are formed early in life, and the home life experiences of children are highly influential in determining the attitudes of children as they mature (Miller, Wood, Halligan, Keller, Hutchinson-Pike, Kornbrot, and deLotz, 2000). It is in adolescence when students experience the highest level of peer pressure, and when many girls lose interest in ICT (Gürer and Camp, 2002). Early adolescence is also the time when career preferences are formed, and these are heavily influenced by gender role socialisation (Poole and Low 1985 in Watson, Quatman, and Edler, 2002). However, Trauth (2002) points out that individuals experience societal influences in different ways because of their differing personality traits and intellectual qualities. Teague (1997) states that it may take generations to change the environmental and behavioural factors, which are so fundamentally part of Western society, that contribute to the under-representation of women in the ICT field.

The current generation is often referred to as ‘Generation Y’ or the ‘Net Generation’ (Oblinger and Oblinger, 2005). They have and “are being socialized in a way that is vastly different from their parents” (Prensky, 2001b, p. 1). Many of them were introduced to ICT as toddlers, or during early childhood education, and have been “socialised to use computers and the Internet from an early age” (Durndell and Miller, 2006, p. 696). Consequently, they are confident and competent users of computers, mobile phones, the Internet, email and instant messaging. Moreover, their developmental years have been accompanied by rapid technological change

(Flanagan 2003 in Genrich, Roberts, Cater-Steel, and Low, 2004) and they have become accustomed to the connected, graphics-oriented, random-access, quick payoff, twitch-speed world of computer games, the Internet and music videos (Prensky, 2001b). They are also anecdotally just-in-time consumers of information, who find theoretical knowledge irrelevant (Langridge, 2003) and are often bored by traditional educational methods (Prensky, 2001b).

2.3 Social Factors

2.3.1 Family

According to Dryler (1998), during childhood and adolescence, one of the most influential contexts of socialisation is the family. Barker and Aspray (2006, p. 25) concur with Dryler and state that "school policies and teachers can have a significant influence on children, but no influence is greater than that of family". Family expectations, influenced by the cultural setting of the family, have been found to contribute towards the decision of females to enter ICT education or vocations (Lang and McKay, 2006). Quite possibly, the economic situation of the family also plays a role in female technical career choices, with a large number of families having both parents in the paid workforce (Lang and McKay, 2006). In their study of Australian ICT enrolment factors and trends, Lang and McKay found that "the emergent trend is of high family expectations influencing career choices of students, and supports the earlier findings that technically educated parents strongly influence the career paths of their daughters" (Lang and McKay, 2006, p. 54). Still, while many girls gather career knowledge from family members, who act as role models for a variety of professions, due to the low female representation in the ICT field, few would have had personal exposure to female ICT professionals.

Relationships with parents and siblings are usually the strongest early relationships and involve exposure to the possible and appropriate roles for girls and boys (Barker and Aspray, 2006). Children may also be exposed to unintentional and subtle gender bias in the home by parents (Gürer and Camp, 2002). Parents are often unaware that they are teaching their children gender roles through nonverbal cues, as their own gender orientations are firmly established (Henslin, 1999). "These lessons continue throughout childhood" (Henslin, 1999, p 73). Children are keen observers and notice the role their parents take in everyday life (Margolis and Fisher, 2002, p. 21), and children frequently model their behaviour on their same-sex parent (Moorman and Johnson, 2003). Margolis and Fisher (2002) also found that parents, particularly fathers, were more likely to be more actively engaged in ICT activities with their sons than with their daughters. The ICT attitude of their parent potentially provides inspiration for some, or despair

for others, especially females, as there is an absence of strong tech-savvy female ICT role models in the home (Moorman and Johnson, 2003).

Paa and McWhirter (2000, p. 41) found that "both girls and boys identified their parents as important influences on their career explorations". Early parental involvement in a child's career planning has been clearly found to have a positive bearing on the choice of ICT as a career (Adya and Kaiser, 2006). Additionally, parental support for a child's career exploration was found to have a direct effect on the likelihood of seeking and listening to parental advice about career options (Meszaros, Laughlin, Creamer, Burger, and Lee, 2006). "The trust placed on parents to know what is best may override the authority of others, like advisors and/or faculty members, who are better acquainted with a wide range of career options, especially in highly technical fields, but are less trusted because they do not know a student personally" (Meszaros et al., 2006, p. 966). Dryler (1998) also found that children often make vocational and occupational choices in the same area as their parents' expertise because of the belief that there was more possibility of obtaining their assistance in this particular area. Moreover, Dryler (1998) established that service-class and highly educated parents promoted gender atypical occupations more than less educated, or working-class parents.

"As fathers continue to influence girls' career choices and mothers get involved in the workforce, educating parents about IT career options is important" (Adya and Kaiser, 2006, p. 286). The importance of educating parents about ICT careers is strengthened by the research of Hinds and Croft (2006), who found that parent perceptions about ICT careers were mostly negative. These perceptions were that: ICT careers could pay well, but there are few job opportunities; there is a high turnover rate; it is solitary work; it follows a boom/bust cycle; and that it is a hard and competitive field to enter. Furthermore, "mothers could benefit from additional resources about information technology and other non-traditional careers so that the guidance they provide to their daughters supports the consideration of a wide range of career options" (Meszaros et al., 2006, p 965).

2.3.2 Peer Group

Peers exert a powerful influence on a child's beliefs and behavioural choices. (Barker and Aspray, 2006; Henslin, 1999). "Peers influence children's beliefs about the value of education, appropriate and possible gender performance, and academic choices" (Barker and Aspray, 2006, p. 34). In addition, males and females are likely to engage in different activities and acquire different competencies, patterns of expectations, values and long term goals if their peers reinforce traditional gender role behaviours and values (Eccles, Barber, and Jozefowicz, 1999).

Moreover, “during adolescence peer influence, particularly of boys on girls, impacts on female self-concept, self-efficacy, classroom experiences and external goal orientation” (Adya and Kaiser, 2006, p. 283).

Student perceptions and attitudes towards ICT are affected by the views of friends or peers, and friends play a role in student course selection decisions (Margolis and Fisher, 2002). Throughout the teenage years, individuals feel an increased need to conform to the qualities that their peers feel are acceptable (Barker and Aspray, 2006). Students are also generally concerned about being teased or bullied about being different, and avoid subjects or activities that make them appear that way. In order to avoid negative attention from their peers, students are more likely to choose subjects that are locally considered to be appropriate for their gender role (Barker and Aspray, 2006). ICT classes in secondary school are predominantly filled with male students; consequently, the female students have few female colleagues to share ideas and stories with. They are also more likely to stand out in the class and feel more uncomfortable.

Peer networks can influence students’ academic motivation by being a source of social interaction, by allowing them to observe the interactions of others and providing access to activities (Pintrich and Schunk, 2002). It may be useful to use students who have been educated about careers in school-based interventions to facilitate career awareness and the information-gathering process amongst their peers (Paa and McWhirter, 2000). Likewise, according to Margolis and Fisher (2002, p. 115), “*some of the best recruiters of girls [in ICT] are other girls*”. Gürer and Camp (2002) also recommend that in classrooms girls be paired with other girls to encourage equal access. This would also provide girls with a support system.

2.3.3 Media

“We live in a culture which specializes in manipulating our thoughts and attitudes through images” (Frieze, 2005, p. 400). Mass media, such as television, movies and magazines, play a large role in influencing people’s impressions of ICT (Gürer and Camp, 2002) and “enhance gender stereotypes that emphasise physical images” (Adya and Kaiser, 2006, p. 283). Mass media images of ICT carry implicit and significant messages about gender roles; computer programmers and developers are often depicted as men, while the users are frequently female (Barker and Aspray, 2006). Students who have not had actual exposure to tertiary-level ICT students or professionals in the ICT industry rely on images in popular culture (Goode, Estrella, and Margolis, 2006). “For students living in a media-saturated society who have no access to people in the field, the Hollywood image translates into a perceived reality” (Goode et al., 2006, p. 99). Television, advertising and computer games also reinforce cultural expectations of

© 2007 Kaylene Clayton

gender and gender stereotypes (Henslin, 1999). For instance, inaccurate media sources report that women cannot genetically compete with men in technical fields, which encourages females to avoid these areas (Gürer and Camp, 2002).

The things that children learn at school are reinforced at home through family and entertainment, with television, music and movies reiterating gender stereotypes (Kimmel, 2004). It is problematic that there is a distinct lack of both fictional and real-world role models within mass media and, where they do exist, they reinforce unflattering and negative stereotypes and spread misinformation about the use of ICT in real-world situations (Multimedia Victoria, 2001). Often, archaic stereotypes are produced and reproduced by the media. Recent examples of this include the movie *Swordfish* (Sena, 2001) and the Australian movie *Bad Eggs* (Martin, 2003). The male computer experts in these movies are portrayed as anti-social, powerful and intense or geeky. Only a few males would identify with these role models; moreover, there is no sign of a female equal within either of these movies. A further example is the television sitcom *The IT Crowd* (Linehan, 2006, 2007), set in the IT department of a large British organisation. It parodies common ICT stereotypes and numerous gender stereotypes. While this show is clearly intended as a parody, it does serve to reinforce commonly held beliefs about working in the ICT industry.

In television shows, women are now portrayed in powerful positions in previously male dominated areas such as medicine, law and forensic science (Jepson and Peri, 2002b). However, there are few prime-time shows in an ICT setting, let alone one with a powerful female lead character. One relatively positive example of a female ICT role model in the media is the character Penelope Garcia, from the television show *Criminal Minds* (Davis, 2005, 2006, 2007). Once again, although the Garcia character is an attractive female working in a technical role, many ICT stereotypes are reinforced. She is portrayed to be an intense, quirky person who wears glasses and likes online gaming. When she is shown working with computers, she is usually working alone in a darkened room. Furthermore, she is referred to as ‘sweet cheeks’ and ‘the tech with glasses’ by her colleagues. This show is rated M and falls into a late evening timeslot because of themes that are unsuitable for a younger audience.

Most advertisements in computer magazines also only show male users, or women being assisted by a male co-worker. Girls will not find role models in these magazines (Carey, 2001). There has been some improvement over the years with trade journals showing young women in professional roles, but the problem is that teenagers do not usually access this form of media (Adya and Kaiser, 2006). One of the recommendations that Jepson and Peri (2002b) make to encourage girls into ICT education is to create biographies and successful stories of women in

ICT that girls can read. A number of researchers are now pointing to the Internet and World Wide Web as a means to provide role models and overcome negative media stereotypes (Carey, 2001; Jepson and Peri, 2002b). However, media is only one of the elements which influence an individual's concept formation (Kimmel, 2004).

2.3.4 Role Models

A role model is a person who possesses the skills, values, attitude and appearance admired by another, and serves as a source of inspiration for another person to emulate (Lagesen, 2006). "Role-models tend to provide ideals for a particular role only, rather than a pattern to be emulated across all the constituent roles of an individual's life and self" (Marshall, 1994, p. 572). They may not be personally known to the person they model to, and can also be real, historical, or media figures who have distinguished themselves in some way (Marshall, 1994). Moreover, the role models may not even be aware that they are serving this function (Beyer, 2006). Role models can be found in various settings throughout socialisation and can include parents, older siblings and teachers, whose beliefs about appropriate topics of educational interest, social norms and gendered behaviour are communicated both explicitly and implicitly (Barker and Aspray, 2006). Besides family members, teachers are one of the most common role models for students because of the amount of time they spend together, and the authority relationship that is in place (Barker and Aspray, 2006). The gender of the role model is not always an important consideration, as good role models can be found in all genders and roles (Standley and Stroombergen, 2001). However, a key consideration is that the role model's achievements must represent attainable goals (Standley and Stroombergen, 2001).

Teachers, parents and peers acting as role models and the students' experiences can influence educational and vocational decisions (Eccles, 1994). "Role models may provide vicarious learning experiences that increase the likelihood of choosing a specific career" (Quimby and DeSantis, 2006, p. 298) or course of study (Ogan, Robinson, Ahuja, and Herring, 2006). According to Quimby and DeSantis (2006), after meeting women in non-traditional fields who successfully manage both career and family responsibilities, female high school students may be inspired to pursue a similar path. "If female students lack female role models with whom they can discuss career choices with relationship to life-style implications" they may "self-select themselves towards careers in which they observe other women, thus further intensifying the gender-based stereotyping of professionals" (Ahuja, 2002, p. 25).

© 2007 Kaylene Clayton

2.3.5 Gender Stereotypes

Gender roles and stereotypes develop early in life with the outcomes of gender stereotyping affecting subject choices and subsequently preferred or possible occupations (Miller and Budd, 1999). Gender roles are a primary reason for the rejection of certain occupations, and out of all of the vocational choice compromises made, gender roles are the last to be compromised (Trusty, Robinson, Plata, and Ng, 2000). They are learned in the home, at school and through the media. For example, in children's television shows and books, girls are seen as being helpful and caring, occupying the less-valued roles and serving as a backdrop (Kimmel, 2004, p. 165). Teacher encouragement may also affect the way that students see themselves and their subject choices (Margolis and Fisher, 2002, p. 39). "Teachers' beliefs and attitudes about appropriate behaviors and roles for boys and girls, combined with their attitudes and beliefs about technology can subtly influence girls not to study computers" (Barker and Aspray, 2006, p. 20). Furthermore, Eccles and her colleagues found "that parents and teachers distort their perceptions of the competencies of particular girls and boys in various domains an a gender role stereotypic fashion" (Eccles, 1994, p 604).

The masculinisation of the ICT field discourages many people from choosing ICT as a career (Byrne and Lyons, 2001; von Hellens, Nielsen, Beekhuyzen, and Trauth, 2003). However, there is no behaviour that is universally associated with masculinity or femininity, and what may be considered masculine in some societies is considered gender-neutral or feminine in others (Trauth, 2002). However, as the technical environment of ICT increases, the more atypical it is for a woman to be involved in it (Trauth, Nielsen, and von Hellens, 2003). Theorists also point to the strong link between economic power and the success of people with technical expertise, and believe that this has influenced the masculinisation of the ICT work environment over the past thirty years (Tapia and Kvasny, 2004). Likewise, the perceived status and salary range, educational achievements and degree of ICT knowledge needed in an occupation is generally negatively offset by the presence of women in the occupation (Harris and Wilkinson, 2004). Trusty, Robinson, Plata and Ng (2000) also believe that women from higher socioeconomic backgrounds are more flexible in gender-based vocational choices.

In previous research, female students declared a dislike of narrow and technically focused programming classes (Countryman, Feldman, Kekelis, and Spertus, 2002; Teague, 2002), disliked spending extended time at the computer solving difficult problems, and disliked failures at any level (Teague, 2002). Girls have also been found to have a higher propensity for taking personal responsibility for their failures and more frequently attribute their failure to lack of ability (Eccles, Wigfield, and Schiefele, 1998). Studies have also shown that females tend to be

© 2007 Kaylene Clayton

more interested in the use of ICT, and the relations between ICT and other fields; prefer practical tasks; and prefer to be shown how to do tasks, rather than initiating computer explorations (Margolis, Fisher, and Miller, 1998; Young, 2002). While boys are known to generally embrace ICT into their lives, girls tend to use ICT as a means to an end (Multimedia Victoria, 2001).

There are a number of things that systematically guide females away from ICT pathways including culture and climate, traditional gender roles and other societal pressures (Gorski, 2002). The myth that 'women are not as good at IT' is common and is particularly detrimental to female students (Cuny and Aspray, 2000). Inaccurate media reports declaring that males are more suited to ICT careers because of genetic predispositions have consequently encouraged females to avoid ICT pathways (Gürer and Camp, 2002). Many women struggle over whether they are suited for ICT careers (Margolis et al., 1998), and particularly with the message that men are smarter and are more suited to ICT work and study (Nielsen, von Hellens, and Wong, 2001; Teague, 1997). Society, family, friends and teachers spread the idea that ICT is not an appropriate occupation for females, even though they may have excelled in introductory ICT subjects (Gürer and Camp, 2002). Loss of self-efficacy and underperformance may result from this stereotype, leading females to feel that they do not belong in ICT careers and study (Gürer and Camp, 2002). However, the different abilities, attitudes and skills acquired by females may become more sought after in ICT jobs in the future (Teague, 2002).

Research has shown that many females ascribe their ICT successes to chance and hard work, and their failure to inability, while males attribute their accomplishments to natural ability (Harrelson, 1999). Moreover, when females demonstrate social and communication skills, they are seen simply as female characteristics, but these same skills are specifically recognised and valued in their male peers (Woodfield, 2002). Another problem is that "too many social scientists have adopted a male standard of ideal achievement when judging the value of female achievements" (Eccles, 1994, p. 586). Many females also report the 'impostor syndrome' (Harrelson, 1999), invisibility and isolation (Gürer and Camp, 2002; Harrelson, 1999), sexual harassment and male humour, gossip, patronising behaviour (Trauth, 2002) and the belittlement of their knowledge and attainments (Gürer and Camp, 2002; Margolis and Fisher, 2002, p. 80). ICT work environments where males are believed to be competent, and females incompetent unless proven otherwise, are not helpful in maintaining the confidence and motivation of women (Nielsen et al., 2001). Even so, it should be noted that high achieving ICT students are intimidating to both genders (Multimedia Victoria, 2001).

© 2007 Kaylene Clayton

Over the years, there have been many initiatives, including scholarship and equity programs, to encourage girls into the ICT pipeline because of their minority status. However, some girls may misinterpret the reason for their selection into ICT programs, and may believe that they were selected primarily because of their gender, not because they are high achievers with the ability to succeed; this further undermines their self-confidence (Gürer and Camp, 2002). Girls have also been found to be often less assertive than male students in promoting themselves, or attempting new or challenging activities (Cuny and Aspray, 2000). Problematically, "girls and young women feel caught between their need to be 'nice' and their need to achieve" (Eccles et al., 1999, p. 178). Moreover, female students are particularly anxious about confirming negative ICT stereotypes (Margolis et al., 1998).

Children receive gender-specific messages regarding the suitability of ICT as an occupation (Margolis and Fisher, 2002, p. 32). Gürer and Camp (2002) believe that gender differences in ICT education become more pronounced over time, as most students in early education appear not to be influenced by gender and maintain positive attitudes towards computers. Christensen, Knezek and Overall (2005) confirm Gürer and Camp's view in their study of Texan students in Years 3 to 12. They found that in Years 4 and 5, girls report higher levels of enjoyment in using computers than boys, but by Year 6, the level of enjoyment begins to decline, and in Year 8, it is significantly lower than the boys' enjoyment.

The Australian secondary school matriculation gender ratio is also changing, with almost 9% more females matriculating than males (Lamb, 1997). The matriculation rate is affected by socioeconomic background, region and type of school (Lamb, 1997). In the past, tertiary study enrolments were dominated by males, but this trend has reversed with more girls qualifying for university entry and enrolling at almost double the rate of boys (Lamb, 1997). In 2005, 40.6% of female Year 12 leavers in Queensland were intending to enrol in university compared to 31.8% of males (Polesel, Helme, and Teese, 2005). In 2006, these figures increased to 41.1% for females and 31.9% for males (Polesel and Teese, 2006). If this trend was consistent throughout all study programs, it should mean that female enrolments in ICT programs would be increasing, but this is not the case. For example, planned female enrolments in tertiary ICT programs in Queensland have remained constant in 2005 and 2006 at 0.9% of all female Year 12 leavers (Polesel et al., 2005; Polesel and Teese, 2006).

2.3.6 ICT Stereotypes

Occupational stereotypes include the personalities and lives of people working in the occupation, the work performed and rewards given, the conditions of the workplace, and how

appropriate the occupation is to different categories of people (Gottfredson, 2002). One of the major inhibitors to increasing the uptake of ICT in education, or as an occupation, is the widespread stereotyping of the characteristics of people involved in the ICT industry. The ICT field is beset with negative stereotypes that are reinforced by the media (Multimedia Victoria, 2001), some of which are justified, while others are grossly incorrect. Goode et al. (2006, p. 112) state that an important task will be to dispel ICT stereotypes and myths, such as "it is only about the love of the computer, that it is solitary, that it is focused on tinkering and gaming rather than being relevant to real-world issues, and that only antisocial people engage in it".

The ICT field is seen as a masculinised domain (Gürer and Camp, 2002; Newmarch, Taylor-Steele, and Cumpston, 2000; von Hellens et al., 2003), which requires strong mathematical or logic abilities, rather than literacy or interpersonal skills (Harrelson, 1999; Nielsen et al., 2001; von Hellens and Nielsen, 2001). ICT jobs are stereotyped as being highly technical, rather than creative (Multimedia Victoria, 2001), encouraging obsessive and competitive behaviour (Cuny and Aspray, 2000; Harrelson, 1999), and requiring unobtainable skills (Standley and Stroombergen, 2001). The general image of ICT professionals relates to them working long hours programming in social isolation (Cuny and Aspray, 2000; Harrelson, 1999; Jewell and Maltby, 2001; Miller et al., 2000; Multimedia Victoria, 2001; Myers and Beise, 2001; Nielsen et al., 2001; Teague, 2002; Young, 2002) in what is described as a 'coke and pizza culture' (Nielsen et al., 2001; von Hellens and Nielsen, 2001). Females are particularly sensitive to the stereotype that ICT careers are socially isolated (Margolis and Fisher, 2002).

ICT professionals are generally believed to be Caucasian males, with antisocial tendencies (Countryman et al., 2002; Gürer and Camp, 2002), who work in an occupation that is boring and 'geeky' (Countryman et al., 2002; Joshi and Kuhn, 2001; Multimedia Victoria, 2001; Myers and Beise, 2001; Newmarch et al., 2000; Standley and Stroombergen, 2001). The term 'geek' has been formally defined in The Australian Concise Oxford Dictionary (Moore, 1997, p. 550) as "a socially inept or boringly conventional or studious person" and "a computer expert; a computer fanatic". However, "the popular image of computer people as geeks may or may not be a barrier to girls' study of IT" (Barker and Aspray, 2006, p. 39), as "within certain youth cultures, the word 'geek' is taking on an ironic coolness" (Multimedia Victoria, 2001). Furthermore, the belief that ICT students are especially smart is refuted by most ICT students who also say that they have broad interests outside of ICT (Margolis and Fisher, 2002, p. 67-69). Byrne (1993) also points out fewer androgynous boys are enrolling in technology in each generation because the image of technology acts as an incorrect filter to these boys along with most girls.

Many of the stereotypes, which affect study and career decisions, start to take effect during childhood (Peiris, Gregor, and V, 2000) because of the absence of alternative stereotypes (Multimedia Victoria, 2001). Goode et al. (2006) found during a study that students were unable to clearly or consistently describe a computer scientist because they had not encountered someone working in this occupation and were consequently unsure of what was involved in the job. “There is very little awareness of the breadth and depth of the industry, the career options that are available, the jobs available to individuals and the day-to-day activities one would undertake” (Hinds and Croft, 2006, p. 23). Spencer (2003) believes that students should be introduced to the use of ICT in real-world contexts from early in their education. Jewell and Maltby (2001) agree, and say that students need to be educated that areas such as law, health and education will all depend on ICT in the future. Further research needs to be done regarding stereotypes, to determine if they are changing over time and, if so, what are the new trends (Downes, 2004).

2.4 Structural Factors

2.4.1 Teacher

Teachers are expected to be highly competent, deliver a quality curriculum and prepare their students for future careers, but many teachers are under-prepared to deliver the ICT curriculum in the classroom (Goldman, 2003). Students are being taught by teachers with a disparate range of ICT skills (Barker and Aspray, 2006), partially due to the level of exposure and training the teachers have received in their pre-service and in-service education, and their access to software and hardware (Goldman, 2003). While teachers are expected, through cultural or organisational pressure, to undertake training to improve their ICT skills (Goldman, 2003), many of them struggle to keep pace with changes in technology (Multimedia Victoria, 2001). Barker and Aspray (2006) reiterate the need for these teachers to undertake training in ICT areas, as well as the need to provide teachers with the time to be able to implement ICT effectively in the classroom. For example, Lai and Pratt (2004) found that, on average, ICT coordinators (a teacher who supports the ICT professional development of teachers and coordinates and manages ICT implementation in the school) spent the equivalent of one month’s full-time work doing ICT-related professional development, primarily in their own time. While these ICT coordinators are respected by their colleagues as leaders, this role is often seen as an additional function on top of their normal teaching responsibilities (Lai and Pratt, 2004). Barker and Aspray (2006, p. 43) believe that “policy has not enabled teachers the time, training, or reward structure to incorporate this newfound access into effective learning strategies”.

Technology is evolving at an exponential rate and, over the years, teaching has also changed by reflecting new technological developments (Goldman, 2003). ICT is now considered an integral part of the curriculum and pedagogy, but this complicates the demands and issues around effective teaching practices. Teachers who did not grow up with ICT frequently assume that the teaching methods used when they were students will work as well for their current students, but Prensky (2001a, p. 3) states "*that assumption is no longer valid*". There is also an expectation that the number of teachers who have all the required skills to integrate ICT into their pedagogy is increasing at the same rate as the technology, but this does not match reality (Goldman, 2003). Teachers also need to consider the tools that they use in their ICT pedagogy. According to Huff (2002), there is often a male bias in educational software used within the classroom, with programs designed for children generally looking like software designed for boys. Most teachers also see computers as tools (King and Bond, 2001), and they may unwittingly be weaving gender stereotypes into ICT due to the software being used within the classroom (Huff, 2002). Correspondingly, Dorman (1998) states that it is the way that we use computers that reinforces gender bias, not the computer itself.

"Teachers are generally perceived by their students as having legitimacy, authority, and expertise; they thereby influence the opinions and behaviors of their students, both in short and long terms" (Barker and Aspray, 2006, p. 20). Teachers are particularly important role models for students (Downes, 2004); they need to inspire and engage students, who look up to them, by showing that they enjoy and are comfortable and capable with ICT. Furthermore, additional research evidence shows that teachers who role-model the use of ICT in their teaching practices help their students to build confidence and competence as ICT users (Matthew, Callaway, Letendre, Kimbell-Lopez, and Sephens, 2002). Having good role models in the ICT classroom is also important for the recruitment of students, particularly girls. The career decisions of adolescent girls, especially high achievers, are influenced by, amongst other factors, the kind of role-modelling and attention that they receive from their teachers (Watson et al., 2002). Correspondingly, Cuny and Aspray (2000) also report that a number of females confirm that having a teacher working with them and encouraging them influences their decision to enter the ICT domain. However, there is a lack of female ICT teachers and appropriate visible role models within the secondary school system (Byrne and Lyons, 2001; Carey, 2001; Harrelson, 1999; Newmarch et al., 2000; Reinen and Plomp, 1997). Kimmel (2004, p. 174) also states that "men are dramatically overrepresented at the top of the educational pyramid", further decreasing the number of powerful female role models.

© 2007 Kaylene Clayton

2.4.2 School Environment

School students belong to a community comprising his/her classmates, teachers and other staff members, in a sociocultural setting that is mediated by roles and rules, including school rules and regulations (Lim, 2002). Within the ICT classroom environment, students and teachers may experience problems with gender and cultural issues (Little, Granger, Adams, Holvikivi, Lippert, Walker, and Young, 2000). Attention needs to be paid to these cultural issues in the ICT curriculum, in order to encourage the participation of minorities in ICT (Little et al., 2000). Girls will benefit from these ICT learning environments being thoughtfully designed and implemented (Countryman et al., 2002). As part of this, teachers require training in how to create an environment conducive to both genders. According to Carey (2001), teachers presently receive little or no training in the ways that technology can be used to create an equitable, innovative and engaging learning environment.

Researchers need to focus on the characteristics of school environments, in terms of socialisation and contextual issues, which may influence children's motivations at the transition points between the different stages of schooling (Eccles et al., 1998). Primary school classrooms tend to be less impersonal, formal, evaluative and competitive than secondary school classrooms (Meece, 1997). In coeducational secondary schools, girls are often in classes with boys who have spent countless hours learning about and playing with computers, and these boys have friends (usually male) with whom they can collaborate (Margolis and Fisher, 2002). Girls, on the other hand, are often left behind in relation to hands-on experience (Gürer and Camp, 2002). Decreasing the competition for computers, by increasing their availability within the classroom, will create a classroom environment where girls feel more comfortable and less threatened (McNair, Kirova-Petrova, and Bhargava, 2001).

The ICT classroom environment describes the tone and atmosphere of a school or classroom and involves things such as the relationships between teachers and students (Logan, 2004), as well as the encouragement and reward systems used. The secondary school ICT learning environment has a number of unique features, including a predominantly male teaching cohort, who usually have a science or mathematical background, and curriculum exercises and assessment largely driven by masculine interests (Logan, 2004). Goode et al. (2006) also found that student experiences in the ICT classroom environment tended to have a negative impact on students' attraction to, and understanding of, the ICT field of study. Equally, male oriented language, attitudes, teaching material and curriculum content, which ignore the social component of ICT, can exacerbate the barriers to ICT study for females (Evans, 1995). The

© 2007 Kaylene Clayton

macho or competitive culture present in many schools needs to be addressed to provide a relaxed, supportive atmosphere for minorities, including females (Jackson, 2002).

The influence of the gender makeup of schools and classrooms has been a topic of debate for some time. There are a number of different permutations of this idea: students may belong to male or female single-sex schools, coeducational schools and classrooms, or coeducational schools with single-sex classrooms. The female single-sex school setting is now receiving particular attention (Watson et al., 2002). Kimmel (2004) believes that female single-sex colleges may challenge gender inequality by teaching females they can do anything that males do, whereas male single-sex colleges reproduce inequality by teaching the males that females *cannot* do what males do. In addition, Scott (1996) found that girls from coeducational schools had more negative attitudes towards ICT than those attending single-sex schools. He believes that the positive ICT attitude experienced by girls attending the single-sex schools may be due to the use of more computer applications and having greater access to teaching staff. However, Byrne (1993, p. 71) believes that different social interactions and discourse may also happen in these environments. Moreover, girls at single-sex schools also were found to have higher real career aspirations than their peers at coeducational schools (Watson et al., 2002). Barker and Aspray (2006) confirm this finding and state that children from relatively affluent backgrounds are more likely to attend single-sex schools and enter professional careers of some form. Attention is also beginning to focus on male single-sex schools, as a way to address the issue of underachieving male students (Jackson, 2002).

Some studies have also shown that the gender splitting of classes can be beneficial for both genders, with the boys working more cooperatively and quietly, and the girls not being subjected to detrimental attitudes (Countryman et al., 2002; Gürer and Camp, 2002). Gürer and Camp (2002) believe that, to encourage girls into ICT subjects in coeducational schools, some female single-sex ICT classes should be created to allow students to learn about ICT in a stress free environment. However, Byrne (1993) cautions that there is no conclusive evidence that single-sex classroom environments enable students to develop a greater interest in ICT or perform better. Furthermore, the same benefits of female single-sex classrooms in coeducational schools cannot automatically be ascribed to male students (Jackson, 2002). More work needs to be done on exploring the benefits and problems of introducing single-sex classrooms in coeducational schools (Jackson, 2002).

© 2007 Kaylene Clayton

2.4.3 ICT Access and Resources

In the past ten years, there has been a rapid growth in the availability of computers (Barker and Aspray, 2006), and students usually use ICT on a daily basis (Hartmann, 2003). Students are generally comfortable with ICT and are creatively and extensively using ICT to push the boundaries of communication and interaction (Hartmann, 2003). “The availability of computers in the home, school, and other places influences children’s experiences with computing, and shapes their perceptions of how they get used and who uses them” (Barker and Aspray, 2006, p. 25).

“While having access to computers is one step in familiarizing children with computers, the manner in which they use computers may influence beliefs and attitudes about technological careers” (Adya and Kaiser, 2005, p. 238). Children have been introduced to the use of computers through keyboarding, word processing and the use of basic applications; the limited nature of these tasks may disenchant the students (Barker and Aspray, 2006). Furthermore, “technological advances such as the Internet, the World Wide Web, multimedia, and a vast array of packaged software have changed the ways that boys and girls interact with computers” (Barker and Aspray, 2006, p. 42). According to Barker and Aspray (2006), the teachers’ knowledge of ICT and their teaching about, and with, ICT also influence their students’ computer use, attitudes and computing related behaviours.

A combination of the increased accessibility of computers, popularity of online games and applications, and the integration of ICT into the curriculum will negate the differences in time spent on computers between genders (Adya and Kaiser, 2005). Cleary (2006) also believes that computer and Internet access often leads to interest in ICT, and current research now suggests that the amount of computer and Internet use by boys and girls is now relatively similar. Furthermore, girls often report higher levels of satisfaction with the availability and use of ICT in schools compared with their male peers (King and Bond, 2001). However, some researchers are now questioning the relevance of access to computers in terms of the under-representation of females in the ICT pipeline (Barker and Aspray, 2006).

Students often use ICT in different ways outside of educational settings (Hartmann, 2003). For some boys, playing computer games and tinkering and experimenting with computers is the catalyst for them to become interested in learning more in the ICT area (Goode et al., 2006). Jepson and Peri (2002b) state that girls are perceived to be natural communicators and are attracted to chat rooms and programs. While both boys and girls use the Internet as a communication medium, Hapnes and Rasmussen (2000) state that girls are drawn to the Internet

because of the opportunities it provides to increase their social status, which programming and gaming do not provide. However, girls are often unaware that mobile phones, chat programs and the Internet are more than artefacts and applications (Falkenberg Lund and Spanner Witzke, 2006). While the Internet is not tied to the gendered and asocial nerd symbol (Hapnes and Rasmussen, 2000), and girls use the Internet equally (Cleary, Pierce, and Trauth, 2006), Internet use is not translating into interest in ICT careers (Myers and Beise, 2001). Whitehouse, Lovegrove and Williams (1997) agree, and state that the Internet and multimedia may reduce technology barriers, but probably will not have much effect on the number of girls studying ICT in the future. However, in more recent research, Moorman and Johnson (2003) suggest higher rates of computer interest and competency may be seen in future secondary school students because of early exposure to the Internet.

Routine use of computers in the home has an impact on children's perceptions of computers (Barker and Aspray, 2006, p. 28). Moreover, the presence of ICT resources and expertise in the home is the most important factor related to the level of Internet use amongst school age children (Cleary, 2006). "The level of family education, marital status and family income are important independent determinants of Internet use among the school age children" (Cleary et al., 2006, p. 370). Cleary (2006, p. 98) adds that "research indicates that female headed households may be less able to provide and maintain Internet resources and support their children in Internet activities." This has implications for children growing up in single-parent households. Households with higher socioeconomic status seem to gain more from home computing, possibly because more affluent and highly educated parents may be able to help their children and are more aware of the significance of engaging in learning with their children (Attewell and Battle, 1999). Pintrich and Schunk (2002) maintain that homes rich in interesting activities are especially influential to children's motivations to learn, especially in their early childhood.

Schools are expected to provide students with access to computers and monitored access to the Internet as part of their normal classroom experience (Goldman, 2003). However, it is important to consider that the amount of technology available in a school is not always an indicator of the quality of education; "schools can be simultaneously technology rich and curriculum poor" (Goode et al., 2006, p 98). Individual schools often make their own computer purchasing decisions, and teachers and principals, often without technical expertise, usually make these decisions (Soloway and Norris, 1999). Additionally, the full cost of maintaining computer laboratories in schools is rarely considered (Soloway and Norris, 1999). Many schools do not have the technical expertise or budgets to keep the ICT in the classrooms performing at an optimal level, and in some cases a teacher also doubles as a technician (Soloway and Norris,

© 2007 Kaylene Clayton

1999). Schools may also have to deal with an assortment of platforms and architectures, legacy machines and well-meant donations and prizes (Soloway and Norris, 1999).

Most students receive their first formal education about ICT at school (deRaadt, 2004), but ICT is increasingly being found and incorporated into the home environment. King and Bond (2001) believe that the differing levels of ICT access and resources between home and school may be responsible for students being dissatisfied with technology at school. They found that students often have better ICT access at home and are frustrated by deficient access at school. Larger schools also tend to have greater difficulty in providing students with similar levels of ICT access available at their home (King and Bond, 2001). However, the availability, quantity and quality of school ICT resources and Internet access are important if the school student does not have access to computers or the Internet at home (Cleary et al., 2006).

2.4.4 Curriculum

"Inevitably, the use of ICT in education shapes the teaching and learning activities" (Lim, 2002, p. 412). Teaching information literacy or fluency is not enough to prepare students for ICT jobs, as it does not teach them the fundamentals of ICT which are crucial for these jobs (Barker and Aspray, 2006). Moreover, the degree to which students are exposed to computer applications, programming and games varies between schools (Barker and Aspray, 2006). For example, "even at schools that are 'heavily wired,' computer science is too often interpreted as 'computer literacy' and only low-level user skills are taught" (Goode et al., 2006, p. 91). Research is now analysing the variety of ICT use, rather than placing the problem with females, "which implies the acknowledgement that technology is not necessarily beneficial and that non-users may be so by choice" (Gansmo, 2006, p. 724).

While it is important for teachers to focus on good teaching, they also need to evaluate the student's perception of the subject in relation to whether it is intellectually challenging, interesting and useful (Mitchell, Sheard, and Markham, 2000). Many students report negative opinions of ICT-specific subjects and general dissatisfaction with the ICT curriculum (Carey, 2001; Multimedia Victoria, 2001). Both boys and girls found secondary school ICT classes boring (Pau, Argles, White, and Lovegrove, 2005; Teague, 1998) because they had lost the element of fun and creativity, and there was little difference between what is taught at the primary and secondary school levels (Pau et al., 2005). Hinds and Croft (2006) also found that most students are open to less classical and more creative ways of solving problems, and find that teaching ICT in a step-by-step manner dampens their interest. Furthermore, students are obtaining a skewed view of the ICT field because of the ICT curriculum focus on mastering

software packages and the perception that ICT is simply word processing (Downes, 2004; Newmarch et al., 2000). Additionally, advanced ICT classes often lack a context that captures the interest of technology focused students, as well as a broad range of students (Goode et al., 2006, p. 111). One solution is to introduce multimedia subjects into the secondary school curriculum to provide an engaging and interesting experience for the students (Downes, 2004).

Considerable evidence points to the content and delivery of the secondary ICT curriculum being an important factor in interesting students, especially girls, to continue in ICT pathways (Newmarch et al., 2000). For example, the Reality Bytes report (Multimedia Victoria, 2001) established that many teachers find it difficult to deliver the curriculum in an inspiring and challenging way. Furthermore, the way that computers are introduced into the curriculum lacks the relevance and interest needed to attract girls into ICT study or career paths (Scott, 1996). Scott (1996) also believes that "girls must be encouraged to use computers for completing projects in a range of subjects across the curriculum, and given the opportunity to develop an appreciation of the diverse uses of computers". The curriculum and teachers may also overtly or subtly reinforce gender differences and inequalities (Kimmel, 2004, p. 162). ICT course selection can be influenced by parents, teachers and guidance counsellors steering the girls away from these courses (Barker and Aspray, 2006). Male-dominated ICT classes and a gendered view of the ICT field are more reasons that secondary school girls are avoiding enrolling in elective ICT classes (Barker and Aspray, 2006).

Primary and early secondary school students are first exposed to ICT education through the integration of ICT in the general school curriculum. It is usually only when students leave the middle years of schooling that they have the opportunity to choose elective ICT-specific subjects. However, many of the names given to, and image associated with, school ICT subjects frequently do not reflect the true nature or creativity of the subject (Courtney, Timms, and Anderson, 2006). Furthermore, "the choice of courses is based not solely on what they enjoy but the type of person they hope to be and the type of person they hope their peers will believe they are" (Barker and Aspray, 2006, p. 34). They also choose elective subjects based on their personal experiences and abilities (Young, 2002). Another problem with the secondary ICT curriculum is its lack of relevance for further study programs. Currently, senior ICT subjects are not a prerequisite for tertiary ICT programs. Universities have also found that the composition and content of ICT subjects frequently do not reflect the typical tertiary ICT curriculum (Sheard, Lowe, and Markham, 2001). Furthermore, by Year 11, students are competing in the competitive tertiary entrance system, and it is often too late for them to explore alternative (or first offering) subjects and career pathways, so previous experiences in junior ICT subjects are used in their decision process (Courtney et al., 2006).

© 2007 Kaylene Clayton

Schools have both a manifest function (the formal education and transmission of skills) and a latent function, which includes universality and the hidden curriculum (Henslin, 1999). The hidden curriculum involves "understandings, values and attitudes that are implicit in school structures and the way material is taught" (Krause, Bochner, and Duchesne, 2003, p. 267). Barker and Aspray (2006, p. 16) state that "what is taught at school and what students are required to learn influence students' (and parents') beliefs about what knowledge is important and what is interesting". Consequently, the naming and content of subjects, along with the elective nature of ICT classes, can cause the student to forego enrolling in elective ICT classes because of misleading information and student perceptions. Gürer and Camp (2002) recommend that, in order to prepare students for tertiary ICT study paths, ICT classes should be implemented into the basic school curriculum. These classes should provide students with appropriate ICT skills, and interesting and challenging projects.

2.5 Individual Attributes

2.5.1 Self-concept of Ability in ICT

Males and females "acquire different self concepts, different patterns for success across various activities, and different values and goals through the processes associated with gendered socialization" (Eccles et al., 1999, p. 174). Denner and Bean (2006, p. 730) also state that their research "suggests that aspects of girls' self-identity (such as confidence) and social identity (whether others consider them to be good at computers) affect problem solving and their willingness to try new things". Furthermore, "girls' gender identity may influence assertiveness with computer use at school" (Barker and Aspray, 2006, p. 31). Additionally, definitions of achievement have been characteristically based upon male standards, while discounting or devaluing the achievements of females (Eccles, 1994).

Socialisation shapes "individuals' self-perceptions, identity formation, goals and values" (Eccles et al., 1999, p. 174). Society has perpetuated the myth that subjects such as mathematics, science and computing are inappropriate for girls, even when they have shown exceptional aptitude for these subjects (Camp, 1997). Moreover, when comparing themselves to others, especially males, female secondary students consistently undervalue their mathematical and ICT skills and abilities (Moorman and Johnson, 2003). Both male and female students display attitudes that males have more natural ability for mathematics and ICT, even though research suggests that female academic performance is equal or better than male performance in these areas (Moorman and Johnson, 2003). The general understanding of ICT is that it requires strong mathematical or logic abilities rather than literacy or interpersonal skills (Harrelson,

1999; Nielsen et al., 2001; von Hellens and Nielsen, 2001). This is not entirely true, and seems to be based on the assumption that computing is a technical occupation and ignores the more people-oriented side of ICT, such as many of the roles in the IS area. Byrne and Lyons (2001) also state that, although the link between mathematics ability and programming is commonly accepted, its empirical demonstration is debatable. While the findings of their study show that there is a clear link between existing aptitude for mathematics and science subjects and programming ability, they believe this is due to similar pedagogical structures and approaches in the subjects, as well as students having similar cognitive skills.

Ambrose, Lazarus and Nair (1998), state that there are four main areas which are pivotal for self-confidence: performance and accomplishments; observing and learning from others; freedom from anxiety concerning work and conduct in a particular field; and persuasion and support from others. Female ICT students are more likely to focus on performance outcomes, react with higher levels of anxiety and stress (Smith, Sinclair, and Chapman, 2002) and be less confident than their male peers, even when they have the same grades (Margolis et al., 1998). Yet, lack of ability is not an issue; it is the perception of ability that is the problem; for example, children's beliefs about their ability and their expectations for success in mathematics are more predictive of their results than are previous grades or achievement values (Wigfield and Eccles, 2000). Steele (1997) also found that females did not perform as well as males in a mathematics exam when informed that their gender affected the score, as compared to when they were told that gender had no impact on the outcomes. He concluded that societal stereotypes affect confidence and achievement levels. This is significant, as the level of early school achievement determines the types of jobs that teenagers engage in (Lamb, 1997).

Motivations and values that link success to effort rather than ability are important to encourage the persistence of students (Margolis et al., 1998). Research in general has consistently shown that "students who believe they can do the task and expect to do well are more likely to achieve at higher levels, be more cognitively engaged, and try harder and persist longer at a task" (Pintrich and Schunk, 2002, p. 70-71). However, discouragement can occur if they feel that it is only effort that brings the success, proving, in their eyes, that they lack essential inherent talent and ability (Margolis et al., 1998). Research has also shown that many females ascribe their successes to chance and hard work, and failure to inability, while males attribute their accomplishments to natural ability (Harrelson, 1999). Women are a minority in ICT (Lee, 2002), yet they sometimes misinterpret minority initiatives, believing that the reason that they were selected to study ICT was due to their gender and not their ability, which further undermines their self-confidence (Gürer and Camp, 2002).

© 2007 Kaylene Clayton

"The antecedents of students' attributions for success and failure fall into two general categories: environmental and personal factors" (Pintrich and Schunk, 2002, p. 139). For example, the amount of time spent on the computer, along with the student's perception of the skills and characteristics required for success in an ICT career, are factors influencing the interest and perceived ability of females in ICT (Chan, Stafford, Klawe, and Chen, 2000). Van Der Vyver et al. (2004) state that the extrinsic rewards offered by a senior school ICT subject, Information Processing and Technology, drives students more than the intrinsic nature of the subject, and the choice of this subject is strongly motivated by career-related issues. Furthermore, males were influenced more by the extrinsic rewards and their career goals, while females were influenced more by the subject topics (Van Der Vyver et al., 2004). Hinds and Croft (2006, p. 12) add: "what tends to drive [career] choice however tends to focus on one's personal strengths and interests more so than career/financial stability".

While students share similar views about ICT careers, male and female students have different ideas about characteristics and desired outcomes of their ideal careers (Young, 2003). Young (2003) found that girls valued interesting and challenging work, as well as working with people. This contrasts with the common portrayal of ICT as being highly technical, solitary work. Telecommuting, self employment and working alone are available, albeit unpopular, options for girls within the ICT industry, and while these need to be acknowledged, information is needed to emphasise the optional nature of these factors (Young, 2003).

2.5.2 Interest in ICT

The secondary school level has been identified as the place where the barriers to ICT careers are established (Chan et al., 2000). A large proportion of girls discontinue ICT study when they have the opportunity to choose elective subjects. As the students continue to move into and through the tertiary educational system, the number of females remaining in ICT studies dwindles (Young, 2003). Young's research found that only 5% of the Year 9 students in her study intended to enter into ICT careers, with boys outnumbering females four to one. Furthermore, O'Keefe (2005) states that the Department of Education and Training reported that women made up 22% of the ICT student body in 2004, down from 24% in 2003. The choice of IPT as a senior schooling subject is influenced by students balancing the career advice of significant others with their own research and the importance of achieving well in the tertiary entrance score (Van Der Vyver et al., 2004). Students are advised to choose subjects they enjoy and are good at when competing in the tertiary entrance system (Courtney et al., 2006). Even for girls interested in the ICT area, the primary reason given for not pursuing ICT subjects was strategic; the girls felt that it was not worth taking ICT classes as they did not academically

© 2007 Kaylene Clayton

'buy' them enough, and they were concerned about preserving their competitive standing in the academic marketplace (Goode et al., 2006). Other subject choice influences include the advice of friends, reputation of the teacher and the subjects available to the student through timetabling (Van Der Vyver et al., 2004).

Software design can "carry social values, can influence the behaviour of others, and may even contribute to influences on career choice" (Huff, 2002, p. 115). There are two schools of thought regarding the use of computer applications to increase interest in ICT. De Raadt (2004) suggests that general ICT tasks, for instance word processing, need to be isolated from tasks such as programming. This separation will allow the students to become aware of the influence and significance of programming. Carey (2001), however, suggests that girls be allowed to use the computer as a tool to write papers and make web pages to increase their motivation to learn. He states that girls should also be given collaborative projects to encourage them in this area. Hapnes and Rasmussen (2000) also found that middle-class girls and girls who were educationally motivated often spoke about the utility of ICT for the future and their excitement about the Internet, while working-class girls spoke more about the entertainment or fun aspect of ICT.

Moorman and Johnson (2003) state that there is a lack of games marketed towards female interests and that this may affect the numbers of girls being attracted to ICT at an early age; they do not see computers as being fun. Research has shown that women tend to be more interested in the uses of computing and the relationships between ICT and other fields, and prefer tasks that have a practical outcome (Margolis et al., 1998; Young, 2002). This is in direct contrast to boys 'tinkering' to figure things out and doing things on the computer simply for the sake of it. According to Harrelson (1999), females see computers as a 'tool' for solving problems, whereas males see them as 'toys'. The common acceptance of ICT as a tool by most teachers contrasts with the general view of computers being 'toys' for boys (King and Bond, 2001). The teacher's view of ICT is an interesting point to consider, bearing in mind that, in the early stage of education, a large number of these teachers are female. It is also important to remember that technology is not a just a neutral tool of the educator (Bowers, 1988).

2.5.3 Utility of ICT

Eccles (1994) states that the utility value of the task in achieving long-term goals or rewards, the intrinsic interest and enjoyment of the task, along with the attainment value and the cost of engaging in the activity, contribute to the probability of whether an individual will choose an activity. Furthermore, more value is placed on tasks that are congruent with, or allow the

opportunity to fulfil, an individual's self-image and long-term goals (Eccles, 1994). In their research, Paa and McWhirter (2000, p. 41) found that in the first two years of secondary school, students had begun the process of self-exploration and "were aware that their interests, values, and personalities contributed to their current career expectations". Carey (2001) also states that girls said they did not enrol in ICT classes, as they did not intend to work in ICT in the future. However, "parents agree that children do not think long term – most children accept and believe they will change careers over their lifetime" (Hinds and Croft, 2006, p. 41).

Research has found that there are a number of reasons why students do not participate in ICT subjects. It has been suggested that students are receiving limited information about ICT subjects and the choices available, and that more appropriate information and advice should be made available (Van Der Vyver et al., 2004). Moreover, the limited and narrow description of what ICT is, and the job role of ICT professionals, play a key role in influencing a student's decision to enrol in ICT classes (Goode et al., 2006). Students see the ICT field as a male domain (von Hellens, Nielsen, and Beekhuyzen, 2004), which is struggling to move away from its computer-centric, technical, engineering origins (Spencer, 2003). They also believe that working in ICT gives them little chance to engage in socially useful work (Jewell and Maltby, 2001). In their study of female senior secondary school students in Queensland, Anderson, Timms and Courtney (2006) also found that students who did not enrol in an ICT subject had a cynical view of the ICT industry and considered ICT occupations as being boring. Conversely, students who enrolled in ICT subjects saw ICT as an interesting and rewarding career. They also found that the beliefs of the non-ICT students were without any real foundation and appeared to be based on negative stereotypes and perceptions. Jewell and Maltby (2001, p. 7) confirm this and say "females appear to be rejecting involvement in information technology not because of their perception of what it is but because of what it is not".

Downes (2004) found that the most commonly cited, important career aspects of ICT for students are enjoyment of and being good at ICT, as well as good job prospects and remuneration. Furthermore, Carey (2001) found that the most common reasons for secondary students for choosing ICT courses were interest in ICT and the perception that what they learnt would be useful in the future, possibly to obtain employment. Consequently, de Raadt (2004) states that secondary school students need assurance that the outcome of their tertiary studies will result in a well paid, respected position. Students are aware that ICT careers are well remunerated; however, the effect of the negative publicity about ICT employment opportunities since the 'dotcom' bust continues. An emerging trend noticed by parents is that their children are less focused on securing a job and financial security than on finding a career that is of personal interest to them (Hinds and Croft, 2006).

© 2007 Kaylene Clayton

Most secondary school students lack information and understanding about the nature of ICT work (von Hellens et al., 2004) and generally fail to recognise the full scope of ICT careers and the way that they could fulfil their career goals (Young, 2003). This is an increasing problem. With the technology explosion, technologies are being developed which create new and unusual vocational opportunities (Carey, 2001). However, students do not know about the job activities involved with more established ICT roles, such as computer scientist, let alone the new opportunities that are being created (Jepson and Peri, 2002b). Therefore, they do not know how their talents and skills apply in that domain. For instance, Jewel and Maltby (2001) also reported that 25% of the students in their research indicated that they were misinformed about ICT careers and may have considered tertiary ICT study had they been given better information.

Career advisers and teachers have also expressed concern that they have difficulty in maintaining current knowledge of ICT careers, and this adds to the ICT recruitment problem (Newmarch et al., 2000). Moreover, according to the Reality Bytes report (Multimedia Victoria, 2001), students act on misinformation about ICT and reject ICT careers if career advisers are unaware, ill-informed or hold out of date views about ICT. Therefore, teachers need to be made aware of the new opportunities that are arising for students in the ICT field (Carey, 2001). However, describing ICT job roles and specialities is a non-trivial exercise, even for experts in the area (Spencer, 2003). More work is needed to define the ICT field in order to inform the teachers, parents and students about the opportunities available.

2.6 Socioeconomic Factors

“Young people’s attitudes appear to be linked to those of their parents and to the socioeconomic backgrounds of their families” (Volman and van Eck, 2001, p. 625). Moreover, underlying socioeconomic factors, “such as level of education, household income and marital status of the household are important determinants of Internet use among school-age children” (Cleary, 2006, p. 98) and are “a key predictor of later IT career pursuits” (Zarrett, Malanchuk, Davis-Kean, and Eccles, 2006, p. 80). Low socioeconomic status families have fewer resources to support their children’s learning outside of school, compared with families of higher socioeconomic status (Meece, 1997). Moreover, in schools serving the lowest-income students, the most serious problem is that suitable ICT courses are not available, and when they are present, they are based on a vocational rather than an academic model of ICT (Goode et al., 2006). Children from lower socioeconomic backgrounds are also often unprepared and lack proper training to enable them to fit into the middle-class orientation of schools and classrooms, and this leads to discipline and behaviour problems in the classroom and affects motivation and achievement (Pintrich and Schunk, 2002). They may also have difficulty in understanding the

© 2007 Kaylene Clayton

relevance and importance of schoolwork in achieving their future goals (Meece, 1997). Still, a child coming from a low socioeconomic background will not necessarily have problems with motivation and achievement (Pintrich and Schunk, 2002). It is the factors accompanying the low socioeconomic status that cause low levels of motivation and achievement, rather than the low socioeconomic status itself (Meece, 1997; Pintrich and Schunk, 2002).

2.7 Theories and Models for ICT Recruitment Research

Over the past three decades, there have been a number of models and theories that have been used or developed with regard to the investigation of the educational and vocational choices of women, girls and children. One emerging theory is Trauth's Individual Differences Theory of Gender and IT. It relates to ICT being socioculturally constructed at an individual level, taking into account personal characteristics and backgrounds, as well as environmental influences (Trauth, 2006b). Trauth also spoke of a number of themes that were echoed throughout the participants' life histories. These included ICT being a male domain, blatant and subtle discrimination, and the need for females to earn their place in the ICT classroom or workplace while their male peers are just accepted.

In their 2002 report, Gürer and Camp identified fourteen areas that affect girls' decisions to engage in ICT educational and vocational pathways. These areas include: attitudes; computing experience; loss of interest early in the pipeline; computer games; mentoring and role models; self-confidence; computing environments; family and teacher encouragement; all-female environment; equal access; graduate school; balancing work and family; societal influence; and other forms of discrimination (Gürer and Camp, 2002).

Clayton and Lynch (2002) also identified and classified a number of factors in their paper on strategies to encourage girls into ICT pathways in Queensland. The factors they identified included the primary and secondary school environment (perception of computer career, limited maintenance of equipment, role models, peers, teacher's expertise and support, curriculum and competing access to equipment), the home environment (role models and competing access to equipment), the community environment (media and industry) and the tertiary environment (delivery mode, critical mass, role models, course structure, nerdy image, system and gender inclusive teaching).

Another new model developed to investigate the under-representation of girls in the ICT educational and vocational environments is Adya and Kaiser's (2005; Adya and Kaiser, 2006) Model of Girls' Career Choices. Adya and Kaiser's model comprises three main areas that

© 2007 Kaylene Clayton

influence career choice: social factors, structural factors and individual differences. Social factors include five sub-factors, namely, family, peer group, media, role models and gender stereotypes. The structural factors are teacher/counsellor, school access, personal access and same-sex education. The social and structural factors are also influenced by the ethnic culture in which they are situated. The individual factors aspect stands alone and has not been explicitly expanded to include any sub-factors. However, Adya and Kaiser (2006) make mention of personality characteristics and enjoyment of computing as factors that influence early career choices. This model has been drawn from literature and is currently untested.

In 1983, Eccles and her colleagues identified that existing research into students' academic choices was limited by the lack of an integrative theoretical framework. The need to understand the motivational factors underlying achievement-related decisions in educational or vocational settings, for both genders, was the driving force behind the creation of the model (Eccles et al., 1999). The Eccles, Wigfield, and colleagues' Expectancy-value Model of Achievement-related Choices (2000) relates the influence of social values, expectancies and values on achievement motivation, with the central constructs being the subjective task value of a particular occupation, or study path, and the expectations of success in that job or subject (Lupart and Cannon, 2000). It has been extensively used since 1983, in various stages of its evolution, to investigate how subjective task values affect a child's motivation to choose, pursue and persist in tasks or school subjects. These studies include a number of longitudinal school-based studies throughout the world.

Children interpret what they believe is involved in various occupations through their experiences and the transferred interpretations of others including their parents, peers, teachers and eventually career counsellors. From early in their lives and through everyday activity, people start constructing their interpretation of roles and how they identify with those roles. In 1981, Gottfredson developed a theory to assist career counsellors to understand how children to young adults deal with the vast and increasing array of vocational choices available to them. The theory has as its base Holland's Theory of Careers (see Holland, 1973), which has been successfully used to assist people to make career choices based on their personality type. Gottfredson's Theory of Circumscription, Compromise, and Self-Creation (2002) has been applied or used in association with a number of demographics including a longitudinal study of second to twelfth grade children (see Helwig, 1981) and an Australian context (for example Pryor and Taylor, 1986). It has been used in mixed method (see Helwig, 1981), quantitative (see Millward, Houston, Barrett, and Larkin, 2006) and qualitative studies (see Hill, Ramirez, and Dumka, 2003; Pizzolato, 2007).

© 2007 Kaylene Clayton

In Chapter Three, Adya and Kaiser's model of Girls' Career Choices (2005), Eccles, Wigfield, and colleagues' Expectancy-value Model of Achievement-related Choices (2000) and Gottfredson's Theory of Circumscription, Compromise, and Self-Creation (2002) will be discussed in greater detail.

2.8 Conclusion

This chapter presented and explored a range of academic literature with regard to girls and young women in primary, secondary and tertiary education and the factors that influence their decision to participate in ICT subjects and courses, and ultimately ICT careers. In order to accomplish this, literature from a diverse range of research disciplines, including IS and computer science, education and educational psychology, career psychology, psychology, gender science and sociology, was reviewed to provide a holistic view of the problem domain.

The cultural context section reviewed literature relating to culture and socialisation fundamental to the study. The review of literature found that female representation in ICT is low and decreasing in Australian, Anglo-Saxon and some other Western cultures, while some other countries have achieved relatively even gender representation. It also identified that cultural influence, socialisation and the gendering process begin early in life and affect attitudes towards ICT. Furthermore, many Australian children are confident users of ICT and have been "socialised to use computers and the Internet from an early age" (Durndell and Miller, 2006, p. 696).

Social factors such as family, peer group, media, role models and gender and ICT stereotypes were explored in Section 2.3. Family members are one of the most significant influences on a child and can shape beliefs, opinions of occupations, and gender roles. Similarly, the peer group is an important influence in socialisation and can influence gender role beliefs, values and attitudes. Role models can be found throughout socialisation and they communicate beliefs about appropriate areas of interest, social norms and gendered behaviour. The media also play a role in socialisation through the reinforcement and transmission of images and messages related to gender roles and stereotypes, which may or may not be correct. Stereotypes about gender and the ICT field are common, and their influence can affect self-efficacy and lead to the rejection of entire occupational areas. Many of these stereotypes continue due the hidden nature, and lack of definition of, the ICT field, and lack of alternative stereotypes.

Section 2.4 focused on structural factors including teacher, school environment, ICT access and resources and curriculum. Teachers are an important role model for children, but often have a

disparate range of ICT skills and lack the time, training and experience with ICT to be able to effectively use ICT in the classroom and deliver an inspiring ICT curriculum. The debate about the implications of the gender makeup of schools and classes continues, but female single-sex schools may provide a more positive ICT environment for girls than coeducational schools. The naming and content of subjects along with the elective nature of ICT classes can also cause the student to overlook elective ICT classes due to erroneous perceptions. Furthermore, the quality and availability of ICT resources at school and at home can influence ICT experiences and shape interest in and perceptions of ICT.

Literature related to individual attributes including self-concept of ICT ability, interest in ICT and utility of ICT was reviewed in Section 2.5. Self-concept of ICT ability, learnt through the processes of gendered socialisation, is different for males and females. Some of these aspects of self-concept and identity can influence girls' problem solving and their willingness to try new activities. Furthermore, females often see computers as a 'tool' for solving problems and there is a lack of computer games marketed to girls. These factors can influence girls' interest in the ICT area, as they do not see computers as being fun. The most common reasons for secondary students to choose ICT courses were personal interest in ICT and the perception that what they learnt would be useful in their career. Enjoyment of, and being good with ICT, combined with good job prospects and remuneration, are commonly cited reasons for becoming involved in ICT careers. Finally, the socioeconomic status of the student, their family and their school affects the provision of quality ICT resources, support and curriculum and subsequently may influence the student's interest and motivation in the area.

The final section of this chapter provided a brief introduction to three models and theories that are useful in the investigation of study and career choices. Chapter 3 now discusses these models and theories in greater detail and provides a conceptual model used to guide this research. Chapter Four outlines and justifies the research methodology, the creation of the thematic framework for analysis drawn from the literature and the practical implementation of the methodology. In Chapters Five and Six, the results of the analysis using the thematic framework are described.

© 2007 Kaylene Clayton

Chapter 3 Theories and Models for Study and Career Recruitment

3.1 Introduction

This chapter further discusses the three models, introduced in Chapter Two, which are useful to the investigation into girls' low and declining interest in ICT educational and vocational pathways. Chapter Two also provided an overview of relevant background literature as a context for the research and identified key themes and gaps within the existing literature. This literature was gathered from a diverse range of research disciplines including IS and computer science, education and educational psychology, career psychology, psychology, gender science and sociology. Chapter Four describes the research design and the practical implementation of the research approach. In social science research, there are multiple competing theories drawn from various disciplines directed at individual, organisational, group and social levels which enable a phenomenon to be viewed through multiple perspectives or lenses (Anfara Jr. and Mertz, 2006). As with Wolcott (1995, p. 183), I too, looked for theoretical frameworks that would "guide and clarify" my observations, data collection and analysis.

Section 3.2 describes the Eccles, Wigfield, and colleagues' Expectancy-value Model of Achievement-related Choices (2000), including the concepts of the model, which are used in the thematic framework to guide the exploration of the underexplored individual attributes aspect of research in this area. No attempt is made to prove or disprove the causalities between the concepts of this model in this study. Section 3.3 then describes the concepts, processes and stages of Gottfredson's Theory of Circumscription, Compromise, and Self-Creation (2002), which also contributes towards the individual aspects component of the research, and the career choice process. Adya and Kaiser's Model of Girls' Career Choices is outlined in Section 3.4. This model was published at the beginning of the data collection for this research and many features of this model closely resembled my initial conceptual model.

Concepts from these three models and the literature discussed in Chapter 2 will be used in combination to create a thematic framework to analyse and provide insight into the reasons that students, in particular girls, are less interested in educational and vocational ICT pathways. My initial conceptual model can be found in Section 3.5. This conceptual model has its base in literature from a variety of research disciplines including IS and computer science, education and educational psychology, career psychology, psychology, gender science and sociology.

© 2007 Kaylene Clayton

3.1.1 Nurture Versus Nature

A review of literature points to two dominant schools of thought involving the under-representation of females in ICT fields (Trauth, 2002). The first, Essentialism, focuses on the inherent biological differences between males and females to explain the masculinised domain of ICT (Trauth, 2002). This view has been taken by a number of researchers in the past when discussing gender differences in ICT, including Dennis, Kinney and Hung (1999), and by Venkatesh and Morris (2000), in their controversial paper in *MIS Quarterly*. Social Construction is the second, and more widely used, view when researching females and ICT. The Social Construction of ICT points to the relationship between females and ICT as being of a social, rather than a biological, nature and proposes that the causes of female under-representation in ICT can be found in the wider society, as well as within the ICT domain (Trauth, 2006b). It maintains that the development and maintenance of a masculine culture excludes minorities from ICT educational and vocational paths (Tapia and Kvasny, 2004). The Social Construction perspective assumes that gender equity is required and implies that the ICT curriculum and environments can be changed to become more attractive for women (Spencer, 2003). Trauth (2002) explains that the Essentialist perspective creates more problems than a Social Construction point of view, as Essentialist recommendations act to further isolate women by emphasising stereotypes.

The basic assertion of Social Construction Theory relates to the way we analyse and categorise our experiences within the socio-historical world and how this influences and forms our understanding of reality (Berger and Luckmann, 1991). The understanding of what is real is socially relative to individuals involved in the reality, and as such "the sociology of knowledge is concerned with the relationship between human thought and the social context in which it arises" (Berger and Luckmann, 1991, p. 15-16). This reality is shared with others, usually by face-to-face social interaction (Berger and Luckmann, 1991). Everyday knowledge is structured in terms of relevance to the individual and knowledge of the relevance to others, and is "possessed differently by distinct individuals and types of individuals" (Berger and Luckmann, 1991, p. 59-60).

There are three main ideas to Social Construction Theory: Institutionalisation, Legitimation and Internalisation. Institutionalisation occurs when there is a sharing of habitualised behaviour and forms over time in every social situation, while "legitimation produces new meanings that serve to integrate the meanings already attached to disparate institutional processes" (Berger and Luckmann, 1991, p. 110). During Internalisation, socialisation occurs when the individuals internalise and conform to social norms (Abercrombie et al., 2000). Henslin (1999) maintains

© 2007 Kaylene Clayton

that society uses gender socialisation to guide the way we think, feel and act according to culturally established guidelines of what is appropriate for our sex. Primary socialisation is the most important type of socialisation for an individual in becoming a member of society, and happens in childhood (Berger and Luckmann, 1991). Children learn their designated social place in the world and abstracts the roles, values and attitudes of significant others to roles and attitudes in general (Berger and Luckmann, 1991). Secondary socialisation follows the same basic structure as primary socialisation, and is the subsequent process where the individual learns the apposite behaviour, as a member of a small group within a larger society (Berger and Luckmann, 1991). The people and groups, including family, school, peer groups and mass media, who influence our behaviour, attitudes, self-concept and emotions, are the agents of socialisation (Henslin, 1999).

It is difficult to understand why some children from a family of similar genetic backgrounds and environmental influences will choose very diverse occupations, while others will follow similar pathways (Eccles, Wigfield, Harold, and Blumenfeld, 1993). Accordingly, a third perspective is emerging, in terms of the participation of females in ICT, as an alternative theory to Essentialism and Social Construction. Trauth (2002) is using empirical data to support the emerging Individual Differences Theory of Gender and IT, which falls in the middle ground between the Essentialist and Social Constructivist views. It draws from psychology literature as well as the prior work of Trauth (2002) to understand female participation in the ICT workforce (Trauth, Quesenberry, and Morgan, 2004). The Individual Differences Theory of Gender and IT relates to ICT being socioculturally constructed at an individual level, taking into account personal characteristics and backgrounds, as well as environmental influences (Trauth, 2006b). "The focus is on differences *within* rather than *between* genders" (Trauth, 2006b, p. 1156). This notion is very similar to the view addressed within Gottfredson's evolving theory of Circumscription, Compromise and Self-Creation (Gottfredson, 1981, 1996, 2002, 2005, 2006). This research takes the view that a complex interaction of individual and social factors influences student career choices, and consequently leads to the under-representation of females in ICT pathways.

3.2 Eccles, Wigfield, and Colleagues' Expectancy-Value Model of Achievement-Related Choices

The first framework used to guide this research is the Eccles, Wigfield, and colleagues' Expectancy-value Model of Achievement-related Choices (Wigfield and Eccles, 2000). This framework has been used, in various stages of its evolution, in a number of longitudinal school based studies since 1983, to investigate how subjective task values affect a child's motivation to

choose, pursue and persist in tasks or school subjects. Trusty, Robinson Plata and Ng (2000) state that the advantage of this model is that it considers domain-specific achievement and values by gender. In this study, the Expectancy-value Model of Achievement-related Choices (Figure 3-1) was used as a tool to guide the exploration of the underexplored area of individual influences, including the students' ICT educational experiences and their beliefs about, and values they place on, these experiences. Their beliefs are formed according to their interpretation of the attitudes and expectations of their socialisers, and past experiences, personal goals, self-schemata, task value and cost, and expectations of success related to engaging in ICT pathways.

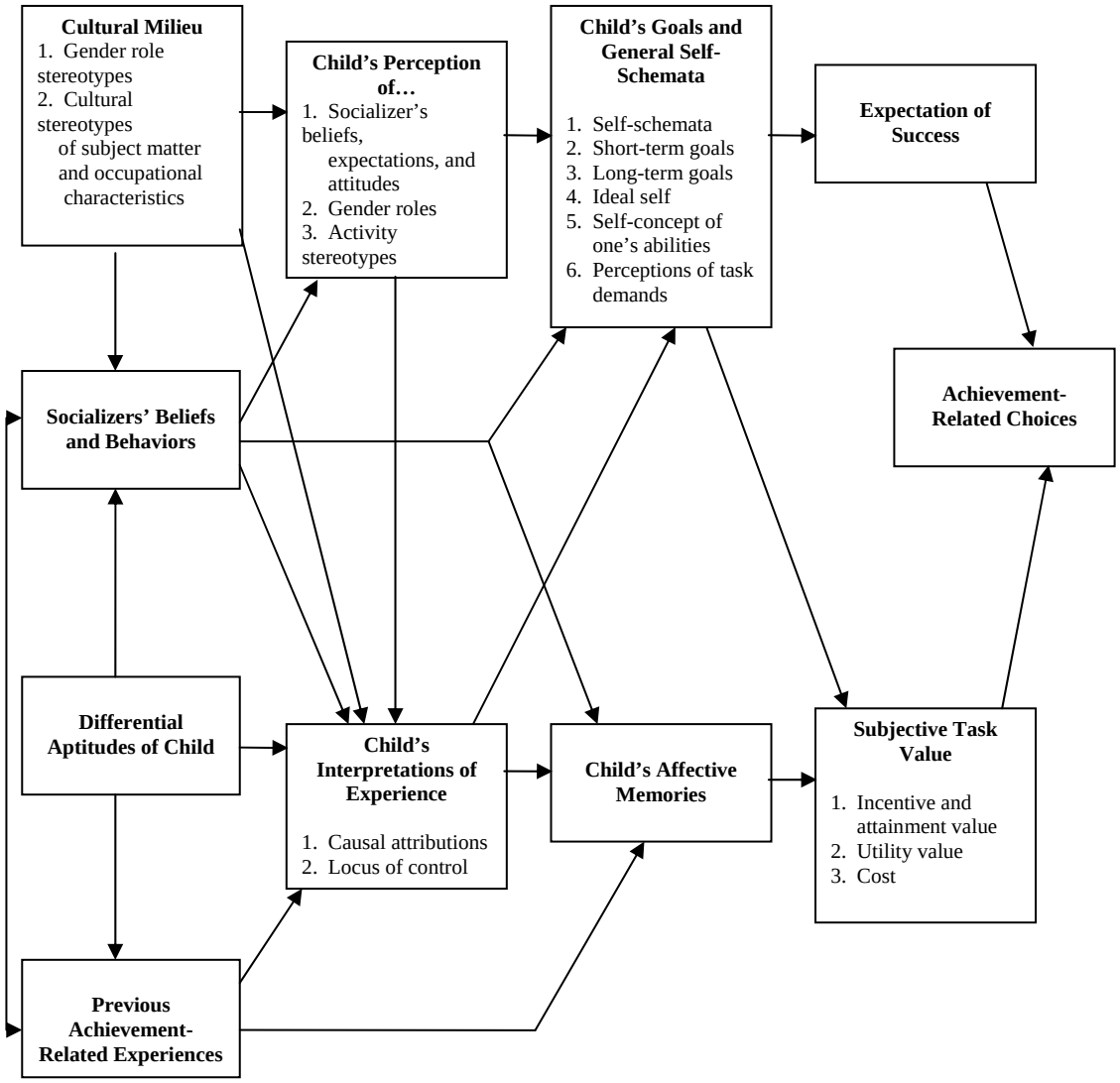

Figure 3-1 Eccles, Wigfield, and colleagues' Expectancy-value Model of Achievement-related Choices (Wigfield and Eccles, 2000)[1]

[1] Reprinted from Contemporary Educational Psychology, 25/1, Wigfield, A. and Eccles, J., Expectancy–Value Theory of Achievement Motivation, Pages 68-81, Copyright (2000), with permission from Elsevier.

The need to understand the motivational factors underlying achievement-related decisions in educational or vocational settings, for both genders, was the driving force behind the creation of this model in 1983 (Eccles et al., 1999). It draws on theoretical and empirical work related to decision making, achievement theory and attribution theory (Eccles et al., 1999). The central concepts of this model are the subjective task value of a particular occupation, or study path, and the expectations of success in that job or subject (Lupart and Cannon, 2000). Eccles (1994) states that there are three features of this model that make it important in the quest to understand the gender differences in educational and vocational decisions. The three features are: the primary outcome focus is on achievement-related choices; it allows the conceptualisation of gender differences in achievement-related behaviours in terms of choice; and the wide variety of choices that these achievement-related decisions originate from occur within the context of a complex social reality. Eccles (1994) also points out that definitions of achievement are usually based on male standards, and female achievements are typically devalued or ignored.

The Eccles, Wigfield, and colleagues' model "links achievement-related beliefs, outcomes and goals to interpretive systems like causal attributions, the input of *socializers* (primarily parents, teachers and peers), gender role beliefs, self-perceptions and the self concept, and perceptions of the task itself" (Eccles et al., 1999, p. 155). It also links these educational, vocational and other achievement-related choices directly to the individually assigned importance, or value, of the options believed to be available, and the individual's expectations of success (Eccles, 1994; Eccles et al., 1999). The relationship between these two factors, and other factors which are commonly linked to achievement-related activities, including cultural norms, experiences, aptitudes and other personal beliefs and attitudes, is specified (Eccles et al., 1999). These achievement-related decisions are consciously or unconsciously made by the individual within the context of a complex social reality, and have immediate and enduring consequences (Eccles et al., 1999). According to Eccles, Barber and Jozefowicz (1999, p. 158-159), the decisions are guided by: "(a) one's expectations for success on and sense of personal efficacy for the various options, (b) the relation of the opinions to both one's short- and long-range goals and one's core self identity and basic psychological needs, (c) one's gender-role-related schemas, and (d) the potential cost of investigating time in one activity rather than another. All of these psychological variables are influenced by one's experiences, cultural norms, and the behaviours and goals of one's socializers and peers."

3.2.1 Cultural Milieu

"The Eccles and colleagues model was originally designed to explain a sociocultural phenomenon" and, like gender-role socialisation, cultural socialisation processes influence the

perceptions of members of the cultural group, and the goals and values they hold (Wigfield, Tonks, and Eccles, 2004, p. 169). One of the earliest influences on children are their social and cultural background, where they learn their designated social place in the world and abstract the roles, values and attitudes of their socialisers to roles and attitudes in general (Berger and Luckmann, 1991).

There are a number of things that systematically guide women away from ICT subjects, including culture and environment, traditional gender roles and other societal pressures (Gorski, 2002). In Australia, Young (2002) affirms that the influence of national culture and families was undoubtedly apparent in relation to females and ICT. Moreover, Teague (1997) asserts that, in Western society, environmental and behavioural factors contribute to the under-representation of women in the ICT field. This cultural influence shapes the perceptions about ICT, how ICT is used, and influences the potential entrants to the ICT field (Harris and Wilkinson, 2004). Furthermore, gender role socialisation could "lead male and female students to place different values on various long-range goals and adult activities" (Eccles et al., 1999, p. 175). Trauth (2002) also points out that individuals experience societal influences in different ways, as they bring different personality traits and intellectual qualities with them to ICT.

Gender and activity stereotypes can have impacts on perceptions of the range of available alternatives, subjective task values and expectations of success, and subsequently on the selection of long-term goals and careers (Eccles, 1994). According to Trusty, Robinson, Plata and Ng (2000), gender roles develop early in life and are a primary reason for the rejection of certain occupations and development of career preferences. The male-oriented characteristics of ICT are observed by children in social settings where they encounter ICT, through the language and accounts of insiders and behavioural norms (Kiesler, Sproull, and Eccles, 1985). ICT has a number of other activity stereotypes associated with it, and the general image of ICT professionals relates to them programming, or working long hours, in social isolation (Cuny and Aspray, 2000; Harrelson, 1999; Jewell and Maltby, 2001; Miller et al., 2000; Multimedia Victoria, 2001; Myers and Beise, 2001; Nielsen et al., 2001; Teague, 2002; Young, 2002). A more comprehensive review of cultural influences and gender and activity stereotypes can be found in Sections 2.2, 2.3.5 and 2.3.6 respectively.

3.2.2 Socialisers' Beliefs and Behaviours

According to Dryler (1998), during childhood and adolescence, one of the most influential contexts of socialisation is the family. The strongest, early relationships are with parents and siblings, which lead to an individual's first exposure to possible and appropriate gender roles

(Barker and Aspray, 2006). Parents can directly affect the options available to the student through financial support and the provision of resources, as well as by encouraging, or discouraging, the various options available (Eccles, 1994). Parents also provide very different experiences and messages about educational and vocational options, and the child's talents and abilities, depending on whether the child is male or female (Eccles, 1994), and may expose their children to unintentional and subtle gender bias in the home (Gürer and Camp, 2002). Children are keen observers and notice the role their parents take in everyday life (Margolis and Fisher, 2002, p. 21), and children often model their own behaviour on their same-sex parent (Moorman and Johnson, 2003). Dryler (1998) also found that children often make vocational and occupational choices in the area of their parents' expertise because of the belief that they would have more chance of obtaining guidance in this particular area.

The information and experiences provided by parents, teachers and career advisors can influence the perception of the career options available to the student (Eccles, 1994). The behaviours and attitudes of teachers about appropriate gender specific roles and ICT can subtly influence girls not to engage in ICT subjects or courses (Barker and Aspray, 2006). Teachers can share their beliefs with their students, who believe what is being verbally and non-verbally communicated because of the legitimate and expert power of the teacher (Barker and Aspray, 2006). "What is taught at school and what students are required to learn influence students' (and parents') beliefs about what knowledge is important and what is interesting" (Barker and Aspray, 2006, p. 16). While some women report that the influence of their teachers was the reason for their involvement in ICT pathways (Cuny and Aspray, 2000), most of the images of ICT coming from parents and teachers (Gürer and Camp, 2002), and reinforced by the media, are unattractive (Multimedia Victoria, 2001). Parents and teachers can also distort their perceptions of girl and boy competencies, in a gender role stereotypical fashion (Eccles, 1994). For example, some teachers believe that boys are more competent with ICT than girls (Barker and Aspray, 2006).

Peers are a powerful influence on behavioural choices, beliefs about the value of education and academic choices, as well as possible gender performance (Barker and Aspray, 2006). Student perceptions and attitudes towards ICT are affected by the views of peers, and their friends play a role in subject decisions (Margolis and Fisher, 2002). Reinforcement of gender role behaviours and values by peers influences the activities that children participate in while they are growing up (Eccles, 1994). Peers can directly or indirectly affect the options considered by the student by providing or withholding support for the alternatives (Eccles, 1994). Students who make subject choices outside of the norm for their gender may also suffer from negative attention from the other students (Barker and Aspray, 2006).

© 2007 Kaylene Clayton

3.2.3 Interpretation of Past Experiences and Aptitudes

Causal attributions have a significant impact on the development and change of self-perceptions (Skaalik, 1997). Motivations and values that link success to effort, rather than ability, are important to encourage the persistence of students (Margolis et al., 1998). However, discouragement can occur if they feel that it is only effort that brings the success, proving that they lack essential inherent talent and ability (Margolis et al., 1998). Research has also shown that many females ascribe their ICT successes to chance and hard work, and failure to inability, whereas males attribute their accomplishments to natural ability (Harrelson, 1999). Female ICT students are also more likely to focus on performance outcomes, and react with higher levels of anxiety and stress (Smith et al., 2002), and be less confident than their male peers, even when they achieve the same grades (Margolis et al., 1998). Yet, lack of ability is not an issue; it is the perception of ability that is the problem. The academic performance displayed by females is equal or better than male performance in technical areas (Moorman and Johnson, 2003).

"Perceived self-efficacy and locus of control are sometimes mistakenly viewed as essentially the same phenomenon measured at different levels of generality" (Bandura, 1997, p. 20). Perceived self-efficacy relates to beliefs about whether an individual can produce certain actions, while locus of control deals with whether actions affect outcomes (Bandura, 1997). With an external locus of control, the person thinks that the environment controls the outcome, while with an internal locus of control, the individual believes that they control the outcome (Wentzel and Wigfield, 1998). "Students who believe they control their achievement outcomes tend to do better in school, and they persist when encountering difficulties" (Wentzel and Wigfield, 1998). As outcomes occur from actions, the action performed will usually determine the outcome experienced (Bandura, 1997). Outcomes that are perceived to be successful raise self-efficacy, while outcomes perceived to be unsuccessful lower self-efficacy (Pajares, 1997). Bandura (1997, p. 433) also states that "perceived efficacy is a central mediator through which socialization practices and past experiences influence educational and career choices". Efficacy expectations for different tasks are a major determinant of an individual's willingness to expend effort, their activity choice and persistence (Bandura, 1997).

"People are often willing to relinquish control over events that affect their lives to free themselves of the performance demands and hazards that the exercise of control entails" (Bandura, 1997, p. 17). Children evaluate their competence in different areas using ability beliefs, and the concept related to these beliefs is their expectancies for success (Wigfield, Eccles, and Rodrigues, 1998). "Expectancies refer to children's sense of how well they will do on an upcoming task, instead of their general belief of how good they are at the task"; these

beliefs are a predictor of future performance in different tasks (Wigfield et al., 1998, p. 75). People who have a positive sense of their ability and efficacy to perform a task are more likely to choose to undertake a task, persist at it and maintain the effort required for the task (Wigfield et al., 1998). Future performance and engagement is predicted by efficacy and competence beliefs (Wigfield et al., 1998).

3.2.4 Child's Goals and General Self-Schemata

Within the Eccles, Wigfield, and colleagues' model, the child's goals and self-schemata influence expectations for success and subjective task values. The child's goals and self-schemata concept include: self-schemata; ideal self; self-concept of one's abilities; long- and short-term goals; and perceptions of task difficulty. Self-schematas "reflect individuals' beliefs and self-concepts about themselves" (Pintrich and Schunk, 2002, p. 62). They are generalisations about the self based on past experience, including name, personal appearance and traits, which influence how we process information (Ewen, 1998). These elements of the self-schemata vary from person to person, and consequently cause information to be processed in unique ways (Vandiver and Bowman, 1996). There are three main categories that represent the self including: actual self (who one really is); ought self (one's perceived duty); and ideal self (who one would like to be) (Higgins, 1987).

Self-perceptions of ability and perceptions of task difficulty are the most significant mediators of subjective task value and expectations of success (Li, Lee, and Solmon, 2007). Beliefs in ability are crucial to the expectancy-value theory of motivation and are focused on the present situation in relation to an individual's performance in a task (Wigfield and Eccles, 2000). "Ability beliefs are defined as the individual's perception of his or her current competence at a given activity" (Wigfield and Eccles, 2000, p. 70). As children progress through to early adolescence, their ability-related beliefs and values become more negative in certain activity areas (Wigfield and Eccles, 2000). Wigfield and Eccles (2000) offer the explanation that children increasingly engage in social comparison with their peers and become more attuned to interpreting and understanding the evaluative feedback they receive.

"Self-efficacy affects choice of activities, effort and persistence" (Pintrich and Schunk, 2002, p. 161) and develops through observation of others, receiving encouragement, mastering experiences and experiencing low levels of frustration (Bandura, 1997). The two most frequently used attributions to explain why an individual has succeeded or failed involve ability and effort, while other common reasons include task difficulty, luck, teacher help, mood and health (Pintrich and Schunk, 2002, p. 139). Individuals who believe they are capable of

© 2007 Kaylene Clayton

successfully completing a task are likely to participate; those who have low self-efficacy for accomplishing an activity or task may shun it (Pintrich and Schunk, 2002). Moreover, observation of peers successfully performing a task can motivate students to undertake the same task and raise their self-efficacy; however, seeing others fail can lead to student perceptions that they also lack the competence to succeed, and this deters them from attempting the task (Pintrich and Schunk, 2002). Eccles also found "clear evidence of gender differences in personal efficacy for various occupations among high-school seniors" (Eccles, 1994, p. 593).

Over the years, theorists have examined aspects of motivation, but recent research has focused on social cognitive theories, which include dimensions such as goals, achievements, expectancies, task choice and attributions (Eccles et al., 1998). The value of a course to an individual is influenced by several factors including: enjoyment of the subject; the need for the course in meeting a short- or long-term goal; the influence of socialisers to take or not take the course; and fear of the course material (Eccles, 1994). According to Pintrich and Schunk (2002, p. 62), "goals are cognitive representations of what students are striving for or trying to attain" which "can be shaped by self-schemas and self-concepts". Furthermore, Eccles et al. (1998, p. 1042) state that, over time, the relations of goals to performance should change as the meaning of ability and effort evolves.

3.2.5 Subjective Task Value

"Task value is a quality of the task that contributes to the increasing or decreasing probability that an individual will select it" (Eccles, 1994, p. 596). It can be defined in terms of four dimensions, namely: intrinsic interest in and enjoyment of the activity; the value of being involved in or having ability with an activity, in terms of it being consistent with self-image (attainment value); the usefulness of the task in achieving long- and short-term goals and rewards; and the cost of participation in the task or activity (Eccles, 1994, p. 596). Individuals seek to confirm their possession of those characteristics central to their self-image through various tasks; individuals place more value on those tasks that are congruent with self-image, or provide the opportunity to fulfil self-image, and are more likely to select tasks with a higher subjective value (Eccles, 1994). These factors need to be considered in terms of the differing socialisation experiences of boys and girls because expectations of success, as well as the subjective value, and perceived cost of the task, are communicated to the student by their teachers and parents (Golombok and Fivush, 1994).

Belcher, Lee, Solmon and Harrison Jr. (2003) found that an individual's perceptions about the gender-appropriateness of a task have an significant influence on beliefs about ability and

subjective task value. Gender roles can indirectly influence the subjective value of educational and vocational options, behaviours and attitudes of others (Eccles et al., 1999), as well as educational and vocational choices, through perceptions of viable options, subjective task value and impacts on their expectations (Eccles, 1994). There is also explicit evidence of gender differences in the values attached to a range of school subjects and activities (Eccles and Harold, 1992 in Eccles et al., 1999). Furthermore, "children's subjective task values are also important predictors of children's activity choices" (Eccles et al., 1993, p. 831). Wigfield and Eccles (2000, p. 77) also found that "children's subjective task values are the strongest predictors of children's intentions to keep taking math and actual decisions to do so".

Eccles et al. (1998, p. 1028) define the incentive and attainment value dimension of the model as "the personal importance of doing well on the task." Furthermore, intrinsic value refers to the individual's enjoyment of undertaking the task (Wigfield and Eccles, 2000, p. 72). Attainment value can be defined in terms of the personal values and needs that the activity fulfils (Eccles, 1994). Even children in the early primary school years are able to differentiate their subjective task values and ability-related beliefs; "they appear to have distinct beliefs about what they are *good* at and what they *value* in different achievement domains" (Wigfield and Eccles, 2000, p. 75).

The utility value of the task captures the "more 'extrinsic' reasons for engaging in a task, such as doing a task not for its own sake but to reach some desired end state" (Wigfield and Eccles, 2000, p. 73). It refers to how the activity will fulfil, or help accomplish, an individual's future plans and goals (Wigfield and Eccles, 2000, p. 72). "The model predicts that people will be most likely to enroll in courses that they think they can master and that have a high task value for them" (Eccles, 1994, p. 589). However, students will sometimes enrol in subjects that they do not particularly find interesting or enjoy in order to fulfil a study requirement, please their parents, or to remain with their friends (Eccles et al., 1998, p. 1029).

Cost is the perceived negative aspects of being involved in a task (Pintrich and Schunk, 2002). The cost of participating in an activity can be conceptualised in terms of a trade-off between the time and energy required for that and other activities, and is influenced by many factors including: fear of failure, or the social consequences of success; anticipated anxiety (Eccles, 1994); and fear of losing the sense of self-worth (Covington, 1992). This is related to Covington's theory of self-worth where the motive for self-worth is the need to establish and sustain a positive self-image (Covington, 1992).

© 2007 Kaylene Clayton

3.2.6 Expectations for Success

The Eccles, Wigfield, and colleagues' model predicts that individuals will select activities for which they have the highest expectations for success (Eccles, 1994). When expectations of success are high, individuals set themselves binding goals, and when their expectations of success are low, they will forbear goal setting (Oettingen and Gollwitzer, 2001). Furthermore, people who have a low expectation for success tend to avoid challenging tasks (Hyde and Rosenberg, 1976). An individual's expectations for success are shaped from prior experience in particular domains and their subjective interpretation of those experiences, and depend on the person's confidence in their intellectual abilities and their perceptions and expectations of task or subject difficulty (Eccles, 1994).

Socialisation processes affect an individual's expectations and values and subsequently their life choices (Eccles et al., 1999). Expectations for success, confidence in abilities, gender roles and their influences on behavioural choice are domain specific, and "believing that one can succeed at an occupation is critical to one's decision to enter that occupational field" (Eccles, 1994, p. 599). However, while occupational choice is predicted by expectations for success and personal efficacy, there are other predictors that influence occupational choice including the value attached to occupational characteristics (Eccles, 1994). Furthermore, when choosing from a range of occupational options, many options are not contemplated or seriously considered because the individual is unaware of their existence, or the individual has received inaccurate information about the option or the possibility of achieving in that domain (Eccles, 1994).

3.3 Gottfredson's Theory of Circumscription, Compromise and Self-Creation

Gottfredson's Theory of Circumscription, Compromise and Self-Creation was first published in 1981. Since then, it has been revised and expanded to create the 2002 version used within this research project. It has its base in the field of Career Psychology and considers the process of limiting occupational choices and compromises that people go through when choosing a career. Gottfredson (2002, p. 87) claims that the view that individuals act as "active agents in creating themselves and shaping their own destiny" is consistent with the traditional view of career psychology. This theory represents the average person, but it must be remembered that individuals can vary widely.

Circumscription and compromise are the processes where occupational aspirations are explored, developed and relinquished throughout the individual's first two decades of life (Gottfredson,

2006). The theory suggests that people circumscribe the types of occupations they deem to be acceptable by evaluating the sex type, prestige associated with the occupation and their personal interests. However, “most such circumscription occurs without their knowing, or wondering much about, what workers actually do in the jobs they so peremptorily reject” (Gottfredson, 2005, p. 77). The process of compromise occurs when the individual relinquishes their preferred career aspirations within their zone of acceptable alternatives for more realistic or accessible occupational choices. The zone of acceptable career alternatives contains occupations that have not been eliminated according to incompatibilities with the sex type and prestige of the occupation and the individual, and according to whether the perceived effort required is acceptable to the individual (Lapan and Jingelski, 1992). “Circumscription and compromise therefore represent processes of self-definition and self-creation” (Gottfredson, 2002, p. 129).

The theory falls in the middle ground between the nurture versus nature debate, linking both genetic heritage and traits (nature) with environmental factors including culture (nurture). “Whereas socialization theory sees us as mutely following the life compasses that our culture sets for us, the latter theory [nature-nurture partnership theory by (Eysenck, 1998)] points to the quiet but persistent genetic compasses with which nature equips each of us at birth and which vie with culture in shaping our travels through life” (Gottfredson, 2002, p. 108). This is in line with Trauth’s Individual Differences Theory of Gender and IT (Trauth et al., 2004), which places itself between Social Construction and Essentialism. These views also reflect my position regarding the relative influence of nature and socialisation in girls’ ICT educational and vocational choices. While socialisation plays a key role in the choices made by girls, I believe that other factors, such as cognitive ability, talents and personal interests, can also play a role in these choices. In this research, Gottfredson's theory (2002) acts as guidance to assist in the understanding of the student's process of limiting occupational choices and making compromises when choosing a career.

3.3.1 Circumscription

Circumscription is the process of progressively narrowing the set of acceptable occupational choices, by rejecting or accepting occupations in terms of the sex type and prestige associated with the occupation and personal interest. As children develop, their world becomes more concrete as they “apprehend and organize the complex, abstract information about themselves and their world” (Gottfredson, 2002, p. 94). According to Gottfredson (2002, p. 88), self-concept is the public and private view of oneself and “includes appearance, abilities, personality, gender, values and place in society”. Purkey (1988, p. 2) continues, and defines it as the “totality of a complex, organised, and dynamic system of learned beliefs, attitudes and

opinions that each person holds to be true about his or her personal existence". These concepts may be difficult to articulate, and perceptions of these self-concepts may be incorrect (Gottfredson, 2002). For example, people who have lost large amounts of weight may not instantly recognise unexpected reflections of themselves because of the perception of how they expect to look in the reflection.

Self-concept is a dynamic social product which is shaped and reshaped through an individual's life experiences, especially with their key socialisers (Purkey, 1988). It is firmly established by about the sixth year, but during the early formative years and adolescence, it is susceptible to the influence of other people (Milliken, 1998). Once established, self-concept can be slowly modified over time, and with conscious effort, later in life (Milliken, 1998). As an individual's self-concept develops, their vocational preferences are developing at the same time and they are interacting and mutually influencing each other (Gottfredson, 2002). Moreover, new insights into the increasingly complex information about self and occupations can occur while they are still incorporating and acting upon prior, more concrete insights. Occupations that conflict with the individual's self-concept are progressively eliminated (Gottfredson, 2005) at the same time that they integrate more abstract elements, such as gender and social class, into their self-concept. Once an occupation is eliminated, it is rarely spontaneously reconsidered, unless there is a new formative experience, or a significant or consistent change in their social environment. The changes described above happen gradually and are unseen, unless there is a strong external stimulus such as changing schools or peer groups (Gottfredson, 2002).

The process of circumscription starts in early childhood, and there are four stages of development: orientation to size and power (ages 3-5); orientation to sex-role (ages 6-8); orientation to social valuation (ages 9 -13); and orientation to the internal, unique self (ages 14 and beyond) (Gottfredson, 2002). However, the delineation of ages between these stages is not fixed (Gottfredson, 2002). Individual differences, in terms of mental ability and maturity, at given ages mean that some children will reach each stage earlier or later than their peers. As each stage is reached, the child's potential social space is narrowed in accordance with their cultural environment, as their view and understanding of the more complex aspects of themselves and occupations evolve.

During stage one, where orientation to size and power occurs, children begin to classify people in terms of their size and power, as well as recognising adult roles and moving away from desires of being a fantasy character or inanimate object when they grow up (Gottfredson, 2002, 2005, 2006). The groundwork for stage two, orientation to sex roles, is laid in stage one. While they do not have stable or coherent conceptions of sex roles in stage one, they are able to

© 2007 Kaylene Clayton

recognise observable differences in gender in terms of both appearance and behaviour, and often prefer to play with same-sex peers (Gottfredson, 2002).

In stage two, orientation to sex roles, children are able to understand the concept of sex roles, but tend to focus on visible cues such as clothing and observable actions to distinguish between male and female. Sex roles are "a constellation of qualities an individual understands to characterize males and females in his [or her] culture" (Block, 1973, p. 512). "Both sexes believe that their own sex is superior" (Gottfredson, 2002, p. 96), and their vocational aspirations are linked to appropriateness of the occupation to their sex type. Boys tend to report more higher-status occupational preferences than the girls, but this could be related to how visible the same-sex occupations are to the children in terms of equipment, personal contact, tasks and uniforms (Gottfredson, 1996). Block (1973) also believes that socialisation narrows the sex-role definitions and behavioural options for females, but enhances experiential options and encourages more androgynous sex-role definitions for males. Children at this stage think dichotomously and have not yet exhibited concern about occupational prestige, but are aware to some degree of distinctions in social class (Gottfredson, 2002).

Orientation to social valuation occurs in stage three, and the children become more aware of social class and the opinions of others. The children have now progressed past dichotomous thinking and become sensitive to social evaluation by peers and society (Gottfredson, 2002). They now think similarly to adults in terms of ranking occupational prestige, and they have learned which occupations are not considered desirable by their family and surrounding community (Gottfredson, 2005). Armed with this knowledge, low-status occupations are removed from occupational preferences. Adults, including teachers, have also formed perceptions of the child's level of ability in relation to her or his peers. "Schools have perhaps the biggest impact today on children's perceptions of occupational difficulty, because they starkly illuminate students' differences in intelligence and thus their prospects for rising socially via higher education" (Gottfredson, 2002, p. 98). Occupations falling outside of the tolerable effort boundary, that is, ones that are perceived to be too difficult to obtain with reasonable effort, or ones that present a high risk of failure, are also disregarded as a potential occupation (Gottfredson, 2002).

The intellectual ability of the child and social desirability of the occupation together form tolerable level boundaries of the highest and lowest prestige occupations that are commensurate to their level of ability (Gottfredson, 2002). Occupational alternatives within zones of acceptable alternatives are often not regarded as equal and are often graded from high to low desirability. According to Pallas (2000), parental education is a measure of socioeconomic

© 2007 Kaylene Clayton

status, and well-educated parents are more likely to provide their children with better educational resources and information. Bright children are also encouraged to aim higher in education than their more average peers of the same socioeconomic status (Gottfredson, 2002). Furthermore, children from a higher social class are expected to reach a higher occupational status than children from a lower social class who may have similar aptitudes and abilities. “By the end of Stage 3, then, children have blacked out large sections of their occupational map for being the wrong sex type, unacceptably low level, or unacceptably difficult” (Gottfredson, 2005, p. 79).

During stage four, where orientation to the internal, unique self occurs, children now become more concerned with their attractiveness and desirability to the opposite sex and fitting in to the ‘right’ social crowd (Gottfredson, 2002). This may reinforce adherence to sex and status stereotypes and impact on decisions made at this stage about subject choices. They are also struggling with what their interests, abilities and values are, and require “experience in new activities and unfamiliar settings” in order to expose, expand and test their specific strengths and weaknesses, likes and dislikes, and world view (Gottfredson, 2002, p. 99). Individuals are now also beginning to consider which occupations will allow them to fulfil social obligations as well as fulfilling personal goals (Gottfredson, 2005). However, exploration of the myriad of occupations that can be considered as part of this quest has now been scoped to include only those within the zone of acceptable alternatives (Gottfredson, 2002).

The task at hand is to reflect upon personality, values, aptitudes and needs in order to identify which of those occupations that have filtered into the zone of acceptable alternatives are available and most desirable. By early in secondary school, students usually have acquired a framework to understand the social and economic meaning of being involved in different occupations (Lapan and Jingelski, 1992). However, the process now becomes more difficult and complex as the students’ vocationally relevant personal attributes are still forming, and they have not had sufficient opportunity and experience to test their vocational abilities, interests and available opportunities (Gottfredson, 2005). Compatibility of the occupation with all elements of the self is rarely achieved, but the higher the compatibility, the stronger the preference for the occupation. Occupations that will be the most rejected are the ones that conflict with core elements of self-concept. An occupational aspiration also only represents one alternative within the zone of acceptable alternatives at any one point of time, and it may change quickly as perceptions of suitability and accessibility change. Furthermore, career advisors should promote self-insight to prevent or reverse inappropriate circumscription (Gottfredson, 2006). The possible opportunities as well as barriers to implementing preferred choices are now considered, and this begins the process of compromise.

© 2007 Kaylene Clayton

3.3.2 Compromise

Compromise is the process of "adjusting aspirations to accommodate an external reality" where the individual's most preferred occupations are relinquished from the zone of acceptable alternatives (Gottfredson, 2002, p. 100). New preferences are established from their less preferred or even previously unacceptable alternatives when external barriers are anticipated or encountered. As the zone of acceptable alternatives decreases, the difficulty of the compromise increases and seems less voluntary. Individuals will opt for work in a different area of their social space, instead of compromising either prestige or sex type. Should no such work be accessible, they will choose lower-level work rather than occupations that conflict with gender self-concept (Gottfredson, 2006).

There are two types of compromise, anticipatory and experiential compromise, and the degree of compromise can range from minor to significant. Anticipatory compromise happens when the teenager moderates their compatibility with their perceptions of accessibility of the occupation (Gottfredson, 2002). Experiential compromise occurs when the teenager encounters a barrier, such as availability of education for that occupation or discrimination in hiring practices, when implementing their most preferred choices (Gottfredson, 2002). Furthermore, in order to identify the best vocational option, values and interests are balanced or exchanged and the degree of compromise in sex type, prestige and field of interests can range from low to high (Gottfredson, 2002).

The perceptions of accessibility affect vocational aspirations and are dependent on the information that the individual is exposed to and that they seek out (Gottfredson, 2002). Many factors beyond the control of the individual limit the accessibility of the occupation, including labour market conditions, the availability of appropriate training, and the cost and effort involved in finding up-to-date and timely opportunities for education or training and employment (Gottfredson, 2006). Moreover, "information on accessibility degrades quickly as time passes, and it may always be difficult to obtain for some occupations" (Gottfredson, 2002, p. 101). There are three main principles related to gathering information about occupational accessibility (Gottfredson, 2002). Firstly, individuals are more likely to search for information about highly preferred occupations than less desired ones. Secondly, the closer an individual comes to implementing the occupational aspiration, the more serious he or she becomes about focusing on the career information and the more realistic the aspiration becomes. Finally, the teenager will seek information and guidance primarily from trusted and convenient sources, such as parents, teachers and others in their social network.

© 2007 Kaylene Clayton

For individuals beginning their adult life, there are four principles governing the process of compromise; in general, the importance of protecting one's visible social self is given higher priority than protecting the more private psychological self (Gottfredson, 2002). Developing conditional priorities is the first principle of compromise, where the relative importance of sex type, prestige and occupation depends on the seriousness of the compromise required. To summarise this principle: "if compromises are severe, protect sextype; if compromises are moderate, sextype is good enough, so favor prestige; if compromises are minor, that means both sextype and prestige are good enough, so favor interests" (Gottfredson, 2002, p. 104). The second principle refers to opting for the "good enough", where individuals are satisfied to settle for a good choice and are unwilling or unable to go through the demanding process of identifying the best possible choice. Staving off the "not good enough" is the third principle, where the individual will avoid, if possible, committing to a choice if they are not satisfied with any of the choices available within the social space. The fourth principle is accommodating to compromise where individuals are most willing to psychologically accommodate major compromises in the field of work, less to compromises in prestige and least of all to shifts in sex type, which undermine an acceptable gender identity (Gottfredson, 2002).

3.3.3 Self-creation

According to Gottfredson (2005, p. 74), "we are not passive products of either nature or nurture, but active agents in our own creation". We each have a unique genetic makeup and enter an evolving social world at birth in which we have our own unique experiences. Individuals and environments are mutual creations of each other and emerge simultaneously from an individual's stream of experience. "In other words, nature activates and shapes nurture" (Gottfredson, 2002, p. 117). Moreover, culture constrains and facilitates the expression of our most basic differences (personality, physique and intelligence); it does not create these factors (Gottfredson, 2005). Individuals are born with precursor traits (primitive capabilities and temperament) and develop general traits and end-specific trait combinations that are demonstrated through observable outcomes (life events, behaviours and achievements). The core to our individuality is our inner genetic compass; when given a choice, it draws us to or repels us from certain paths, activities and opportunities, causes us to respond differently in the same environment and to create different social niches for ourselves (Gottfredson, 2006). This view "helps to explain which cultural pathways we follow or avoid in life and to what extent our paths deviate from those trod by our social peers" (Gottfredson, 2002, p. 116).

Gottfredson (2002, p. 123) defines niche development as "the gene-driven but culturally constrained development of our most global social roles, activities and life achievements, which

© 2007 Kaylene Clayton

occupations being perhaps the most key among them in the world today". There are five principles of niche development to explain "why some individuals are more likely than others to attain congruent life niches" (Gottfredson, 2002, p. 123). Principle one is culture as a finite menu of possible life niches, where cultural roles and activities are the building blocks that genetically-distinct individuals use to build their preferred social niche. Principle two refers to life course as a gradual, uncertain journey from birth niche to adult niche. This is when we shift from our birth to a life niche which "resonates better with one's inner self" (Gottfredson, 2002, p. 125).

Personal freedom, as a major external factor governing the subset of experience available to us, is principle three. Not all individuals have, or want, equal access to the panoply of life roles, activities and social niches that are available; instead all cultures steer individuals towards various paths for a variety of reasons. Temperament or personality, as a major internal factor governing the subset of experiences actually available to us, is principle four. Depending on their temperament and personality, not all individuals have the inclination to exploit the cultural pathways that are available to them. The final principle is development as increasingly gene-directed, person-centred and insightful. That is, the more we are exposed to life's possibilities, the more likely we are to reflect on these and discover ourselves. "It is only with the dawning and cultivation of self-knowledge that individuals become more the director and less the directed in their own lives" (Gottfredson, 2002, p. 129).

© 2007 Kaylene Clayton

3.4 Adya and Kaiser's Model of Girls' Career Choices

Adya and Kaiser's model (Figure 3-2) was published while the data collection for this research was under way. However, many features of this model resembled my conceptual model (see Section 3.5), and this helped confirm the legitimacy of my model. Like my model, it considered social and structural factors identified through a search of literature. It also considered the importance of individual factors. However, I felt that ethnic culture was too narrow and that socioeconomic status was missing as an important consideration, and I disagreed with the placement of Individual Differences and some of the sub-factors and influences.

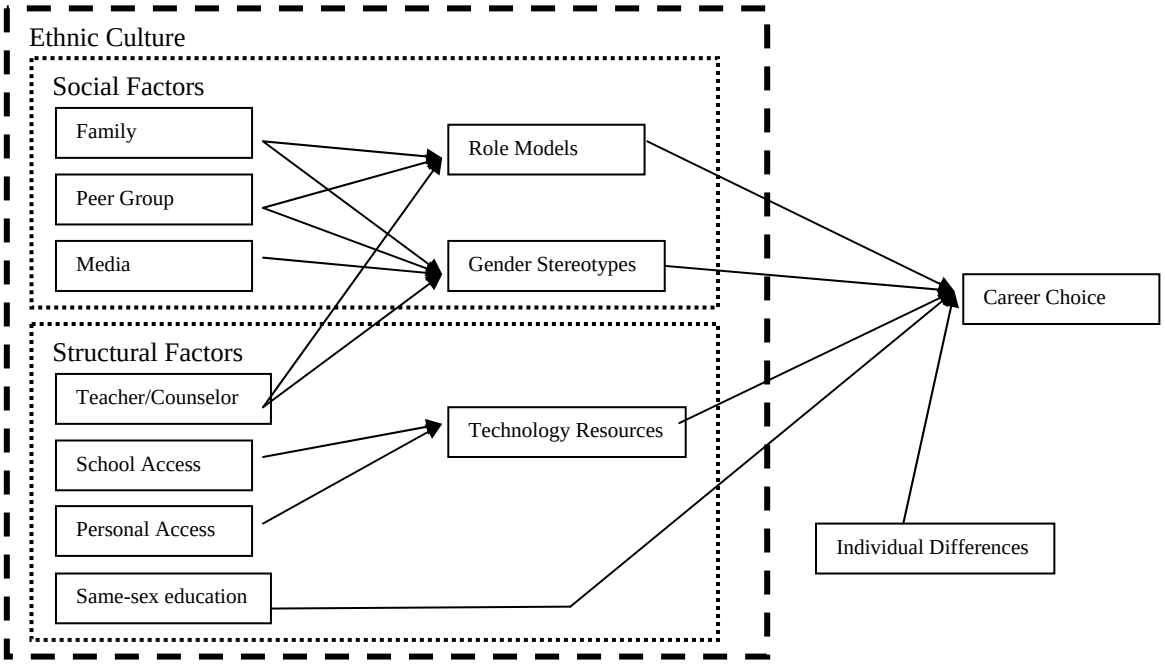

Figure 3-2 Model of Girls' Career Choices (Adya and Kaiser, 2005)[1]

I felt that this model also fit with my underlying research assumptions. The structures identified in the model fit with my critical realist ontology in that I believe social reality is largely preconstructed. That is, social structures and institutions are difficult for individuals to resist or modify and appear to possess causality. Adya and Kasier (2005) also suggest the need to gain right insights into girls' experiences, and I believe that this supports my interpretivist epistemology in that it assists in the understanding of reality from the point of view of the participant's constructions. Further discussion on my research assumptions can be found in Section 4.2 of this thesis.

[1] Reprinted from Information Technology and People, 18/3, Adya, M. and Kaiser, K. M., Early determinants of women in the IT workforce: a model of girls' career choices, Pages 230-259, Copyright (2005), with permission from Emerald Group Publishing Limited.

Based on past research, literature and hypotheses about the future of the IT workforce, Adya and Kaiser set out to develop a testable model for girls' technology-based career choices (Adya and Kaiser, 2005). To develop the model, they amalgamated literature from the fields of psychology, sociology, computer science and IT, education and business. However, while Adya and Kaiser's research has been cited a number of times, to date this model remains untested.

Factors in the Model of Girls' Career Choices are grouped into three main categories: social factors, structural factors and individual differences. Adya and Kaiser state that they drew from and modified Ahuja's (2002) classification of social and structural influences on women's IT careers, the Beise et al. (2003) model of women's career decisions and Trauth's (2002) suggested individual difference factors. The main weakness of this model is that Adya and Kaiser drew from Ahuja's and Beise et al.'s models that were created with adult women in mind, and modified Ahuja's model to suit children. However, adult and child responses to influences can differ (for example, peer influences), but due to the lack of relevant literature, the adult responses have been extrapolated to children. Adya and Kaiser (2005, p. 232) also state that "young adolescents are not exposed to structural factors to the same extent as women and men in professional settings".

In their model, Adya and Kaiser believe that social and structural factors are influenced by the ethnic culture in which they are situated. They believe that, in certain countries, the underlying culture and expectations of the country have changed the landscape to place a greater emphasis on technology excellence, software development and a rich educational system. This in turn makes IT careers more viable and affects work habits, education and interactions within families (Adya and Kaiser, 2005). For example, they propose that girls who live in countries where local ICT development is increasing will be more inclined to follow an ICT career path than those who live in countries where the ICT industry is increasingly being outsourced to other countries (Adya and Kaiser, 2005).

3.4.1 Social Factors

In Adya and Kaiser's model, the five social factors are family, peer group, media, role models and gender stereotypes. Furthermore, "while both social and structural factors can influence decisions about career choice, early perceptions of children are most influenced by social factors such as parents, peers, and role models" (Adya and Kaiser, 2005, p. 232).

According to Dryler (1998), during childhood and adolescence, one of the most influential contexts of socialisation is the family. This influence can be direct or indirect. Furthermore,

© 2007 Kaylene Clayton

Adya and Kaiser (2005) also identified that parental education and careers are key motivators of a child's choice of career. Parental influence is very strong in terms of non-traditional career choices; they may act as achievement and perseverance role models even if they are not IT professionals (Adya and Kaiser, 2005). Adya and Kaiser (2005) also believe that more girls will cite their mother as being an ICT career role model, but fathers in particular will continue to be a key positive influence in their daughter's ICT career choice. Similarly, older siblings and other relatives can influence career choices (Adya and Kaiser, 2005). However, Adya and Kaiser (2005) caution that family influence in their model relies on an intact family structure, and single-parent or same-sex families may have different influences on the child.

Student perceptions and attitudes towards ICT are affected by the views of friends or peers, and friends can play a role in student course selection decisions (Margolis and Fisher, 2002). Furthermore, Barker and Aspray (2006, p. 34) state that "peers influence children's beliefs about the value of education, appropriate and possible gender performance, and academic choices". However, Adya and Kaiser (2005) are of the opinion that male peers will not have a significant influence on girls' ICT career choices. Furthermore, they believe that, during adolescence, peers may have little influence on career choice and more influence on behaviours and attitudes, fashion styles and social responsiveness. Future studies should give consideration to peers as role models, whether peers have encouraged ICT career choice, or if peer career advice is more valued than family career advice (Adya and Kaiser, 2005). Adya and Kaiser (2005) suggest that the inclusion of the perception of 'geekiness' or 'nerdiness' would be useful when examining this factor in their model.

Mass media, such as television, movies and magazines, play a large role in influencing people's impressions of ICT (Gürer and Camp, 2002). Moreover, "printed and electronic media influences and enhances gender stereotypes that focus largely on physical image rather than on motivating career choices" (Adya and Kaiser, 2005, p. 235). Popular teen magazines for girls, such as *Dolly* and *Seventeen*, have little content that portrays women in professional, technological careers (Adya and Kaiser, 2005). Trade journals have begun representing women in more professionally active roles, but they are not usually accessible or popular reading for teens (Adya and Kaiser, 2005). Television, advertising and computer games can also reinforce cultural expectations of gender and gender stereotypes (Henslin, 1999). Adya and Kaiser (2005) believe that stereotypes that are detrimental to girls' ICT career choices will continue to be perpetuated by the media.

According to Adya and Kaiser, "teen role models are often societal figures that promote a certain lifestyle, social image, and behaviors that have little impact in motivating career choices

other than in music, sport, or movies". Adya and Kaiser's model separates the influence of media and family role models and focuses on role models which directly influence academic choices (Adya and Kaiser, 2005). These role models are often family members or are part of the education system (Dryler, 1998). Adya and Kaiser (2005) believe that mothers will be seen as an ICT role model more frequently, but fathers will continue to be a positive influence on their daughter's ICT career choice. Additional insight may be gained by assessing students' perceptions of teachers acting as role models (Adya and Kaiser, 2005).

"While parents, teachers, and peers positively influence career choices, these role models also reinforce gender stereotypical career perceptions" (Adya and Kaiser, 2005, p. 236). Furthermore, beliefs about the role-appropriate behaviour of others can restrict career choice decisions (Miller and Budd, 1999). Many women struggle over whether they are suited for ICT careers (Margolis et al., 1998) and with the message that men are smarter and better fulfil the requirements for ICT work and study (Nielsen et al., 2001; Teague, 1997). The ICT field is seen as a masculinised domain and this can discourage many people from choosing ICT as a career (von Hellens et al., 2003). While Adya and Kaiser's model includes gender stereotypes, it seems to ignore occupational stereotypes associated with ICT. The nerdy/geeky image associated with ICT can also discourage potential entrants into this field. Adya and Kaiser (2005) believe that these stereotypes will continue to be shared by media.

3.4.2 Structural Factors

The structural factors in Adya and Kaiser's (2005) model include the teacher/counsellor's role in students' ICT exposure, access to ICT resources at home and school and the nature of the school environment (same-sex/coeducational). These structural factors represent institutional support for females when pursuing their career and can influence the gendering or offsetting of ICT careers (Adya and Kaiser, 2005).

Based on empirical evidence, Adya and Kaiser (2005) believe that teachers and counsellors can have a negative influence on technology career choices. They cite research that support that teachers and guidance counsellors can discourage females entering the ICT field and male lecturers have positively and negatively influenced female entry into ICT study. Adya and Kaiser (2005) also state that male domination of the ICT faculty and the associated lack of female ICT faculty teaching female students is problematic. Another problem is that counsellors fulfil a number of roles and are able to devote very little of their time to vocational counselling (Adya and Kaiser, 2005). Thus, the amount of counselling that students receive is minimal and, when given, tends to direct females in traditional career roles (Adya and Kaiser, 2005). Adya

and Kaiser (2005) feel that the influence of teachers and counsellors on girls' career choices is unlikely to change much in the near future and that the trend of stereotyping careers and encouraging girls into traditional careers will continue.

Adya and Kaiser (2005) believe that disparity in computer access can have lasting effects, and propose that early exposure to ICT may reduce technology intimidation and lead to more involvement in ICT careers . This access may occur in the home or at school. Adya and Kaiser have identified a number of areas to examine when investigating technology access at school and home. These include the presence of computers at home and school, the amount and nature of computer access and teacher, parental and sibling access at home (Adya and Kaiser, 2005). The increased availability of computers at home and at school, computer games, instant messaging and integration of ICT into the K-12 curricula have reduced gender differences in the amount of time boys and girls spend using computers (Adya and Kaiser, 2005). However, while computer technology and access have significantly increased over the past decade, children in low socioeconomic areas may not have the same opportunities as middle-class or more affluent areas (Adya and Kaiser, 2005). Care should be exercised, as much of the literature about computer use and access at home and at school, including that cited by Adya and Kaiser, is dated and may well be invalid.

Adya and Kaiser also emphasise the importance of different types of school environments in their model. They state that researchers should explore the impact and outcomes of same-sex and coeducational school environments on perceptions and career choices (Adya and Kaiser, 2005). They maintain that "same-sex schools may either allay gender stereotypes or further deepen them" (Adya and Kaiser, 2005, p. 241). Furthermore, Adya and Kaiser (2005) suggest that students attending same-sex schools may not be as likely to adopt gender-specific career choices, and parents enrol their daughters in these schools in the expectation that there is minimal gender discrimination. Consequently, they expect them to excel at maths, science and technology subjects. However, they recognise that there are similar structural factor influences in same-sex and coeducational school environments and the difference may be the impact of peers at these school types (Adya and Kaiser, 2006). Despite this, they have not considered the differences in impact and outcomes of government and private educational environments.

3.4.3 Individual Differences

The third major category of Adya and Kaiser's model is Individual Differences. Adya and Kaiser (2005) recognise that this category is immature and, because of its nature and scope, the most open to change. It considers differences such as perceptions about technology, technology

use, personality preferences and socioeconomic status amongst others. It differs from Trauth's (2002) emergent Theory of Individual Differences in that it includes socioeconomic status. Trauth's theory focuses on individual differences among women and their participation in the ICT field resulting from a combination of sociocultural influences and individual characteristics and does not explicitly consider the socioeconomic status of the individual. However, Adya and Kaiser (2005) state that the individual differences part of their model mainly focuses on personality differences, perceptions of self-efficacy and attitudes towards computers.

The individual factors aspect stands alone and has not been explicitly expanded to include any sub-factors, as seen in Social Factors and Structural Factors. Adya and Kaiser do not spend a great deal of time discussing the individual differences part of their model and have suggested that future researchers will be able to provide further insight into this component.

While they have given very little treatment to the personality area, this could be partially due, in terms of girls' IT career choice, to the multifaceted and uncircumscribed nature of personality. Adya and Kaiser have provided some guidance on personality measurement instruments that could be used when testing this model, but they have not provided any guidance on the personality characteristics that could be important. Conversely, Trauth (2002) suggests several personality traits that could relate to female IT professionals, such as being strong, ambitious, logical, less social and competitive. However, these traits may not be apparent in middle-school girls, as it may be too early in their social development for these to be evident.

Adya and Kaiser also provide very little discussion on the role of self-efficacy and computer attitudes and perceptions in their model and how they affect IT career choices. However, they do state that "an adolescent's career choice will often be influenced by social, structural, and economic pressures that may have little to do with attitude towards technology" (Adya and Kaiser, 2006, p. 233). Adya and Kaiser provide a number of suggested survey instruments that may be useful for investigating self-efficacy and computer attitudes and perceptions. However, they do not provide guidance about areas of specific interest that future researchers should concentrate on.

© 2007 Kaylene Clayton

3.5 Conceptual Model for Girls' ICT Study and Career Choices

Based on a search of the available literature, various themes and factors were identified as being relevant to the selection of an educational or career pathway in the ICT field. However, Eisenhardt (1989) cautions that not all factors identified early in theory creation are guaranteed to be included in the final version of theory. The literature search identified several main factors that could be grouped as social or structural factors. However, the distinction between social and structural factors was not always clear and, depending on how the factors were viewed, they could be included in social or structural factors, or at times both. A number of researchers (e.g. Adya and Kaiser, 2005; Eccles, 1994; Trauth et al., 2004) also suggest that individual attributes, rather than social or biological factors, influence the ICT pipeline. As with the Eccles et al. model (1999) and Adya and Kaiser's model (2005) discussed in Sections 3.2.1 and 3.4, the significance of culture is recognised and, in the conceptual model for this study (Figure 3-3), the cultural context overlies all of these factors.

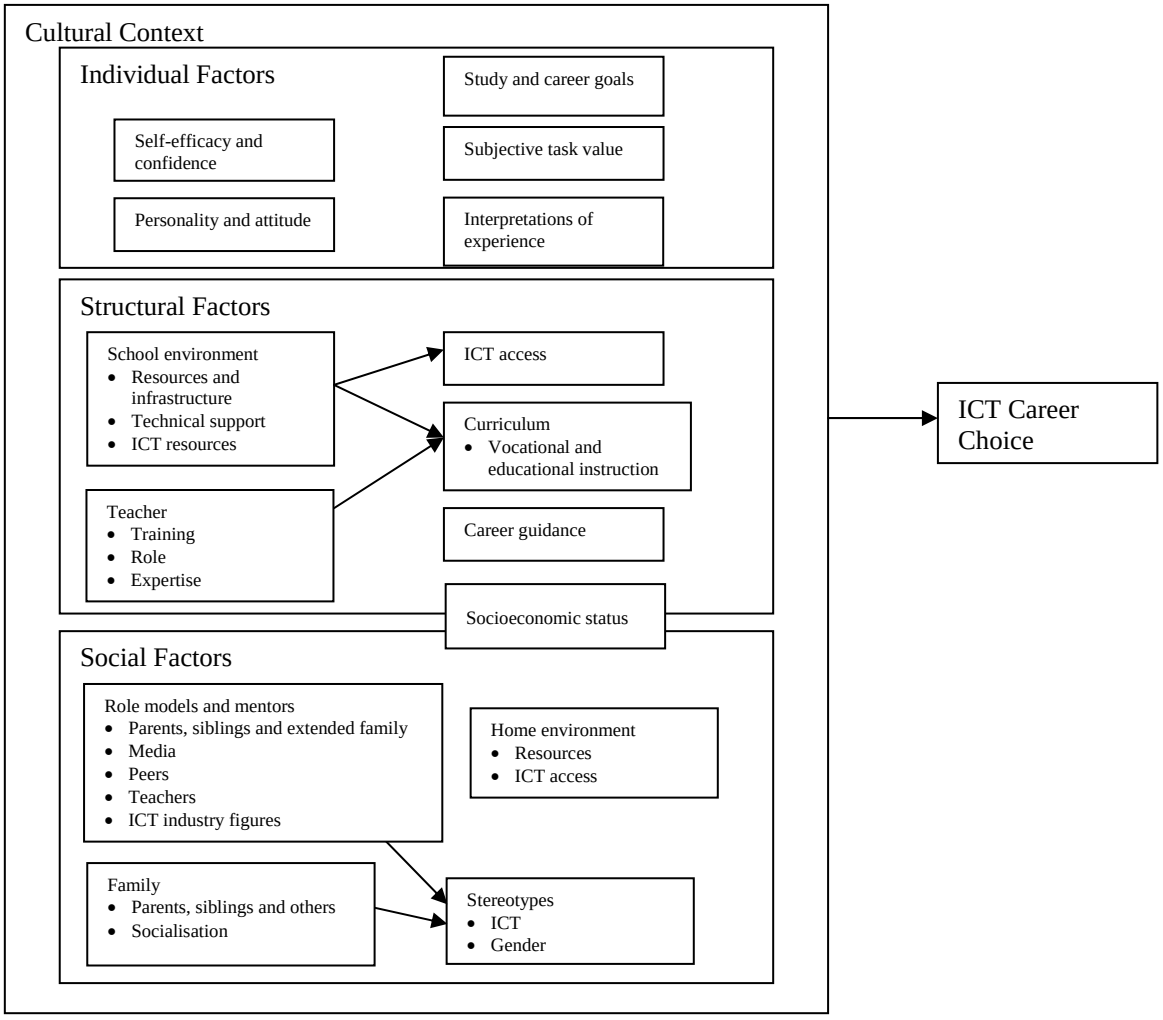

Figure 3-3 Initial conceptual model for the study

It has been shown that the decline of girls' interest and involvement in ICT career paths is not a world-wide phenomenon (Adams et al., 2003), possibly because of the differing expectations for girls and the importance of gaining positions in well-respected and well-remunerated professions within individual cultures and countries (e.g., Adams et al., 2006; Eidelman and Hazzan, 2006; Gharibyan and Gunsaulus, 2006). Furthermore, within social and youth groups, subcultures with different styles, behaviours and interests have also been shown to exist (e.g., Irwin, 2005).

In this study, individual attributes such as personalities, aptitudes and attitudes; goals and general schemata; subjective task value; and interpretations of experience were gleaned from the various models discussed in this chapter, including personality and attitudes from Trauth's Theory of Individual Differences (2002), Adya and Kaiser's Model of Girls' Career Choices (2005), Gottfredson's Theory of Circumscription and Compromise (2002) and Eccles, Wigfield, and colleagues' Expectancy-value Model of Achievement-related Choices (2000). However, the distinct aspects of personality and attitude require further identification and clarification. Factors such as individual aptitudes, goals, subjective task value and interpretations of experiences, identified in the Eccles, Wigfield, and colleagues' model (Wigfield and Eccles, 2000) and by Gottfredson (2002), were felt to be significant contributors to girls' choice of ICT educational and career choice and were included in the Individual Factors section.

The Structural Factors were identified from the literature and discussed in their respective sections in Chapter Two and confirmed in part by their inclusion in Adya and Kaiser's (2005) model. The Structural Factors include influences from ICT access (Section 2.4.3) and the teacher (Section 2.4.1), which were also included in Adya and Kaiser's model, school environment (Section 2.4.2), curriculum (Section 2.4.4) and career guidance (Section 2.4.1). The school environment includes the amount and quality of resources (ICT and non-ICT, such as buildings and rooms, consumables, furniture and staff) available, technical support available to the teachers and students, and ICT access including ICT infrastructure (such as networks, power), computer access and software and Internet access.

The school environment influences ICT access and the curriculum in that a lack of resources and technical support affects the amount of access available and the activities and types of skills taught in the classroom. Areas of interest related to teachers include the amount of pre-service and post-service ICT training they have received, the teacher's role and the teacher's ICT expertise gained through personal and formal exposure to ICT. The curriculum includes traditional education components and vocational training. It is determined at the macro level by the educational authorities, and this is interpreted and implemented by the teacher. Teachers

© 2007 Kaylene Clayton

influence what is taught at a micro level and how the curriculum is implemented through personally developed programs and ideas. Teachers may, at times, provide general career guidance, but most secondary schools have guidance counsellors who can offer career guidance.

The Social Factors component of the conceptual model includes influences that were identified in the literature in Chapter Two and Three consisting of the home environment (Sections 2.4.3 and 3.4.2), family (Sections 2.2.1, 2.3.1, 3.3.2 and 3.4.1), role models and mentors (2.3.4, 3.3.2 and 3.4.1), and stereotypes (Sections 2.3.3, 2.3.5, 2.3.6, 3.3.2 and 3.4.1). The home environment includes the amount and quality of resources available (ICT and non-ICT, such as accommodation, consumables and furniture) and ICT access including ICT infrastructure (such as networks, power), computer access and software and Internet access. Accommodation issues can affect the amount of space available for a computer and the ability to afford a computer and utilities such as power and telephone, and therefore the amount of ICT access available at home. As seen in Section 2.6, Socioeconomic Status is influenced by Structural Factors (such as the local, national and global economy and economic policies) and Social Factors (such as the social position and financial status and employability of the family). Thus it falls into both Social Factors and Structural Factors in the conceptual model.

Family members normally act as the primary socialisers in a child's life. Children learn their designated social place in the world and abstract the roles, values and attitudes of significant others to roles and attitudes in general (Berger and Luckmann, 1991). Parents are a key part of this socialisation process, but siblings and extended family can also influence their values and attitudes. As such, gender and ICT role stereotypes can be shared between family members and the child. Gender stereotypes can include the type of work that is acceptable for males and females, and ICT stereotypes include the perception that ICT is 'nerdy/geeky' and an asocial and isolated occupation. Family, media, teachers, ICT professionals and peers can also serve as role models to a child. These role models can be positive or negative and have far-reaching effects on stereotype development and transmission. Teachers and ICT professionals may also see the value in mentoring a child in order for them to reach their full potential.

3.6 Conclusion

The purpose of this chapter has been to focus the literature search on three theoretical models that gave insight into and assisted the development of the thematic framework for analysis. Walsham (2006, p. 324 - 325) states that "the choice of theory is essentially subjective" and "lies in the researcher's own experiences, background and interests". In this fashion, the three theoretical frameworks along with literature from a variety of domains were used to guide the

research. In this chapter, the Eccles, Wigfield, and colleagues' Expectancy-value Model of Achievement-related Choices (Wigfield and Eccles, 2000), Gottfredson's Theory of Circumscription, Compromise, and Self-Creation (Gottfredson, 2002) and Adya and Kaiser's Model of Girls' Career Choices (2005) were described and their relevance to the development of the initial conceptual model and subsequent thematic framework was described. This conceptual model has its base in literature from a variety of research disciplines including IS and computer science, education and educational psychology, career psychology, psychology, gender science and sociology.

The Eccles, Wigfield, and colleagues' Expectancy-value Model of Achievement-related Choices (Wigfield and Eccles, 2000) shows that educational and occupational choices are guided by an individual's expectations for success and personal efficacy, in terms of short- and long-term goals, self-identity, gender role schemas and basic psychological needs, as well as the potential cost of the activity, in terms of time and energy. These issues are all influenced by socialisation factors, including cultural norms and the goals and behaviours of the person's socialisers and peers, along with personal experience.

The 2002 version of Gottfredson's Theory of Circumscription and Compromise is used for this research project to assist in the understanding of how occupational choices are circumscribed and the compromises that people make when choosing an occupation. The theory falls in the middle ground between the nurture versus nature debate, linking both genetic heritage and traits (nature) with environmental factors including culture (nurture). This is similar to Trauth's Individual Differences Theory of Gender and IT (Trauth et al., 2004), which places itself between Social Construction and Essentialism.

Adya and Kaiser's Model of Girls' Career Choices (2005) was published during the data collection phase of this research and after the initial conceptual model had been created. Adya and Kaiser's model has a number of parallels to the conceptual model proposed in this chapter, such as cultural, structural and social factors and individual differences (factors). However, the proposed conceptual model adds detail to the individual differences section and there are differences in the way that sub-factors are classified. Adya and Kaiser's model also helped to confirm the legitimacy of the proposed conceptual model.

Chapter Four describes the research design and the practical implementation of the research approach. In Chapters Five and Six, the initial conceptual framework is used to guide the analysis of the data collected. A new model, based on a synthesis of the literature described in Chapter Two and Three and the analysis of the data, is proposed in Chapter Seven.

© 2007 Kaylene Clayton

Chapter 4 Methodology

4.1 Introduction

Chapters Two and Three provided an overview of relevant background literature to provide a context for the research. The purpose of this chapter is to describe the research methodology used to investigate the problem described in Chapter One and the conduct of the study.

The research methodology is not only the structural decisions and procedures of a project, "it is a description of the chosen procedures and rationales (if any) behind them" and the "philosophy and assumptions that underlie the conduct of a research endeavour" (Shoib et al., 2006, p. 137). As such, this chapter explains and justifies the adoption of the methodology taken. This chapter seeks to aid the reader's understanding of the process undertaken to conduct the study and to show how I arrived at the findings described in Chapters Five and Six and discussed in Chapter Seven.

This chapter commences with a brief overview of the research paradigms relevant to this study, with attention paid to the area of Social Informatics. Section 4.3 discusses the development of the research questions, while Section 4.4 explains the methodology used to answer the research questions, including information about the case study methodology and data collection techniques used. Section 4.5 describes the conduct of the study. Information is provided about the selection of the sample, including how and why the particular cases and participants were chosen, the ethical considerations for the study, practical aspects of the data collection and reflections on the data collection process, data analysis and an evaluation of the quality of the research. Chapters Five and Six present the data collected and analysed using the methodology described in this chapter in order to answer the research questions outlined in Section 4.3.

4.2 Research Paradigms in Information Systems

Research paradigms, and the numerous methodological approaches for Information Systems research, have been widely discussed and debated over the past few decades. However, it is not the intention to debate the qualities, inadequacies and incommensurability of these research paradigms and approaches within this thesis, only to justify the approach appropriate to this research. Three major paradigms, interpretivism, positivism and critical, were considered for this research, and decisions were made about the particular research methods and techniques

© 2007 Kaylene Clayton

used in the conduct of the study. These three paradigms represent differing assumptions about research, including the nature of reality and knowledge and its purpose and design.

The philosophical basis of interpretive (constructivist) research is that reality is socially constructed by people (Mertens, 1997). According to Orlikowski and Baroudi (1991), interpretive studies assume that, as people interact with the social world around them, they generate their own subjective and intersubjective meanings about this world. Interpretive studies seek to find scientific explanations of human intention, and qualitative methods such as case studies and participant observation are encouraged (Chua, 1986). Further discussion of the qualitative methods used in this study can be found in Sections 4.4.1 and 4.4.2.

The positivist (empiricist) paradigm sets out to investigate the real world as it exists and is knowable (Walliman, 2006). Researchers in the positivist paradigm seek to test theories and verify hypotheses established as facts or laws (Guba and Lincoln, 2005). Orlikowski and Baroudi (1991) add that only one description of any chosen aspect of the phenomenon is possible, and real, one-directional cause and effect relationships exist and are able to be tested.

In the critical (emancipatory) paradigm, social reality is historically constructed, and objects can only be understood by studying their historical development and change within their context (Chua, 1986). Reality is virtual and is shaped over time by social, political, cultural, economic, ethnic and gender values, and this reality is understood through vicarious experience (Guba and Lincoln, 2005). Critical studies seek to critique the status quo and transform alienating and restrictive social conditions (Orlikowski and Baroudi, 1991). Guba and Lincoln (2005) state that some commensurability between the interpretive and critical paradigms is possible, but commensurability between positivist and interpretive models is an issue because their axioms are contradictory and mutually exclusive.

Critical realism, on the other hand, is a non-positivist movement that recognises “the existence of a natural order in social events and discourse, but claims that this order cannot be detected by merely observing a pattern of events” (Walliman, 2006, p. 20). Critical realists believe in the existence of underlying structures that generate social events (Walliman, 2006) and accept that there are some differences between the social and natural worlds (Mingers, 2004). Most importantly, critical realism recognises the inherent significance of social interaction while maintaining reality (Mingers, 2004). Furthermore, Mingers (2004, p. 385) states that “the main feature of a critical realist approach to science is a fundamental concern for *explanation* in terms of independent underlying causal or generative mechanisms, which may in principle be unobservable”.

© 2007 Kaylene Clayton

4.2.1 Locating This Study

A broad range of paradigms and methods were considered when developing the research design for this study. While I wanted to avoid labelling myself into a specific paradigm, it is difficult to articulate and justify a position without labelling to some extent. I believed that the research did not fit with the positivist ideology, but I felt it also did not entirely fit within the philosophies of the interpretive or critical research paradigms either. Consideration of the research questions and study objectives required the investigation and explanation of the social and objective structures underlying social reality viewed from the participants' point of view.

Consequently, this research is interpretivist in spirit, as it seeks to understand reality from the point of view of the participants' constructions. However, it also views social reality as being largely preconstructed, that is, social structures and institutions are difficult for individuals to resist or modify and therefore in effect appear to possess causality. This view of social reality fits with the philosophy of critical realism and, as such, critical realism has informed the ontological position of this research. The approach used in this research is supported by Walsham (2006, p. 320), who sees "critical realism as one possible philosophical position underpinning interpretive research" and Walliman (2006, p. 20), who states that "different aspects of life lend themselves to different methods of interpretation".

Ontology is the study of existence and the nature of reality (Abercrombie et al., 2000). A critical realist ontology acknowledges the existence of underlying structures or institutions such as the education system, schools and the Internet as structures that generate social events. An interpretive ontology would not accept the objective existence of these structures in the social reality of the students and teachers. Furthermore, it would be very difficult for teachers or students to modify or resist the organisational structure of the education system and schools. The organisational structure of the education system and schools trigger the local or specific subjective social realities of attending students and teachers, and the Internet exists independently of their construction of it. While a critical realist position was adopted for this study as a means of determining what actually exists, the epistemological stance was aimed at the subjective understanding of the social world through the teachers and students involved.

Epistemology is the study of the origin, nature and limits of human knowledge about the external world (Abercrombie et al., 2000; Jarvinen, 2001). It is "all-encompassing in that it is ever-present in every statement, thought and choice in the study" (Shoib et al., 2006, p. 137). Anti-positivist assumptions maintain that the social world "can only be understood by the individuals that are directly involved in the activities which are to be studied" (Burrell and

Morgan, 1979, p. 5). Moreover, “interpretivism recognizes the ‘embedded’ nature of the researcher” (Walliman, 2006, p. 208). The interpretive epistemology is appropriate for this research as it seeks to gather an understanding of the individual students’ perceptions of ICT, their perceptions of the ICT experiences and what they see as the attractors and detractors for entering ICT study and careers. As in the ‘weak’ constructionist view (Orlikowski and Baroudi, 1991), the role of the researcher in this research is to recount the participants' experience to reveal what the participants are doing and how or why they would do that.

In summary, the study was motivated by the need to understand why young women appear to lack interest in pursuing a career or educational pathway in the ICT field. Consideration of the research questions and study objectives required the investigation and explanation of the social and objective structures underlying social reality viewed from the participants’ point of view. The primary interest in understanding from the participants’ point of view implied that an interpretive approach would best suit the research problem. However, the view of social reality being largely preconstructed inferred the ontological suitability of critical realism. Walsham (2006) supports the use of critical realism to underpin interpretive research.

4.2.2 Social Informatics

The ICT field is a broad and varied area that covers a wide spectrum of skills, from the technical end of the scale to the more social/people-oriented end, which includes Information Systems. This research, which falls into the area of Social Informatics, tends towards the analytical orientation, but shares influences from the normative orientation. It seeks to investigate the social phenomena related to ICT careers and education, in order to provide a deeper understanding of the factors behind ICT study and career choices for ICT educational policy makers.

Within Information Systems, Social Informatics is an emerging transdiscipline for researchers investigating interrelationships between people, their uses of ICT, and ICT institutional and cultural contexts; it is informed by theories of social behaviour (Lamb and Sawyer, 2005). Social Informatics research can be conducted in a number of disciplines including sociology, information systems and computer science (Kling, 1999). It pertains to the systematic interdisciplinary investigation of ICT use and social change in any sort of social setting (Kling, 1999, 2001). Using different theoretical and methodological perspectives to approach the problem, researchers attempt to understand complex ICT issues and uses and challenge common assumptions about ICT and improve the lives of ICT users (Sawyer and Rosenbaum, 2000).

"Social informatics research involves normative, analytical and critical orientations" which can be combined in any particular study (Sawyer and Rosenbaum, 2000, p. 90). Social Informatics research with a normative orientation aims to influence the practice of ICT policy makers by providing empirical evidence of the diverse outcomes of ICT use in organisational and social contexts (Sawyer and Rosenbaum, 2000). Analytically oriented Social Informatics research aims to provide a deeper understanding of the evolution and generalisation of ICT between settings through contribution towards, and the development of, theories about ICT in institutional and cultural contexts (Sawyer and Rosenbaum, 2000). The critical orientation encourages examination of ICT from multiple perspectives, ideal and routine use, and possible failures and loss of service (Sawyer and Rosenbaum, 2000).

4.3 Development of Research Questions

All researchers begin their research with at least a basic idea of the questions that they want the research to answer (Creswell, 1998). As outlined in Chapter One, the aim of this research is to explore the reasons why female enrolments in secondary and tertiary ICT programs and female involvement in the ICT industry are declining. In order to do this, this research explores the ICT experiences, attitudes and perceptions of Year 4 and Year 8 students and their teachers to identify the factors which influence ICT study and careers choices.

The examination of the literature discussed in Chapters Two and Three has shown a number of factors that influence young people's desire to be involved in an ICT educational or career pathway. These factors included social influences, such as parents and family, peers, media, role models and gender and ICT stereotypes, structural influences such as teachers, the school environment, curriculum and ICT resources and their availability at home and at school, as well as cultural influences, including socialisation and individual attributes of the young person. However, most of the studies focused on one or several of these factors and did not address the complexity of the issue and the interplay of all of the issues. As advocated by Eisenhardt (1989), this theory-building research seeks to provide a fresh perspective to this research area.

In particular, the influence that individual attributes have on ICT educational and career choices is one of the newest and least examined areas. This is confirmed by Trauth (2002) and Adya and Kaiser (2005). Furthermore, while the work of Eccles and her colleagues (2000) has been applied in a number of school-based studies to investigate an individual's motivation to pursue and persist in tasks or school subjects, it does not deal with many of the social and structural factors identified in Chapter Two and Three. Furthermore, much of the research discussed in Chapters Two and Three has centred on senior secondary school and university students. Very

little of it has specifically focused on middle-school children (especially the early years) or the Australian context, and even less with a Queensland, in particular Brisbane, focus.

The research question was developed to bring together all of the influences identified in Chapters Two and Three and test them in a holistic model, while addressing the deficiencies in research (that is, the age of the students being investigated and their location). In brief, the problem can be summarised into the overarching question for this study:

> **What is the nature of middle-school ICT experiences in metropolitan Brisbane schools, and what influence do these experiences have on girls' ICT study and career choices?**

To facilitate this research investigation, four sub-questions were developed and appear below:

a) What is the nature of ICT experiences at the Year 4 level?
b) What is the nature of ICT experiences at the Year 8 level?
c) Are the ICT experiences the same for boys and girls, and are there gender differences in the ICT classroom?
d) What influence do these experiences have on girls' ICT study and career choices?

The methodology and the rationale for the methodology and techniques used to answer these questions can be found in Section 4.4.

Most, if not all, of the Year 4 and Year 8 students have been exposed to the integration of ICT throughout their everyday life and do not know a world without computers, the Internet and World Wide Web, mobile phones and computer games (Roberts, 2005). Sub-questions a) and b) attempt to identify the ICT experiences at three school types in metropolitan Brisbane, at the beginning of the middle-years of schooling and when the students commence secondary school. The outcomes for sub-questions a) and b) are described in Chapters Five and Six respectively, and Chapter Seven discusses the findings.

The Year 4 and Year 8 levels were specifically chosen to represent students who are midway through their primary education (Year 4) and in the first year of their secondary education (Year 8). Investigating the Year 8 students is important, as they have completed their primary education and are entering a mature stage of their education, where they may be making choices relevant to their future study and career paths. Furthermore, previous research has highlighted that girls lose interest in ICT around the time that they enter secondary school (e.g. Jepson and Peri, 2002a; Margolis and Fisher, 2002; Newmarch et al., 2000). Teachers were involved as key

© 2007 Kaylene Clayton

informants to provide context and supporting information about the students' ICT experiences and the role that they play (if any) in influencing these experiences.

While both male and female ICT enrolments at Australian tertiary intuitions are declining, female enrolments are at critically low levels and further declines are highly undesirable. For example, only 0.9% of all female Year 12 school leavers in Queensland planned to enrol in tertiary ICT programs in 2005 and 2006 (Polesel et al., 2005; Polesel and Teese, 2006). For male students, the figures were 7.8% in 2005 and 5.5% in 2006. Due to the differences in the levels of male and female intentions to enter ICT fields of study in their post-secondary years, it is useful to determine whether there are any gender differences in the students' ICT experiences, and sub-question c) addresses this issue. Sub-question d) seeks to identify whether the experiences identified in sub-questions a) and b), and any gender differences identified in sub-question c) have a bearing on girls' study and career choices. Chapter Seven discusses the results of sub-questions c) and d). The answers to the four sub-questions are synthesised to facilitate the answering of the main research question for this research in Section 8.2.

4.4 Methodology

Research methodology relates to the choice of methods of enquiry (Iivari and Hirschheim, 1992) and the "approach taken to research and more specifically, how the research data will be collected" (Iivari, 1991). Many factors have influenced the selection of appropriate research methods within this study including time constraints, the research goals, aims and questions, the underlying research paradigm and the availability of an appropriate research site.

With consideration to these factors, this research uses an embedded single case study to understand the research topic by obtaining first-hand knowledge and subjective accounts of the students and teachers. Four data collection techniques were used in the study. Classroom observations were used in conjunction with interviews to see what the students and teachers experience in their everyday school ICT experience as well as to hear their perceptions of their experiences and their opinions about ICT education and careers. Walsham (1995, p.78) supports the combined use of interviews and participant observation in interpretive case studies, as interviews "enable researchers to step back and examine the interpretations of their fellow participants in detail". Documents assisted with the understanding of the context of the education system and the educational and ICT environments at each school. Investigation of the physical artefacts, including classroom environment and ICT resources, assisted with the understanding of the available resources in the schools. The following subsections explain the

research methods (case study, observation, interviews, documents and physical artefacts) used in this study in greater detail.

4.4.1 Case Study

The embedded, single case study design provided the opportunity to study the students and teachers during ICT activities in the natural setting of the classroom. The case study is organised around key themes derived from the literature summarised in Chapters Two and Three in order to answer the research questions introduced in Chapter One and described in Section 4.3. Classroom observations were used in conjunction with interviews to see what the students and teachers experience in their everyday school ICT experience, as well as to hear their perceptions of their experiences and their opinions about ICT education and careers. Investigation of the physical artefacts, including classroom environment and ICT resources, assisted with the understanding of the available resources in the schools. Table 4-1 below provides a summary of the linking of the research objectives and research techniques used to interpret the influence of ICT experiences on girls' educational and career choices, and lists the chapters in which the research objectives are achieved.

Research Objective	Techniques	Chapter
Investigate literature to identify key themes related to low female interest in ICT education and careers. • Development of initial conceptual model from literature	Review of relevant literature	Chapters 2 and 3
Investigate the nature of the ICT experiences at the Year 4 level using the key themes identified in the literature review as a guide. • Sub-question a)	Observation of classroom activities and environment Teacher interviews Year 4 group interviews	Chapter 5
Investigate the nature of the ICT experiences at the Year 8 level using the key themes identified in the literature review as a guide. • Sub-question b)	Observation of classroom activities and environment Teacher interviews Year 8 group interviews	Chapter 6
Investigate whether the experiences are the same for boys and girls and year levels and what influence these experiences have on ICT education and career choice • Sub-questions c) and d)	Observation of classroom activities Year 4 and Year 8 group interviews	Chapters 7 and 8

Table 4-1 Summary of links between research objectives, research techniques and chapters

Year 4 and Year 8 students and their teachers at three school types were observed whilst engaging in ICT use during their classroom activities and were interviewed in order to provide rich insights and further understand their experiences and perceptions of ICT. The classroom observations lasted for one term at each school as complete immersion into the school

environment as a student or a teacher was not physically or practically possible, and long-term immersion in each classroom was not viable. In accordance with Eisenhardt's (1989) comment that the output of case study research can include conceptual frameworks, propositions, concepts and mid-range theory, this research aims to produce a new model to assist with the ongoing problem of low and declining female interest in ICT educational and career pathways.

Benbasat, Goldstein and Mead (1987, p. 370) state that a case study "examines a phenomenon in its natural setting, employing multiple methods of data collection to gather information from one or a few entities (people, groups, or organizations)". Huberman and Miles (1994) add that a case is some form of phenomenon happening within an at times indistinct temporally, socially, or physically bounded context. It can focus attention on one or a number of instances of a social phenomenon in an in-depth or descriptive manner (Babbie, 2000). Case studies are particularly useful when capturing individual differences and experiences amongst participants and unique variations in a program (Patton, 2002). Moreover, "using a case study approach is essentially a way to build theory" (Evans and Gruba, 2002, p. 92).

Case study research can follow various approaches, including positivist and interpretivist approaches (Darke, Shanks, and Broadbent, 1998), and a critical approach, depending on the underlying philosophical assumptions of the researcher (Myers, 1997). However, Walsham (1995, p. 74) states that "there are many points of agreement between case study researchers working in these two traditions [positivism and interpretivism]". As an example relative to this study, both positivist and interpretivist case study research can answer 'how' and 'why' questions, and case study researchers in both traditions should be explicit about their research goals and methods (Walsham, 1995). Walsham (1995) also believes that it is important that case study researchers reflect upon their philosophical position and state this position when reporting on their work.

A 'case' can be defined in various ways. According to Patton, A single case study may also contain embedded mini cases that may involve different units of analysis (Patton, 2002). A single case allows the researcher to do an in-depth investigation of the phenomenon through rich description and understanding, while multiple cases allow comparison and investigation of the phenomenon in diverse settings (Darke et al., 1998). The rationale for a single case study includes: it represents the critical test of an existing theory; it represents an extreme or unique case; it is a representative or typical case; it serves a revelatory purpose where there has not been the opportunity to study the phenomenon in the past; and it serves a longitudinal purpose where the same phenomenon is studied at two or more different times (Yin, 2003). Yin (2003)

© 2007 Kaylene Clayton

also believes that sub-cases can enhance insights into a single case, but care needs to be taken to pay attention to the larger, holistic parts of the case study.

Documentation, archival records, direct and participant observation and physical artefacts are common sources of data in case studies (Yin, 1994, 2003), and data collection methods are often combined (Eisenhardt, 1989). In particular, "theory-building researchers typically combine multiple data collection methods" (Eisenhardt, 1989, p. 537). Each of these sources of data has its own particular strengths and weaknesses with none having a complete advantage over another (Yin, 1994). These data sources are complementary, and good case study design should include as many sources as possible (Yin, 2003). However, Stake (2005) believes that the case studies are a choice of what is to be researched, not a methodological choice. Walsham (1995) also cautions that during in-depth case studies, researchers can influence the interpretations of the participants, and the collection and analysis of data involves the researcher's own subjectivity.

4.4.2 Data Collection Techniques

Within this section, the methods for collecting the four sources of data for this case study are explained. These data sources are documentation, participant observation, interviews and physical artefacts. Documents assisted with the understanding of the context of the education system and the educational and ICT environments at each school. Classroom observations were used in conjunction with interviews to see what the students and teachers experience in their everyday school ICT experience and to hear their perceptions of their experiences and their opinions about ICT education and careers. Investigation of the physical artefacts, including classroom environment and ICT resources, assisted with the understanding of the available resources in the schools. A summary of the number of interviews conducted at each school and information about the participant observation component of the data collection can be found in Section 4.5.3.

4.4.2.1 Participant Observation

This case study implemented participant observation to collect data about the teachers and students. I was unable to become a full participant observer due to the marked age difference between myself and the students being observed. However, I served as a volunteer helper in the classroom in an attempt to blend unobtrusively into the organisational setting and provide an emic perspective. The degree of participation varied over time, but the level of participation tended to be towards the observer end of the spectrum. Field notes of the observations, mostly focused on ICT activities, were recorded during the classroom visits and expanded upon after

leaving the site. Notes about informal conversations, and verbatim key phrases used while the students were engaged in classroom ICT activities, were also recorded during the observations. Classroom observations were used to see what the students and teachers experience in their everyday school ICT experience. Further details about the field visits and observations made at each school can be found in Section 4.5.3.

Observational data comprises detailed descriptions about a human experience in a social setting including people's activities, behaviours, actions, interpersonal interactions and organisational processes (Patton, 2002). It relies on the "memory work of the researcher", and field notes, which are expanded upon at a later time, record the observations; at times, however, these notes need to be recorded retrospectively due to recording difficulties in the field (Coffey, 2006, p. 215). It is important that the observer make notes during observations or as soon as possible afterwards and review those notes after the session (Babbie, 2000). The researcher should record what they 'know' has happened and what they 'think' has happened (Babbie, 2000). Moreover, "participant observation necessarily combines observing and informal interviewing" (Patton, 2002, p. 287).

The researcher may vary the amount of time in the research setting (Babbie, 2000), and the level of participation may also change over time (Patton, 2002). Observational data collection techniques can be viewed on a continuum from neutral observer to participant observer (Babbie, 2000; Walsham, 2006). Moreover, the researcher may choose to observe the entire social setting or pay attention to a limited aspect of it (Babbie, 2000).

Through observation, the researcher is able to understand the context of interactions, and has the opportunity to see things that may be unnoticed by the participants and learn things that participants may be reluctant to talk about in an interview (Patton, 2002). Observational analysis is meant to transport the reader into the observed setting and provide sufficient descriptive detail to allow the reader to understand what occurred and how it happened (Patton, 2002). While Patton (2002) states that participant observation may be the best strategy to fully understand the complexities of an area, Denzin (1978, p. 28) states that "it does not offer direct data on the wider spheres of influence acting on those observed".

Researchers using participant observation face a number of related problems. It can be argued that the researcher can change the setting simply through their presence. However, in some situations, including the classroom, this argument may not be able to be sustained, as the general processes continue with or without the researcher's attendance (Coffey, 2006). Moreover, people being watched by the researcher may modify their behaviour if they know

© 2007 Kaylene Clayton

they are being observed (Babbie, 2000). Participant observation is also an expensive research strategy, as it is extremely labour intensive (Patton, 2002) and it may take some time for the researcher to be accepted in the field (Coffey, 2006).

When conducting participant observation with children, the researcher needs to build and cultivate relationships and rapport with the adults who have responsibility for the children, as well as building trust with the children (Fine and Sandstrom, 1988). It is also difficult for an adult observing patterns of behaviour of children to be an unobtrusive member of that group, and attempts must be made to blend into the environment (Fine and Sandstrom, 1988). The ideal role is to become a friend to the subjects and interact with them, while being relatively lacking in authority and sanctioning power (Fine and Sandstrom, 1988). Fine and Sandstrom (1988, p. 59) state that "the particular challenge for observers of preadolescence is to tolerate (or at least not intervene in) the behaviors of these children that one finds obnoxious and abhorrent".

4.4.2.2 Interviews

Semi-structured interviews were conducted with the consenting teachers in each school type. These interviews were restricted to approximately thirty minutes in duration because of the limited availability of the teachers. Focus group interviews were held with consenting Year 4 and Year 8 students at each of the schools. Due to the age of the students, the focus group size was limited to groups of fewer than eight students. The student age and language level were taken into consideration during these interviews, which lasted for approximately thirty minutes. As time permitted, and according to the flow of the interview, the participants were asked a number of questions from the pool of prepared questions (see Appendix A) and discussed points of interest derived from the observations. With consent, interviews were digitally recorded to allow the researcher to interact with the participants and group and take observational notes for subsequent transcription. The interviews enabled me to hear the students' and teachers' perceptions of their ICT experiences and their opinions about ICT education and careers. Further details about the interviews conducted at each school can be found in Section 4.5.3.

The student interview questions were derived from the themes identified in the literature summarised in Chapters Two and Three. From the preliminary conceptual model, a number of question categories of questions were created. The question topics included: ICT resources and availability; the influence of socialisers including family, teachers and peers; curriculum and learning; careers; ICT use; and abilities, goals, personality and interpretation of experiences. Some questions specific to the Year 8 level about subject selection were also included. The questions posed to the teachers asked about the teachers' ICT experiences and beliefs, their qualifications and training, the ICT curriculum, teaching ICT, ICT resources, their opinions

© 2007 Kaylene Clayton

about their students' ICT abilities and experiences, gender and ICT, and role models. For the SmartBoard-enabled school, the teachers were also asked about the implementation of the SmartBoards and the impact that this has had on their students.

Interviews allow the researcher to probe and follow up the non-verbal behaviour, responses, feelings and motives in order to enrich qualitative data (Davies, 2006). There are a number of ways that interviews can be conducted, including "as part of participant observation or even as a casual conversation" (Mertens, 1997, p. 321). The interview is a common technique, and one of the most important data collection techniques used in case-study and interpretive research (Myers and Newman, 2007). "Data from interviews are idiographic" and the background, experience, gender, age and nationality of the researcher should be acknowledged; it is important to situate the researcher as well as the interviewee during the research write-up (Myers and Newman, 2007, p.15 - 16).

According to de Laine (1997), there are three basic interview models: structured, or formal interviews; focused, or semi-structured interviews; and unstructured interviews. Semi-structured interviews use a prepared but incomplete script which requires improvisation (Myers and Newman, 2007). It is the most common type of interview in Information Systems and allows the researcher to "delve more deeply into the social situation" (Myers and Newman, 2007, p. 12). The interview plan should accommodate some flexibility, openness and improvisation to enable the interviewer to look for surprises and explore lines of questioning (Myers and Newman, 2007). It is also important to set the stage for the interview. This involves: finding the interviewees; gaining their consent; agreeing on the time, location and theme of the interview; arranging the physical layout of the room and the equipment to be used; and preparing the appearance and demeanour of the interviewer (Myers and Newman, 2007).

Interviews may not be as simple as depicted and can be fraught with difficulties (Myers and Newman, 2007). Some of the problems with conducting interviews include: interviewing strangers under time pressure; lack of trust of the interviewer; lack of time leading to incomplete data collection; the level of entry into the organisation; elite bias; the Hawthorne effect (temporary changes in behaviour in response to environmental conditions); constructing knowledge while gathering data; and ambiguity of language (Myers and Newman, 2007). The interviewer also needs to learn to deal with differing behaviours, such as shyness, showing off and boredom, during the interview (Myers and Newman, 2007).

Focus group interviews are particularly useful for exploratory research as they can produce powerful insights (Stewart, Shamdasani, and Rook, 2007). They generally include between four

to twelve participants and a moderator who poses the questions (Hollander, 2004), but with children or adolescent participants a smaller group size of five or six is appropriate (Vaughn, Shay Schumm, and Sinagub, 1996). They are run in order to "elicit perceptions, feelings attitudes and ideas of the participants" (Vaughn et al., 1996, p. 5). In focus group interviews, it is imperative that both the moderator and the question design should be compatible with the group being interviewed (Stewart et al., 2007). Some of the disadvantages of using a focus group technique are: the researcher has less control than in an individual interview; moderators require special skills; and the data are often difficult to analyse (Kreuger 1988 in Babbie, 2000).

Focus group interviews with children can be very successful, but they also pose specific problems (Stewart et al., 2007). The moderator must be comfortable and experienced with children to enable full disclosure, and young children also tend to be more comfortable with a female moderator (Stewart et al., 2007). Furthermore, more flexibility, direction and interaction with adolescent and child focus groups may be required (Vaughn et al., 1996). Serving food also helps to relax the mood of the interview (Krueger and Casey, 2000). Krueger and Casey (2000) state that interviews should last no longer than one hour, especially with preteens. It is also important that the discussion and questions be phrased appropriate to the age and level of understanding of the participant (Stewart et al., 2007). Awareness of age-related behaviour, such as showing-off, and how peer pressure can shape responses are important considerations when conducting focus group interviews with children (Krueger and Casey, 2000). It is also imperative that consent is obtained from care givers of the children (Krueger and Casey, 2000) and school authorities. This is further discussed in Section 4.5.2.

4.4.2.3 Documentation

The documentation collected throughout the study included: newspaper clippings (online and hard copy); reports and information available about the participating school; the Education Queensland and Independent Schools of Queensland websites; promotional material; and subject selection guides from the schools. These documents assisted in understanding the cultural context of the school and educational and ICT environments.

A researcher using document analysis will study, amongst other items, official publications and reports (Patton, 2002). Newspaper clippings and other articles appearing in the mass media should also be considered (Yin, 1994); the Internet is another rich source of documents, including organisational reports and statistics. All of these documents must be carefully examined for accuracy and bias and should not be accepted as literal records of events (Yin, 1994). Documentation can also be used to corroborate and augment the data collected from other sources (Yin, 1994, 2003).

4.4.2.4 Physical Artefacts

Another source of evidence is a physical artefact, for example, classroom computers or printouts of student work (Yin, 1994). This item of data usually holds less relevance to the typical case study, but depending on the nature of the study, physical artefacts may become an important component of the study (Yin, 1994). In the instance of this case study, descriptions of the physical artefacts found within this research setting were crucial to the researcher. The differences in the ICT resources, such as room layout, hardware, software and Internet connectivity available to the teachers and students in the classroom at the different school types, were important to the conceptual model and the understanding of structural influences on the choice of ICT study or career pathways.

4.5 Conduct of the Study

4.5.1 Selection of Cases

Decisions about selection or sampling techniques are an essential part of research design, even within a single case study (Maxwell, 2005). The schools, students and teachers in this study were chosen through purposive sampling. Purposive sampling involves the selection of what the researcher perceives to be a typical sample based on selection criteria specific to the issue (Walliman, 2006) “or capacity and willingness to participate in the study” (Oliver, 2006, p. 244). The schools, year level and types of participants were chosen as a representative sample, but the schools and participants able and willing to be involved in the study and ethical clearance issues limited the pool of candidates. One class of Year 4 students and one class of Year 8 students at each school type were selected to participate in this research. These students represent an important milestone in ICT use in education as they represent the first wave of students who have been exposed to Internet technology from the time that they commenced schooling.

When selecting the participating schools, I tried to find schools that had strong links between the Year 4 and Year 8 levels. This meant finding schools that catered to primary and secondary levels, or alternatively, a primary school that acted as a feeder school to the secondary school. A boundary constraint for the study was imposed to only include schools within a 26km radius of the Brisbane Central Business District in an attempt to make the selection of schools more manageable and establish a study boundary.

© 2007 Kaylene Clayton

The Queensland government education department, Education Queensland, has control of almost 1300 state schools in Queensland[1] of which 51 secondary schools and seven combined primary and secondary schools fell within the selection radius. To narrow the selection further, 32 secondary schools and five combined primary and secondary schools can be found south of the Brisbane River. Each secondary school is associated with a number of primary schools, which act as feeder schools. This school type was the first to be chosen. Education Queensland was approached to allow contact with their school principals, and written and personal contact was made with the principals of the preferred schools. They were chosen because of my familiarity with the local and school environment and the ICT being used within the classrooms, established contacts and ties to the schools, and fulfilment of my research criteria.

Independent schools were chosen because these schools can be directly approached by the researcher. In comparison, the Queensland Catholic Education Commission secretariat must be approached before contact can be made with a Catholic school. This adds an additional level of complexity to the consent mechanism, especially when there is a reluctance of many non-government schools to become involved in research studies. The number of independent schools holding Independent Schools Queensland membership is 177[2]; of these schools, 48 are within 26km of the CBD and 28 are south of the Brisbane River. Some of these schools cater only for the primary years, or the secondary years of education (7). Some are coeducational (22), a smaller number are female single-sex (4), and an even smaller number are male single-sex (2). A small number of these schools cater for special education, or for specific ethnic or religious groups (5). Schools that did not fit the study's criteria were excluded from selection along with some other schools because of past experience with their reluctance to take part in research activities. Originally, it was planned that a male single-sex school would be included in the study to complete the holistic view, but the schools that were contacted declined to participate.

Written contact was made with a number of independent schools seeking permission to conduct research in their schools. The female single-sex school on the south side of Brisbane was the next to be chosen from three possible candidates because of its willingness to participate and location in relation to the government schools. Finding a private coeducational school to participate proved far more difficult than anticipated. Letters of invitation were sent to a number of schools within the 26km zone. Apart from one school, the contacted schools either did not respond or declined to participate. There were also delays in starting research in this school due to administrative changes in the school. Follow-up contact was required to establish participation in the study.

[1] http://education.qld.gov.au/parents/choosing.html
[2] http://www.aisq.qld.edu.au/files/files/Communications/2006%20Annual%20Report.pdf p. 13

Meetings with the principals who had positively responded to the request were arranged through phone calls and email contact. At each school, the principals sourced the Year 4 and 8 teachers who were willing to have research undertaken in their classrooms. Email contact was arranged with the teachers at the independent schools and the government primary school, while personal contact was made with the teachers at the government secondary school. Following the initial contact, communication ensued to arrange convenient and suitable times to attend their classes and for the distribution and collection of consent forms. Table 4-2 provides an overview of the schools that agreed to participate in the research.

	Government coeducational	**Private coeducational**	**Female single-sex**
Established	Primary – 1978 Secondary – 1987	1995	1901
Student enrolment	Primary – 850 Secondary – 1550	Over 1100 (Prep to Year 12)	Over 1100 (Prep to Year 12)
Facilities	Run down	Well maintained	Well maintained
School fees	Book/equipment levy	$5200 to $6950[5]	$4844 to $9000[6]
Percentage of students in special education classes	Primary – 8.2% Secondary – 6.5%	Not disclosed	Not disclosed
Results of Year 3, 5 and 7 reading, writing and numeracy tests	Below QLD average in all years and skills	Year 3 and 5 above QLD average in all skills Year 7 below QLD average for numeracy	Above QLD average in all years and skills
Dress code	Not strict	Reasonably strict	Strict
Unemployment in school suburb	7.7%	3.5%	3.4%
Top 3 occupational groups	1. labourers – 20.6% 2. machinery operators and drivers – 17.6% 3. technical and trades – 16.2%	1. clerical and administrative workers –18.4 % 2. professionals – 17.8% 3. technical and trades – 13.4%	1. clerical and administrative workers – 18.7% 2. professionals – 18% 3. technical and trades – 15.6%
Percentage of single-parent families	25%	16.2%	18.7%
Median weekly individual income for suburb	$437	$602	$520
Percentage of indigenous residents	3.9%	1.4%	1.6%
Percentage of foreign-born residents	31.6%	35.5%	21.4%
Percentage of privately owned/buying houses	57.3%	62.3%	70.3%

Table 4-2 Summary of school demographics

[5] The reference to this information has been suppressed to protect the identity of the school
[6] The reference to this information has been suppressed to protect the identity of the school

4.5.1.1 Education Queensland coeducational schools

The government coeducational primary and secondary schools, run by Education Queensland, are located in a low socioeconomic, working-class suburb in the outer southern part of the Brisbane metropolitan area. The two schools are situated almost opposite each other on a major connecting road and the primary school acts as a feeder school to the secondary school. The primary school caters to Prep to Year 7 while the secondary school caters to Years 8 to 12. The principals of the primary and secondary schools retired shortly after the data collection phase of the research was conducted.

The primary school has a strong ICT focus, with each classroom being equipped with a SmartBoard (interactive whiteboard). The secondary school has a strong vocational education focus with a nationally recognised work education program and is a school of excellence for Rugby League. A large proportion of the students travel a significant distance to attend the secondary school. The primary and secondary schools also have large special education units supporting students with disabilities, including intellectual impairments, autistic spectrum disorders and speech/language disorders.

There are 37 cultural groups represented at the primary school, with over one-quarter of the students identifying in 2006 as being of Aboriginal or Torres Strait Islander, Samoan, Maori, Cambodian, Khmer or Vietnamese ethnicity[7]. Similar cultural and ethnic demographics are expected at the neighbouring secondary school. According to the 2006 Census QuickStats[8], unemployment in the Red Oaks suburb is 2.2% higher than the national average of 5.5%. The median weekly income is also $39 less than the Australian median of $466.

4.5.1.2 Private female single-sex school

The female single-sex school, run by a religious organisation, caters to female students from Prep to Year 12 on one campus. Enrolment preference is given to the children of staff and past students, and siblings of current students. The students are expected to follow a strict uniform, dress and presentation code, and this contributes to its culture of exclusivity. The school offers some scholarships offering half remission of fees based on academic achievement, behaviour and participation.

The school boasts extensive facilities, including five computer laboratories, purpose-built art rooms, sports and music centres, swimming pool, golf driving range and tennis and netball complexes, all set within landscaped grounds. The primary students can access classroom

[7] The reference to this data has been suppressed to protect the identity of the school
[8] The reference to this data has been suppressed to protect the identity of the school

computers, a primary school computer laboratory and clusters of eight computers adjacent to the Year 5 to 7 classrooms. The school also prides itself on its reputation and ability to attract and retain highly competent staff; all of the academic teachers are specialists in their teaching area and are involved in a planned professional development program.

According to the 2006 Census QuickStats[9] for the suburb that the school is located in, the median weekly income is $54 higher than the Australian average. Unemployment is 1.8% lower than the national average of 5.5%. However, caution should be applied when considering these statistics as students may travel considerable distances from other suburbs to attend this school because of the school type.

4.5.1.3 Private coeducational school

The private coeducational school was founded by a number of religious organisations, and since 1998 it has catered to Prep to Year 12 education over two campuses. The junior campus focuses on Prep to Year 6 and is located several kilometres away from the senior campus, which caters to students in Years 7 to 12. Both the senior and junior campuses adjoin Education Queensland schools supporting similar age ranges. The junior campus operates in partnership with the government school that it borders, and at the senior campus, a new resource centre has been built in partnership with the adjoining government school.

All of the students who attend this school receive tuition in a musical instrument and receive pastoral care throughout their education. The school also has an international program enabling international students to intensively study primary and secondary preparation courses.

The average OP score obtained was 12, and approximately 17% of eligible Year 12 students achieved an OP score between 1 and 5. The teachers attend professional development specific to their teaching area, and many teachers are being sponsored by the school to complete their Masters degree. The school spent approximately $1000 per teacher during 2006 for professional development.

According to the 2006 Census QuickStats[10] for the suburb that the school is located in, the median weekly income is $136 higher than the Australian average. Unemployment is 1.7% lower than the national average of 5.5%. However, caution should be applied when considering these statistics as students may travel from other suburbs to attend this school because of the school type.

[9] The reference to this data has been suppressed to protect the identity of the school
[10] The reference to this data has been suppressed to protect the identity of the school

4.5.1.4 Participants

Year 4 students were selected to represent a time approximately midway through the child's primary education. This demographic acts as a base point prior to the student entering secondary education. The Year 8 students are important to this research. These students have completed their primary education and are entering a mature stage of their education. They are at the stage where they are about to make decisions about the elective subjects that they will be enrolled in during Years 9 and 10. Decisions that are made at this stage may affect the eligibility to enrol in more senior Year 11 and 12 subjects, and possibly influence future career decisions. The teachers of these students were also selected to participate in this research as they are part of the significant other group and may influence the students in many ways. These teachers were used as key informants as they are particularly knowledgeable about school background, classroom routine, past students and the current students involved in the study.

4.5.2 Ethical Considerations

Ethical permission was sought and obtained from Griffith University and Education Queensland, and a Commission for Children and Young People and Child Guardian Act 2000 'Working with children check' positive notice was maintained during the research. Consent was obtained from the participating schools and principals, teachers, students and their parents (see Appendix B for sample letters and consent packages).

In Queensland, the Commission for Children and Young People and Child Guardian Act 2000 (Queensland Government, 2007) requires people over eighteen and working/researching in a school environment to undergo a 'Working with children check'. I fulfilled this requirement and currently hold a positive notice 'blue card', which enables the holder to work in a regulated child related area, in a paid or voluntary capacity. This research also followed the Griffith University code of conduct guidelines for research involving humans. Griffith University, Education Queensland and other independent school bodies require ethical clearance to conduct research with children and within their authority. Ethical clearance to conduct this research was sought and obtained from the Griffith University Human Research Ethics Committee. Permission was also sought and obtained from Education Queensland and the independent schools to conduct research in their schools. Samples of the letters sent to the principals and the consent packages can be found in Appendix B.

Participation in this research was voluntary and informed consent was obtained from the individual participants and the student's parents. No information was recorded about students whose parents declined participation. The students also were asked for their permission to

© 2007 Kaylene Clayton

observe them during their classroom activities and to participate in an interview. As with an adult, a child's right to refuse participation in research must be respected, even when part of a group, and they should not be questioned nor their actions recorded (Fine and Sandstrom, 1988). The rights of students who declined to participate were respected, even if they had parental permission, and no information was recorded or collected about these students. The confidentiality and identity of the schools participating in the research, as well as that of the individual participants, were protected through the use of pseudonyms.

4.5.3 Data Collection

Data collection commenced in July 2005 and was completed in September 2006. Data from the Year 8 class at the government schools was collected concurrently with the data from Year 4 and Year 8 classes at the female single-sex school. The principals at the female single-sex school and the government secondary school offered access to their teachers and students during the same school term and I felt unable to refuse either offer. This led to difficulties in arranging mutually convenient data collection times when circumstances required changes to the usual data collection times. For each Year 4 and Year 8 classes at the schools participating in this study, observations were collected during weekly classroom visits over a single school term (9 to 11 weeks) and interviews were usually conducted at the end of the term. Table 4-3 summarises the participants in this study and the number of interviews conducted at each school.

School Type	Year Level	Teachers	Class/Students
Government coeducational (Red Oaks)	Year 4 (ages 8/9)	2 of 3 teachers interviewed **Mrs Cherry** **Ms Ruby**	45 students with an approximately even representation of girls and boys **Interviewed students** 4 mixed gender interviews with 25 students
	Year 8 (ages 12/13)	0 of 1 teachers interviewed **Mr Maroon**	20 students (8 boys and 12 girls) **Interviewed students** One interview with 4 students (girls)
Private coeducational (Greenwood)	Year 4 (ages 8/9)	1 of 1 teachers interviewed **Mrs Emerald**	21 students (14 boys and 7 girls) **Interviewed students** One mixed gender interview with 8 students
	Year 8 (ages 12/13)	1 of 1 teachers interviewed **Mrs Jade**	24 students (11 boys and 13 girls) **Interviewed students** One interview with 4 students (3 boys and 1 girl)
Female single-sex (Pink Hill)	Year 4 (ages 8/9)	1 of 1 teachers interviewed **Mrs Pink**	27 students (girls) **Interviewed students** 2 interviews with 16 girls
	Year 8 (ages 12/13)	1 of 1 teachers interviewed **Mr Rose**	19 students (girls) **Interviewed students** 2 interviews with 12 girls

Table 4-3 Summary of research participants

Semi-structured interviews with the teachers and students were planned to take approximately thirty minutes each, involve asking a selection of questions from a pool of prepared questions and allow the questioning to develop through the flow of conversation during the interview. Three points need to be made about the interview process and questions. Firstly, not every question from the pool of questions was asked, but I attempted to ask the participants the key questions from the pool, with additional questions added as time permitted. Secondly, I adapted the interview process and my interviewing style depending on the reaction of the teachers and students. Thirdly, the selected questions that were asked became more focused based on my interactions with the students and what I had observed, and as my understanding of the students' and teachers' ICT experiences and beliefs progressed.

Classroom observations lasted from one lesson block up to a full day, depending on whether access to the students was available and the type of activities planned. The Year 8 classroom observations typically lasted for one lesson block, while the Year 4 observations typically lasted for a longer time frame because of the structure of their daily timetable. Information about ICT artefacts in the classroom and school environments was collected, such as type and availability of ICT resources and infrastructure. Documents which provided information about curriculum, subject availability and subject selection options were also collected as they became available.

4.5.3.1 Education Queensland coeducational schools

Data collection for the Year 8 classes took place from July to September in 2005, and occurred over a nine-week period. I visited the school nine times for a double period Computer Studies class lasting for 70 minutes each Thursday. This class time fell between morning tea and lunch breaks. Only four female Year 8 students who had parental consent agreed to take part in the interview. Other students whose parents had provided consent declined to participate. This lack of interest in being involved in the interview is believed to be related to the observed lack of interest in ICT in the Year 8 classroom, and the fact of the interview being conducted during the lunch break. The students who did participate were more reserved than the Year 8 students at the other schools in this study, and they did not respond as well to the questioning. The male teacher at this school declined to be interviewed during the term because of time restrictions related to Year 12 reporting requirements. He was unable to be contacted following the data collection term in the school.

Data collection for the Year 4 classes took place from October to December in 2005, and occurred over an eleven-week period. The researcher visited the classroom at varying times and days throughout the term to collect the observational data. These times and days depended on the relevance of the school and classroom activities to the study. Due to the use of the

© 2007 Kaylene Clayton

SmartBoard in the classroom, more classroom activities involved ICT than at the other schools. The length of time spent in the classroom during the visits ranged from several hours to whole days. Four group interviews (mixed-sex) were held with the Year 4 students. The groups were made up of between six to eight students. Table 4-4 summarises the data collected from the government coeducational school.

Year 4 (ages 8/9)			
Term 4 2005 (October to December)	11 weeks of observation	2 of 3 teachers interviewed **Mrs Cherry** **Ms Ruby**	45 students with an approximately even representation of girls and boys **Interviewed students** 4 mixed gender interviews with 25 students
Year 8 (ages 12/13)			
Term 3 2005 (July to September)	9 weeks of observation	0 of 1 teachers interviewed **Mr Maroon**	20 students (8 boys and 12 girls) **Interviewed students** One interview with 4 students (girls)

Table 4-4 Summary of data collection at the government coeducational school

At times it was difficult to control the conduct of the Year 4 interviews. The students behaved in a vastly different manner to the Year 4 students at the female single-sex and the Year 8 students at the government school. The students frequently shouted and talked over each other throughout the interviews and displayed competitive and show-off behaviour. Various tactics, such as reducing the group size, were attempted to minimise these behaviours during the interviews. It was also difficult to find a suitable location at the school to hold the interviews. The teachers frequently stayed in the classroom and worked during their lunch break, and the doors were locked when they were not in the classroom. The student interviews were held in a room near the school office, and in the gardens when that room was unavailable. The teacher interviews were held in the classroom.

The Year 4 class has three female teachers: one full-time teacher and two part-time teachers sharing one position. One of the part-time teachers also had a split role of teaching this class and performing duties in another area of the school. This teacher was also due to take maternity leave at the end of the term. It was difficult to arrange a convenient day and time for the interviews with all of the teachers, because of their responsibilities performed on top of their classroom teaching, including reporting, parent-teacher interviews and playground duty. The full-time teacher and one part-time teacher were interviewed for the study at the end of the term. The teachers were doing work in the classroom prior to, during and following the interviews. It

© 2007 Kaylene Clayton

was felt that their busy schedule impacted on the interview as the answers to the questioning were often short and to the point and there was resistance to elaboration probes.

4.5.3.2 Private female single-sex school

Observational and interview data was collected from the students over nine weeks during Term 3 in 2005 (July to September, 2005). Table 4-5 summarises the data collected from the female single-sex school.

Year 4 (ages 8/9)			
Term 3 2005 (July to September)	9 weeks of observation	1 of 1 teachers interviewed **Mrs Pink**	27 students (girls) **Interviewed students** 2 interviews with 16 girls
Year 8 (ages 12/13)			
Term 3 2005 (July to September)	9 weeks of observation	1 of 1 teachers interviewed **Mr Rose**	19 students (girls) **Interviewed students** 2 interviews with 12 girls

Table 4-5 Summary of data collection at the female single-sex school

The interview with the male Year 8 teacher at this school was delayed until during term 3 in 2006, because of challenges in finding a time that was convenient for the teacher, while the interview with the female Year 4 teacher was held at the end of the school term. The teacher interviews were held in their classroom. Two group interviews were conducted with the Year 4 students and two group interviews were held with the Year 8 students at the end of the school term. Each of the groups contained between six to eight girls. The conduct of each of the group interviews was positive and cooperative with the questioning and responses flowing well. The Year 4 and Year 8 student interviews were held in the classroom and in the area immediately outside of the room.

Observational data was collected on varying days and times, depending on school and classroom activities. The Year 8 data was mostly collected during visits to the mathematics classroom on Fridays, alternating between the first period of 40 minutes in duration and the last period of 55 minutes. During these classes the teacher and students used and programmed graphical calculators, which were wirelessly connected to the teacher's laptop computer, and visited a computer laboratory. The Year 4 data was mostly collected on Wednesday mornings for approximately two hours, and this time included their visit to a computer laboratory.

4.5.3.3 Private coeducational schools

Observational and interview data was collected from Year 4 and Year 8 classes over ten weeks in July to September in 2006 (term 3). Table 4-6 overleaf summarises the data collected from the private coeducational school.

Year 4 (ages 8/9)			
Term 3 2006 (July to September)	10 weeks of observation	1 of 1 teachers interviewed **Mrs Emerald**	21 students (14 boys and 7 girls) **Interviewed students** One mixed gender interview with 8 students
Year 8 (ages 12/13)			
Term 3 2006 (July to September)	10 weeks of observation	1 of 1 teachers interviewed **Mrs Jade**	24 students (11 boys and 13 girls) **Interviewed students** One interview with 4 students (3 boys and 1 girl)

Table 4-6 Summary of data collection at the private coeducational school

I visited the classrooms for the observational data collection on varying times and days throughout the term. The Year 8 classroom observations usually occurred during a Thursday afternoon period lasting for 45 minutes and held in a computer laboratory. The Year 4 observations were made at varying times and days, and classroom visits lasted for approximately 90 to 120 minutes. These classroom visits included classroom activities and visits to the library to use the computers.

Interviews were conducted with groups of Year 4 and Year 8 students and with the female Year 8 ICT teacher and the female Year 4 teacher. Eight Year 4 boys and girls consented to being interviewed, with parental consent. One mixed-sex group interview was conducted. Student behaviour during this interview was similar to, but not to the same extent as, the disruptive interview behaviour demonstrated in the Year 4 government school. The Year 4 student interview commenced in the library and continued in the classroom at the teacher's request. Because of the disruption and the behaviour of the students, not all areas of the interview topics were covered during the interview time allocation. This was disappointing. Only four Year 8 students who had parental consent to be involved agreed to take part in the interview. Other students whose parents had provided consent declined to participate. An interview was held in the classroom area with the Year 8 students, with three boys and one girl participating. The student participation in the interview was similar to that experienced during the Year 8 female single-sex school interviews.

4.5.4 Data Collection in Retrospect

Consent forms were distributed to the teachers and students in the classes chosen to participate. Students who did not give or have permission to be involved in the study were discretely identified and no data was collected related to those students. Furthermore, during the research time at the schools, a number of students joined or left the classes. The new students were discretely identified and were not included in the data collection. Only students who returned

parental consent forms, and consented to the interviews being recorded, were interviewed. The student and teacher interviews were conducted during free time, and snacks were provided in the focus group interviews so that the students would not miss out on their lunch breaks and to relax the mood. The interviews were recorded using a digital voice recorder and transcribed after the interview, while notes were made in the journal dedicated to that particular class.

Schools are a noisy and busy environment, and difficulties were encountered during the collection of interview data and subsequent transcription. It was much harder than anticipated to secure a place at the schools that could be used to conduct the interviews with minimal disturbance and interruptions. Environmental noises made transcription problematical and at times unexpectedly obscured the interview data. The tone and volume of some of the younger children's voices also made it unpredictably challenging to hear and distinguish between genders during transcription, even though they seemed clear and distinct during the actual interview. Who this would affect, and to what extent, was not predictable during the interview and only became apparent when the recording was being transcribed. This meant that it was impossible at times to track which particular child made a comment of interest. It also meant that each interview could take several days to transcribe because of the audibility issues.

Data collection was restricted to the classes, days and times offered by the principals and teachers because of consent, availability and willingness to participate issues. These were not always optimal for the planned research collection activities. Moreover, sometimes the data collection times and days had to be changed due to other classroom activities and it was difficult to reschedule to times that were mutually convenient, especially when data was being collected at multiple schools or classes during the same term. Furthermore, difficulties in finding a school to participate during term 1 and 2 in 2006 meant that data was not collected during these terms.

Collecting data at different times of the year led to constraints and different challenges with accessing the participants. Teachers were at times busier with marking and reporting responsibilities, on top of their instructing role. This left less time and inclination to be involved in data collection activities. In term 1, the schools are busy with many administrative and logistical activities associated with the resumption of school after the summer holiday break and the start of the new school year. There is also no lead time to allow for distribution and collection of consent forms in the school for data collection in the first term. These constraints meant that data collection was not viable in term 1.

Observational data was collected in the classrooms on average one day per week during times when the students were likely to be using computers and other technologies, such as digital

© 2007 Kaylene Clayton

cameras and graphical calculators. Interviews were conducted with the teachers and students towards the end of the term. This was to allow the researcher to observe the classroom environment and establish a rapport with the students and teachers. The female single-sex school Year 8 teacher was interviewed after the term finished due to his limited availability, and the government school Year 8 teacher was not interviewed. He declined to be interviewed during the term citing lack of available time, and attempts to contact him in the following school terms failed. Group interviews with the students were used to encourage discussion and help the students open up to the researcher, while teachers were interviewed individually.

The interview questions were not tested in a pilot study. There were several reasons for the decision, some of which were influenced by the researcher's previous experience in this area. Firstly, given the complexity and degree of difficulty in sourcing schools and participants in this context, using a school to act as a pilot study test case could not be justified. Secondly, while many schools have a similar environment and culture, there are distinct differences in each school that means what is valid and useful at one school may not be at another school. This was reinforced to the researcher during the interview process at the different schools. For example, the interviewees at one school did not have problems understanding the questions and responded well to the way the interview was conducted. At another school with the same size groups of children in the year level, the children did not respond as well to the questions, were distracted and there was a great deal of showing-off, which disrupted the interview. Reducing the group size for the remaining interviews and making other changes in subsequent interviews at that school did not alter the reaction and behaviour of the group.

Even if the methods and questions were tested on the first group of students interviewed, the experienced outcome would not have led to significant changes with the student interviews at the next school. What was reiterated to the researcher was that there was not an easily transferable interview script or technique between the schools in the study. The interview questions were created using the past research experiences of the researcher in this area and the questions were kept as simple as possible. Furthermore, while the questions were not tested in a school environment, they were trialled on younger family members.

4.5.5 Data Analysis and Reporting

The content of the interviews, classroom observations and the associated notes were analysed according to sensitising concepts gathered from literature. These sensitising concepts helped to organise, focus and guide the research. The analysis was conducted on the Year 4 data and the

Year 8 data. This is presented in Chapter Five and Chapter Six respectively. The Year 4 and Year 8 data and analysis were then regarded holistically, and this is presented in Chapter Seven.

According to Patton (2002), interpreting qualitative data is more than simply describing the data; it involves translating and making sense of a vast array of data collected from a variety of sources and summarising the data into themes (McMurray, Pace, and Scott, 2004). Miles and Huberman (1994) add that the analysis of qualitative data includes a sequential series of activities that starts with the coding of text and recording initial reflections, then sorting and sifting through the data to find themes, similarities, differences and relationships, followed by comparing these findings to existing and new data and creating theories which are compared and tested against a formalised body of knowledge. I studied the interview transcripts and observational field notes; sorted selections into categories, used sensitising concepts; and searched for patterns and relationships amongst these selected items. This data analysis process relied on my interpretation of observations and the interviewees' interpretations of their experiences. From the interview and observation data, together with the written documentation, I began to contextualise and make sense of the situation including the subjects' environment and experiences and what this means in terms of their ICT study and career choices.

I commenced the analysis process when I entered the field and this continued through to the end of the writing phase. I found that, as the data collector and transcriber, it was impossible to separate any preliminary analysis that may occur from the data collection and transcription process. According to de Laine (1997), data analysis in interpretive research is characterised by its iterative nature, starting with the first day of field work. In the iterative process, analysis feeds into data collection (de Laine, 1997). The iterative process of observation followed by analysis was followed in this research. Observations were reflected upon on a daily and weekly basis, at the end of each school term and when fresh literature and trends in the area emerged. My interpretations continued to evolve as I reflected on the observation and interview experiences and the ongoing investigation of literature in related domains. As I continued reading relevant literature in the domain, this also helped shaped my interpretations of what I was learning from my reflections and contributed to my themes for analysis. My conceptual model (see Section 3.5) continued to evolve as I reflected on the findings and new literature until the version (see Section 7.8) I felt captured my understanding of the problem.

I investigated a number of data analysis methods, such as grounded theory, symbolic interactionism and thematic analysis amongst others. Most of these were discarded early in my investigation of data analysis methods as I felt that they did not suit my research goals and philosophy. I felt that thematic analysis was an accessible data analysis method that suited my

© 2007 Kaylene Clayton

research goals and beliefs. According to Braun and Clarke (2006), thematic analysis can be a realist, constructivist or ‘contextualist’ (between essentialism and constructivism and characterised by the use of theories such as critical realism) method. “Therefore, thematic analysis can be a method that works both to reflect reality and unpick or unravel the surface of ‘reality’” (Braun and Clarke, 2006,p. 81).

Thematic analysis is a widely used, but poorly defined and ‘branded’ method of data analysis (Braun and Clarke, 2006). It simply organises and describes the data set in rich detail and allows the researcher to identify and report patterns or themes within the data (Braun and Clarke, 2006). It can be used in a deductive (top down) or an inductive manner (bottom up), which bears some similarity to grounded theory (Braun and Clarke, 2006). Deductive or top down thematic analysis is comparable to the top down approach noted by Dey (1993), where an initial set of top-level categories are selected based on concepts underlying the questions.

Due to my involvement in the interview process and the number of times that the interviews were listened to and the time taken to transcribe the interviews, I became extremely familiar with the content of the interviews and the themes and patterns that were emerging. Being a participant observer also helped with the observation analysis as I personally experienced the data collection. At times, things that appeared minor and of no great significance were not recorded in great detail; however, they could be easily recalled as the significance of the item became apparent during the analysis.

I chose not to use a computer-aided data analysis tool (such as N7) in this study for a number of reasons. I felt that I was already close to the data, as I had been the sole data collector, and from my transcription of the interviews and observation notes. My reluctance to use computer-aided data analysis tools was backed up by a number of authors. In particular, Webb (1999) believes that beginning researchers conducting small-scale studies should use a manual data analysis approach to gain insight into the intuitive aspects of analysis. She found that "the intimacy gained by this process gives such a close 'feeling' for and familiarity with what participants have said that it leads to a process of analysis that could appear almost to be automatic and even to have physical elements" (Webb, 1999, p. 329). Furthermore, while Walsham (2006) believes that computer-aided analysis tools can be useful, he also describes disadvantages, such as: they are time consuming; can take the place of generating themes and making data–theory links; and can cause the researcher to be locked into seeing the data in only one way. Webb (1999) adds that there also is a risk of becoming over-concerned with the technical details, which interferes with the creative aspects.

© 2007 Kaylene Clayton

I commenced the formal data analysis phase once I completed my fieldwork. To start the process, I created a thematic framework (Miles and Huberman, 1994) based on the literature identified in Chapters Two and Three and described in my initial conceptual model. I used the categories from my preliminary conceptual model as sensitising concepts in the analysis of the data. I separated the Year 4 classroom observations and interviews from the Year 8 observations and interviews. I began with the Year 4 data and used the highlighting tool to group the interviews by school using different colours. I then repeated this process for the observation notes and teacher interviews using different highlight and text colours. My initial themes (Table 4-6), drawn from literature and the initial conceptual model, were used to analyse the data.

Cultural Context	
Individual Factors	Personality and attitude Self-efficacy and confidence Study and career goals Subjective task value Interpretations of experience
Structural Factors	School environment • Resources and infrastructure • Technical support Teacher • Training • Role • Expertise ICT access Curriculum • Vocational and educational instruction • Career guidance
Socioeconomic status	
Social Factors	Role models and mentors • Parents, siblings and extended family • Media • Peers • Teachers • ICT industry figures Family • Parents, siblings and others • Socialisation Home environment • ICT access and resources Stereotypes • ICT • Gender

Table 4-6 Thematic framework for the research

I began the analysis by reading through the colour-coded interviews and observation notes and copying and pasting the text fitting with a particular theme into another document with the main themes used as headings. Some of the text was pasted into multiple categories as appropriate.

© 2007 Kaylene Clayton

During the multiple passes of the data, patterns, themes and concepts emerged or were refined. As this occurred, data was extracted to these emergent or refined themes and concepts. This process was repeated in a separate document with the Year 8 data. In the coded data, the colour coding allowed me to easily locate and cross-reference data from particular schools and participants.

For example, a passage (shown below) from a teacher interview responding to a question about why students from other schools have poor ICT skills was coded into the following subset of Structural Factor categories. Contextual text related to the quote was also kept with the coded text as required. This example is only meant to represent a small summary of how the text was coded and it is not intended to be representative of the entire coded result from this text passage. Furthermore, there was some overlap with and repetition of codes, which was unable to be completely represented using the coloured text and format below. Similar coding was performed to categorise the text accordingly into other factors as appropriate.

- Structural Factors
  - Curriculum
    - Implementation difficulties
    - Support
  - School environment
    - School type
      - ICT resources
      - Curriculum
    - ICT resources
      - Hardware
      - Support
  - ICT access
    - Lack of ICT access
    - Lack of ICT resources
  - Teacher
    - Lack of time

There is not the access to computers. They don't have that many computers in the classroom, therefore having a couple [of students] going out at a time and therefore the teacher would have to stretch himself or herself between the ones on the computers and the ones that are working in the class. That would make it very difficult. And I guess it depends on whether they have enough paid or parent help so they could get away to help those on the computer. (inaudible) one teacher from a state school and she started doing web pages with two computers up the back. She said that it took an enormous amount of time going through it all and trying to work it out and keep the others busy and there would always be the interruptions coming in while she was teaching the others. She said it was just a nightmare.

I continued until all of the text had been assigned to appropriate thematic categories. After I had completed the first run through of categorising the data, I reflected on the categories and the categorised data. To start with I looked for patterns and recurrent themes in the data in each individual category. Further subcategories were added as required to the categories as recurrent themes were found. In some categories, such as personality, literature was sought that would help to simplify the analysis of such a large and complex category. For personality, the 'Big Five' personality traits were used as themes in this category and the data was searched for text that fitted with these themes.

As the data analysis continued and became more focused, these categories (themes) evolved, with some themes separated out and others subsumed within other themes. This process is described by Dey (1993), who says that categories (themes) can be split into smaller sections and/or merged to form higher umbrella categories. For example, after reviewing the data, the parents and family categories were separated from the role models in the original role model umbrella category and combined into a single-family category. I felt that parents did not require a separate category and on a higher level could be simply regarded as family. I also believed peers and media were a more important influence on the students than simply as a subcategory of role models and I felt they were worthy of an individual category.

Once I had completed this part of the data analysis for the Year 4 and Year 8 data, I then compared and contrasted the data from the different school types and participants within each category. According to Patton (2002, p. 480), interpretation is "attaching significance to what was found, making sense of findings, offering explanations, drawing conclusions … dealing with rival explanations … accounting for data irregularities … and otherwise imposing order". As suggested by Patton (2002), I continually asked myself questions such as, 'What does this mean?' and 'What is really going on here?', or 'Why would they say that?' and 'What are they not saying?', or 'What have I learned from this?'. The results of the comparisons and interpretations were described for each main theme within the top-level category. I then looked to find links and relationships between the data coded into the themes and subcategories. For example, one of the common relationships (as seen in the above example) was between the amount, quality and availability of ICT resources and the successful delivery of the ICT curriculum. I found that schools that struggled to provide quality ICT resources to the students also delivered a basic and somewhat lacklustre ICT curriculum to uninterested and sometimes disruptive students.

I then looked at the themes in the Year 4 and Year 8 data, and in a similar manner compared and contrasted what I found at each year level for each main theme. This method is supported by

© 2007 Kaylene Clayton

Eisenhardt (1989, pp. 540-541), who says one tactic for searching for cross-case patterns is to "select pairs of cases and then list the similarities and differences between each pair. This tactic forces researchers to look for the subtle similarities and differences between cases". Gradually, higher-level meanings were explicated through the process of organising, describing and linking themes and concepts and discovering relationships. The outcomes of this process are reported in Chapter Five and Six and discussed in Chapter Seven. These chapters are organised using the theme categories matching the new conceptual model as outlined in Section 7.8.

I systematically compared the findings, section by section, from Chapters Five and Six to produce the discussion of middle-school ICT experiences in Chapter Seven. As suggested by Eisenhardt (1989), I again systematically compared the evidence with each section of the emergent conceptual model. As the original conceptual model was developed from concepts and themes identified (or not found) throughout the literature search, the comparison of the findings with the emergent conceptual model meant that I was also comparing the findings with the relevant literature (from a variety of disciplines) in the area. This comparison allowed the formation of new insights from the data and provided me with some understanding of why or why not the emergent relationships hold. While this topic as a whole has been heavily researched over the past several decades, the development of the conceptual framework (Chapter Seven) through a case study approach provided a "freshness in perspective" (Eisenhardt, 1989, p. 548) for the topic.

4.5.6 Judging the Research Approach

Qualitative researchers recognize that "research is an interactive process shaped by his or her personal history, biography, gender, social class, race and ethnicity, and those of the people in the setting" (Denzin and Lincoln, 1998, p. 4). As such, my life experiences, family and education, as discussed in Chapter One, influenced the choice of research topic, research approach, data collection and interpretation of the data. Some researchers may suggest that "it is not really possible to specify criteria for good qualitative work … [but] we should not consider our work unjudgable [sic]" (Miles and Huberman, 1994, p. 277).

According to Altheide and Johnson (1994, p. 485), "as long as we strive to base our claims and interpretations of social life on data of any kind, we must have a logic for assessing and communicating the interactive process through which the investigator acquires the research experience and information". In order to do this, Denzin and Lincoln (1998; , 2005) and Weber (2004) suggest four criteria for evaluating the quality of the research reported in interpretive case studies, namely, credibility, confirmability, transferability and dependability.

Credibility refers to whether the results are credible and plausible to the audience and people we study (Miles and Huberman, 1994). To establish credibility, "the collection of field data should include details of the research sites chosen, the reasons for this choice, the number of people who were interviewed, what hierarchical or professional positions they occupied, what other sources of data were used, and over what period the research was conducted" (Walsham, 1995, p. 79). In this research, the details of the research sites (Section 4.5.1), participants and their selection (Sections 5.4.1.4 and 4.5.2), data collection techniques and details (Section 4.4.2) and data collection in retrospect (Section 4.5.4) were discussed in the respective sections. Walsham (1995) also states that researchers should detail how they arrived at their results to establish credibility. The data analysis process was presented in Section 4.5.5.

Mertens (1997) states that multiple strategies such as: prolonged and substantial engagement with the participants; persistent observation; peer debriefing; negative case analysis; progressive subjectivity; member checks; and triangulation can be used to enhance credibility. Ethical and permission issues did limit the length and depth of engagement within this study. However, I found that towards the end of my engagement with the particular classes and participants that much of what I had observed or heard was repeated in the subsequent observations and interviews. Throughout the research, I discussed what I had learned with my supervisors and members of my research group[11] and at educational forums and conferences. The discussions with my peers and the probing questions that were asked helped to clarify my erudition, challenge my constructions and guide my research process. I also felt the need to discuss and disclose my personal experiences in this area to remind myself to keep an open mind and monitor my progressive subjectivity. While it was not practical to transcribe the interviews and conduct a formal member check with the participants, this was done informally at the end of the interviews with the teachers. I also spoke to the teachers about what I had observed during the observations and sought clarification from the students about things that had been said and observed in interviews as required and practicable.

While triangulation is frequently regarded as a positivist technique, it does have application (with a different outcome focus) for interpretivist studies. In positivist research, triangulation is used to test for consistency of the data across sites (Patton, 2002), while in interpretivist research, triangulation is useful for combining data to support findings (Miles and Huberman, 1994). Jick (1979) describes triangulation as the blending and integration of a variety of data and methods in the study of the same phenomenon, to allow a new or deeper understanding to

[11] The Shoe Group is group research support meeting attended by business and information systems academics, visiting academics and PhD and honours students. It meets weekly to discuss research projects and topics and support research activities.

emerge. Triangulation of observation and interview data collected from Year 4 and Year 8 students and their teachers at three types of school was used within this case study to enable a more holistic view of the problem, whilst assisting with the credibility of the research.

Confirmability is the second criterion. According to Miles and Huberman (1994, p. 184), "confirmability means that the data and their interpretation are not figments of the researcher's imagination". This refers to building a logical chain of evidence, where "discrete bits of information come together to make a more economical whole" (Miles and Huberman, 1994, p. 260). The assumption is that data, interpretations and results can be traced back to their sources, and the logic used to construct interpretations is made explicit (Mertens, 1997).

The chain of evidence has been established, starting in Chapter 1 where the research aims and the question are first introduced and justified (elaborated upon in Section 4.3). The literature in Chapter 2 and 3 was synthesised into the initial conceptual model in Section 3.5, and the components of this model were linked back to their origin in the literature. This conceptual model has led to the creation of the thematic framework used for the data analysis and the analysis and synthesis of the data described in Section 4.5.5 As explained in Section 4.5.5, the data was colour coded and the data related to a code (along with contextual data) was copied and pasted into code categories in a document. The data, in its original and coded form, was saved to enable reanalysis and confirmation of codes, themes and relationships, in the event of any doubt existing. Furthermore, over the course of the research project, I made notes about my evolving thoughts and ideas about the problem.

Transferability refers to whether the results are transferable to other contexts and how far they can be generalised (Miles and Huberman, 1994). However, "interpretivism is more relaxed about needing generalisations than positivism is" (Oates, 2006, p. 295). Providing a thick description of the context including details about the participants, location and methods, and using multiple cases can strengthen the transferability of the research (Mertens, 1997). Miles and Huberman (1994) add that the researcher should provide a sufficiently detailed description to enable the reader to make an informed judgement about whether indirect comparisons can be made about the setting that would allow the findings to be transferred to another setting.

Transferability was demonstrated through a variety of methods. Within this research, a description of the Queensland education system was provided in Section 1.6 and detailed descriptions of each research site were provided in Sections 4.5.1.1, 4.5.1.2 and 4.5.1.3. Further descriptive information about the classroom settings and technology in use was provided from the classroom observations in Chapters Five, Six and Seven. Three different school types

(government, all-girl and private coeducational) and teachers and students in two year levels (Year 4 and Year 8) representing the middle-school years were included in the study in an attempt to provide a holistic view of Brisbane middle-schools. A fourth, male single-sex school, was to be included to complete the picture, but all of the schools contacted in this category declined participation. Other factors outside of the scope of the study included inner-city versus suburban schools and the socioeconomic status of the schools. This was partially addressed by choosing schools that were reasonably local to each other, but this was dependent on finding schools that were willing to participate. The process of choosing schools was described in Section 4.5.1.

O'Leary (2004, p. 60) describes the fourth criterion thus: "dependability assumes that what is being studied may not be reliable, consistent or standard – or capturing what is seen as standard may not be possible". Dependability deals with how well the research process is chronicled and the data is documented (Oates, 2006). Miles and Huberman (1994) add that it is crucial that the research approach is consistent and that the evidence is documented. Furthermore, the multifaceted nature of people and their constructions add to the difficulties in assuring dependability of the research (O'Leary, 2004). To deal with research subjectivities, methodological protocols should be consistently, logically and systematically documented and designed (O'Leary, 2004). The dependability of the results is determined by an evaluation of whether the research process is consistent and reasonably stable over time and methods (Miles and Huberman, 1994).

Consistency of the research approach was achieved by documenting and using the same methodology, techniques and types of participants throughout the study. However, the final methods, timing and participants involved were determined by the willingness of the schools and participants to contribute to the study. The methodology and observation and interview data collection techniques used have been described and justified throughout Section 4.4. While the interviews and observations remained largely the same, the size of the focus group interviews changed and the data collection process became more focused and refined as new insights developed. The changes to the wording of the research questions were recorded and notes were made on items to focus on during the observations. The interview data was audio recorded and transcribed into a Word document. The audiotapes were listened to multiple times to ensure that the transcription of the data was as accurate as possible. Observation data was handwritten and included diagrams of the classrooms and descriptions of the technology in use to assist with clarity of data recorded. Notes were also recorded about the documentation collected.

© 2007 Kaylene Clayton

4.6 Conclusion

This chapter described and justified the research strategy used within this research project. A broad range of paradigms and methods were considered when developing the research design for this study. Consideration of the research question, *What is the nature of middle-school ICT experiences in metropolitan Brisbane schools, and what influence do these experiences have on girls' ICT study and career choices?* (Sections 1.3 and 4.3), and study objectives required the investigation and explanation of the social and objective structures underlying social reality viewed from the participants' point of view. However, social reality was also viewed as being largely preconstructed. That is, social structures and institutions are difficult for individuals to resist or modify and therefore in effect appear to possess causality. Consequently, this research is interpretivist in spirit as it seeks to understand reality from the point of view of the participants' constructions, but critical realism has informed the ontological position of this research.

In order to explore the problem, a single embedded case study design was used, and the sections in this chapter explained and justified the adoption of the methodology taken. It sought to aid the reader's understanding of the process undertaken to conduct the study and how I arrived at the findings described in Chapters Five and Six and discussed in Chapter Seven. It commenced with a brief overview of the research paradigms relevant to this study, with attention paid to the area of Social Informatics. Section 4.3 discussed the development of the research questions, while section 4.4 explained and justified the case study methodology and data collection techniques (participant observation, interviews, documentation and physical artefacts) used in the study.

The conduct of the study then described and justified the selection of cases, which included a description of the schools that agreed to participate and the ethical considerations that were involved. The data collection process was described, with details of the timing and number of interviews and length of observation that took place at each school, and reflected upon. Section 4.5.5 described and justified the use of thematic analysis and the technique used to analyse the data in this study. The result of this analysis is presented in Chapters Five and Six and discussed in Chapter Seven. Chapter Seven also presents the new conceptual model that evolved from the preliminary conceptual model (Section 3.5), created through a search of literature from a variety of domains, and the findings in Chapters Five and Six. Four criteria (credibility, confirmability, transferability and dependability) for judging the trustworthiness of this research were discussed and applied in Section 4.5.6.

© 2007 Kaylene Clayton

Chapter Five describes the Year 4 level findings of this study, while Chapter Six presents the findings of the Year 8 analysis. Chapter Seven synthesises and discusses the findings from Chapters Five and Six and outlines the new conceptual model that resulted from this synthesis of findings. All of these chapters organise the findings through the use of the factors and sub-factors developed for the new conceptual model described in Chapter Seven. Rather than using the structure of the preliminary conceptual framework, I felt that using the structure of the new conceptual model would assist the reader in understanding the reasons that the resultant factors and relationships were important to the new model

© 2007 Kaylene Clayton

Chapter 5 Year 4 ICT Experiences

5.1 Introduction

Chapters Five and Six present an analysis of the Year 4 and Year 8 interview and observational data collected from the three school types in metropolitan Brisbane, as described in Chapters One and Four. The purpose of this chapter is to explore ICT experiences at the Year 4 level, identify key factors involved in these experiences, and understand the influence that these factors and experiences have on students' ICT career choices. The findings in this chapter were analysed using the thematic framework described in Section 4.5.5 and are organised through the use of the factors and sub-factors developed for the new conceptual model described in Section 7.8. Rather than using the structure of the preliminary conceptual framework, I felt that using the structure of the Model of Girls' ICT Study and Career Choices would assist the reader to understand the reasons that the resultant factors and relationships were important.

Section 5.2 explores the influence of the cultural context on ICT career choice factors, while Section 5.3 explores social factors that influence ICT career choice. These social factors include family, peer group, media, role models, gender stereotypes and ICT stereotypes. Section 5.4 explores structural factors including teacher, school and personal access, school type, ICT resources and curriculum. Section 5.5 explores and expands on how individual attributes influence ICT career choice, while Section 5.6 discusses the effect of socioeconomic status on the schools and the students. Section 5.7 further explores the process of career choice.

5.1.1 The Year 4 Schools and Participants

The government coeducational school caters to students coming from an extremely broad range of cultural and ethnic groups, including Aboriginal or Torres Strait Islander, Samoan, Maori, Cambodian, Khmer and Vietnamese[12]. It has a large special education unit supporting students with disabilities, including intellectual impairments, autistic spectrum disorders and speech/language disorders. The primary school has a strong ICT focus, with each classroom being equipped with a SmartBoard (interactive whiteboard).

The female single-sex school boasts extensive facilities, including purpose-built art rooms, sports and music centres, swimming pool, golf driving range and tennis and netball complexes.

[12] The reference to this data has been suppressed to protect the identity of the school

The primary students can access classroom computers, a primary school computer laboratory and clusters of eight computers adjacent to the Year 5 to 7 classrooms. The students have a wide choice of cultural and sporting cocurricular and extracurricular activities, from beginner to elite levels. There is an underlying expectation that the students will progress into well-respected professional or semi-professional careers rather than vocational education.

The private coeducational school's junior campus focuses on Prep to Year 6 and is located several kilometres away from the senior campus. The campus operates in partnership with the government school that it borders. The school also has an international program enabling international students to intensively study primary and secondary preparation courses. The school encourages both vocational and professional education. A summary of the key points about the school demographics is provided in Table 5-1 below.

	Government coeducational (Red Oaks)	**Private coeducational (Greenwood)**	**Female single-sex (Pink Hill)**
Established	1978	1995	1901
Student enrolment	850	Over 1100 (Prep to Year 12)	Over 1100 (Prep to Year 12)
Facilities	Run down	Well maintained	Well maintained
School fees	Book or equipment levy	$5200 to $6950	$4844 to $9000
Percentage of students in special education classes	8.2%	Not disclosed	Not disclosed
Results of Year 3, 5 and 7 reading, writing and numeracy tests	Below QLD average in all years and skills	Year 3 and 5 above QLD average in all skills Year 7 below QLD average for numeracy	Above QLD average in all years and skills
Dress code	Not strict	Reasonably strict	Strict
Socioeconomic status of suburb	Low	Middle	Middle to high

Table 5-1 Summary of school demographics

For each Year 4 class, observations were collected during weekly classroom visits over a single school term (9 to 11 weeks), and interviews were usually conducted at the end of the term. The Year 4 classroom observations typically lasted from several hours up to a full day depending on the type of activities planned. Information was collected about ICT artefacts in the classroom and school environments, such as type and availability of ICT resources and infrastructure. Semi-structured interviews with the consenting teachers and students in each school lasted for approximately thirty minutes each. Documents which provided information about curriculum, subject availability and subject selection options were also collected as they became available.

© 2007 Kaylene Clayton

The Year 4 female single-sex school ICT curriculum can be found in Appendix D. In this chapter, the term 'student' may refer to either a male or a female student, while 'boy' refers to a male Year 4 student and 'girl' refers to a female Year 4 student. Table 5-2 summarises the participants in this study and the number of interviews conducted at each school.

School Type	Year Level	Teachers	Class/Students
Government coeducational (Red Oaks)	Year 4 (ages 8/9)	2 of 3 teachers interviewed **Mrs Cherry** **Ms Ruby**	45 students with an approximately even representation of girls and boys **Interviewed students** 4 mixed gender interviews with 25 students
Private coeducational (Greenwood)	Year 4 (ages 8/9)	1 of 1 teachers interviewed **Mrs Emerald**	21 students (14 boys and 7 girls) **Interviewed students** One mixed gender interview with 8 students
Female single-sex (Pink Hill)	Year 4 (ages 8/9)	1 of 1 teachers interviewed **Mrs Pink**	27 students (girls) **Interviewed students** 2 interviews with 16 girls 19 students (girls)

Table 5-2 Summary of research participants

5.2 Cultural Context

Cultural background of the students

The Year 4 class at Greenwood in particular had a number of students from a non-English speaking, international background. These students were required to attend separate classes to learn English before being integrated into a normal classroom. A summary of the 2006 census Quickstats[13] for the suburbs of the school's location is provided in Table 5-3 below.

	Red Oaks	Greenwood	Pink Hill
Unemployment in school suburb	7.7%	3.5%	3.4%
Percentage of single-parent families	25%	16.2%	18.7%
Median weekly individual income for suburb	$437	$602	$520
Percentage of indigenous residents	3.9%	1.4%	1.6%
Percentage of foreign-born residents	31.6%	35.5%	21.4%
English as first language at home	79.9%	79%	92.6%

Table 5-3 Summary of school suburb demographics

[13] Available from the Australian Bureau of Statistics – reference suppressed to protect the identity of the schools

Cultural background of the teachers

The Year 4 Greenwood teacher, Mrs Emerald, has a white New Zealand background and had been working in the school for approximately 18 months. She had a good rapport with the students and the students joked with Mrs Emerald about her accent. A female trainee teacher-aide, who recently emigrated from India, also helped Mrs Emerald in the classroom. Both Mrs Emerald and the trainee teacher-aide had a strong technical background. Mrs Emerald had been extensively exposed to ICT since childhood. The trainee teacher-aide held an IT degree from India and said that she was unable to find IT work in Australia as her qualifications were not recognised. The teachers at Pink Hill and Red Oaks had a white Australian background.

Differences between the New Zealand and Queensland education systems

While New Zealand is one of Australia's closest geographical neighbours and shares many cultural similarities with Australia, Mrs Emerald commented about differences between Queensland and New Zealand in terms of ICT. Mrs Emerald believed that Queensland lagged behind New Zealand in terms of ICT use and resources in schools. While Queensland is currently experiencing an economic boom, the economic benefits of this boom have not fed through to the school system. Many government schools are running on shoestring budgets and have prioritised the way that their budget is allocated. She felt that while the schools in New Zealand and Queensland have similar budgetary constraints, New Zealand schools were more technologically advanced, flexible and open to change. Mrs Emerald recognised the embedded New Zealand culture that recognised the value of ICT when she said, *"I think technology has always just been in New Zealand"*.

Differences between New Zealand and Queensland teachers

Mrs Emerald also perceived cultural differences between the Queensland and New Zealand teacher work ethic. In her opinion, the majority of Queensland teachers were not driven to achieve and excel in their field, while New Zealand teachers were keen to achieve as much as possible. There could be a number of reasons for the difference in attitude; however, she felt that it could be related to the teacher's lifestyle choices. She also felt that ICT tended to be seen as a novelty in Australian schools. Furthermore, in New Zealand, Mrs Emerald brokered deals with multinational technology companies to supply reduced-cost or free ICT resources for her classroom and school in exchange for promoting their product to other schools and teachers. She has found the lack of interest from the Australian ICT industry made it far more difficult to implement a similar model in Australia.

© 2007 Kaylene Clayton

5.2.1 Summary of Cultural Context Key Points from the Year 4 Data

The key points from the Cultural Context analysis of the Year 4 data, further discussed in Chapter Seven, include:

- In this study, Red Oaks had the greatest cultural diversity in student background while Pink Hill had the largest proportion of students with a white Australian background.
- The Greenwood students' teacher was from New Zealand and the teacher aide was from India, while the Pink Hill and Red Oaks teachers had a white Australian background.
- The Greenwood teacher believed that Queensland lagged behind New Zealand in ICT use and resources in schools and was less flexible, open to change and supportive of educators than the New Zealand system.
- The Greenwood teacher believed that Queensland teachers were not driven to achieve and excel in their teaching compared to New Zealand teachers.
- There were differences in the demographics of each school, which were demonstrated in the appearance, motivation and attitude of the students.

5.3 Social Factors

5.3.1 Family

Parents' use of and involvement with computers and technology

Children observe how and when their parents use technology. The Year 4 students described their parents using computers at work and home, and at times working from home using a computer. Typing and email were the two main work activities using computers. The students felt that their mothers used computers for work or study more than for leisure. At home, mothers tended to share a computer with the family, while more fathers had their own computer. Fathers also tended to buy the computer hardware and build computers, while mothers tended to buy software.

In general, the students saw their fathers as being technically competent, or computer gamers. Fathers were seen as the main home computer user and there was a strong association between computer use by fathers and fun activities. For instance, a Greenwood girl remarked, *"[the computer] is my Dad's toy"*. At Pink Hill many of the girls' first experiences with ICT often involved their father, and a number of Pink Hill girls also spoke about playing computer games with their father. However, there were also negative associations about the amount and length of their father's ICT use, with students saying that their father stayed on the computer too long, or that he was always on the computer or the phone.

Student perception of their parents' ICT skill and knowledge

The Year 4 students seemed to measure their parents' ICT skill and knowledge against themselves and had an expectation that they should be comfortable with ICT. Some of the girls at Pink Hill expressed disdain that their mothers did not know much about computers, while others felt that their father was really good with computers, or *"is always on the computer"*. The Year 4 students also spoke about teaching their parents the ICT skills that they had learnt in class, and this sharing of knowledge was encouraged by other students. For example, one Red Oaks girl commented that her mother did not know how to send emails and another student asked *"why don't you show her?"* The majority of Year 4 students believed that their parents did not encourage them with ICT skills

Transference of career values and advice

Even at the Year 4 level, there was evidence of students absorbing the career values and advice offered by their parents. The majority of students believed that the career opinions of their parents were important. At Red Oaks, the students also associated career advice with financial support from their parent whilst pursuing their career. The Red Oaks students were also interested in following the career path of their parents, with one student reasoning that, if they chose a similar career to their parent, their parent would be able to offer domain-specific career tips and assistance. At Greenwood, there was mixed reaction to following their parents' career pathways, but there was evidence that both mothers and fathers were already offering the students career advice. The girls at Pink Hill were interested in working in the same professional area as their mother. Only one girl reported that she wanted to work in the same area (law) as her father. Most of the career aspirations of the Pink Hill girls were stereotypically female careers, which included modelling, being a flight attendant, paediatrics and child care.

Sibling and extended family involvement with ICT

Siblings and extended family also featured in the students' ICT experiences. The students recounted positive experiences of playing computer games and making websites with their siblings and sharing the *MSN Messenger* (instant messaging program) accounts of siblings and cousins. At Pink Hill, one girl used her female cousin's *MSN Messenger* account to talk to her cousin's friends, another female cousin encouraged a girl to play *The SIMS* (a strategic life-simulation computer game) and a third female cousin was described as being *"into computers"*. One Greenwood boy spoke of collaborating with his cousin to personalise his computer, while another boy said that his cousin helped to teach him Internet skills. Competition between family members for computer access was a negative ICT experience commonly spoken about by the Year 4 students.

© 2007 Kaylene Clayton

5.3.2 Peer Group

Peers collaborating and sharing ICT knowledge and skills

The Year 4 students acted as positive role models for their peers, as they were observed to collaborate, share ICT knowledge and help each other to solve ICT problems. The students did this with and without teacher encouragement and appeared to be unafraid to ask their peers for help when needed. Girls were observed collaborating on the design of their work, sharing knowledge, and supporting and helping each other when they were unsure about how to complete a task. In particular, the Pink Hill girls quickly learnt and shared new techniques with each other, and peer groups often completed work using very similar options and techniques. For example, one Pink Hill girl, with an 'ö' in her name, had been shown by her father how to insert this character into a document. She shared this knowledge with her classmates. The other students seemed to be excited about learning this new skill and wanted to reproduce it. Consequently, most of the class used the 'ö' character throughout their work instead of using an 'o' character.

Peer interaction in the ICT classroom

In general, the Year 4 students believed that their peers had reasonably good ICT skills. They also appeared to be surprised when they observed differing levels of ICT ability in their peers. The Year 4 girls were observed praising other girls' work and offering constructive criticism; this was not seen with the boys. The Year 4 boys were more likely to demonstrate what they had found or show-off to their peers. Some research (e.g. Gürer and Camp, 2002) has suggested that boys tend to dominate computer use in the classroom, but in this study, the Year 4 students worked cooperatively with their peers and shared ICT resources fairly. For instance, when helping their peers, the Greenwood teacher expected her students to stand back and direct the actions of the other student. However, out of frustration, the students at times took control of the computer when they helped their peers. This was actively discouraged by Mrs Emerald.

Gender differences in ICT group work

There appeared to be gender differences in the way students worked together and completed their work on the computers. For instance, when the Greenwood girls worked in mixed-sex groups, the girls tended to focus on the ICT task and completed the work, while the boys would frequently leave to talk to other boys. In male pairs, both boys seemed keen to be actively involved with using the computer. The girls seemed to prefer working in same-sex groups. In female pairs, the girls appeared to enjoy decorating their work with fonts and borders and collaborated about the pictures and layouts used in the document. Furthermore, a number of the Year 4 girls spoke about how they used *MSN Messenger* to contact each other outside of school.

© 2007 Kaylene Clayton

5.3.3 Media

Reproduction of stereotypes in the media

The Year 4 students were exposed to various forms of media in their home and school environments. In particular, the reproduction of stereotypes occurred with the use of computer games in the Year 4 classroom. For example, a mathematics computer game played at Pink Hill involved firing cannons, and being a drill sergeant in an army 'boot camp'. One girl deliberately failed the task (shooting answers using cannons) so that the male characters in the game would fail. While the Pink Hill girl chose to play that particular game, she manipulated the masculine concept of the game and said that, *"I am making the girls graduate [by correctly solving the problem] and the boys fail"*. However, other computer games available at Pink Hill, and online games played at Red Oaks, appeared to be gender neutral.

Media influence on the Year 4 students

Further evidence of the media's influence on students, in terms of gender and ICT stereotypes, was observed during classroom discussions and during the interviews. For instance, the Greenwood Year 4 students discussed the genre of magazines during one of their class activities, and the way magazines are targeted to gender groups according to the presumed likes and dislikes of each gender. The students readily agreed that magazines that publish articles about fashion are targeted at girls.

Media influence on ICT stereotypes

While most of the Year 4 students had not had contact with ICT professionals or experienced ICT work, they frequently repeated common ICT and gender stereotypes. For example, when asked about the appearance of an ICT professional, common beliefs included that ICT professionals were male, wore glasses and they referred to them as 'nerds' and 'geeks'. It is unlikely that all of these repeated terms and images would be related to personal experience, but are more likely to have come from their exposure to media images of ICT and gender.

5.3.4 Role Models

Parents and family as role models

Evidence of parents acting as positive ICT role models was observed a number of times throughout this study. For instance, a Pink Hill girl's father, who has an ICT background, frequently volunteered his time as a classroom helper in the computer laboratory. He portrayed a confident and comfortable attitude when helping the students and praised the girls' achievements when they completed ICT tasks. Some parents also acted as professional role

models to the private school students, for example paediatrician and lawyer, while a number of the mothers had returned to study. However, only 5.1% of the population living in the suburb where Red Oaks is located were employed in a professional occupation, while in the suburbs where Greenwood and Pink Hill are located, approximately 18% of the population were engaged in professional occupations. Thus, it was highly probable that few of the Red Oaks students had access to professional role models at home.

Students also acted as ICT role models to their parents and discussed how they shared their ICT skills and knowledge that they learnt at school with their parents. Siblings and extended family also acted as role models. For example, the aunt of a Pink Hill girl gave her time as a volunteer helper in the computer laboratory, and several students at Greenwood and Red Oaks spoke positively about the influence of siblings and cousins with regard to ICT.

Teachers as role models

At all three schools, the Year 4 teachers were positive role models to the students as they were enthusiastic about incorporating ICT into their lessons and encouraged ICT use in the classroom. However, while it is important for teachers to be positive role models to the students, it is also important for the teachers to have positive ICT role models. The teachers spoke of the positive influence of their father or other teachers. For instance, Mrs Emerald had a very strong paternal ICT role model, and she frequently spoke about his positive involvement in her earliest ICT experiences. It was this encouragement in ICT that led her to pursue the same career path as her father, and she is now the ICT coordinator for her school. Furthermore, Ms Ruby saw a female colleague as her ICT role model and said, *"she is a bit of a star"*. Students can also act as positive role models to the teacher. At Pink Hill and Red Oaks, the Year 4 students were encouraged to share ICT techniques and suggestions with the teachers. Mrs Pink described this mutual exchange of ICT knowledge with her students as a win-win situation.

Peers as role models

At each school, the students were encouraged to assist each other when they had difficulties; in this way the students acted as role models each time they assisted another student. For example, a Pink Hill girl was observed mirroring the ICT techniques of another more confident girl. Furthermore, Ms Ruby believed that the SmartBoard had made a huge difference in the classroom, because each time a student used it, it provided a model to the other students. Student work was also used to role-model work and expected outcomes to the other students. For instance at Greenwood, the teacher used the work that one boy had completed on his home computer to demonstrate the final product of an ICT project. Similarly at Red Oaks, two boys demonstrated how to make an animated movie with a computer program, and at Pink Hill, a girl

© 2007 Kaylene Clayton

presented a slide show that she had created about her pets. In the last two cases, the students initiated the activity and wanted to present their work to their peers. Older students also acted as role models to the Year 4 students. For example, a Red Oaks boy said *"my friend in Grade 5 showed me [a particular PowerPoint skill]", w*hile a Year 11 Pink Hill student assisted the Year 4 girls in the computer laboratory.

5.3.5 Gender Stereotypes and Differences

Expectations of ability, confidence and interest

In this study the girls were enthusiastic and confident with ICT, and in some cases more technically savvy than the boys. For instance at Red Oaks, the girls were enthusiastic about using ICT, confident about their level of ability and believed that they tried harder than the boys. However, the girls at Red Oaks also felt that the Year 4 girls had similar levels of ICT skills as the boys, but as boys mature their ICT capability accelerated. At Greenwood, the expectation of student ability and interest was similar to that at Red Oaks. Mrs Emerald believed that the current girls were *"just as much into it [ICT]"* as the boys. She also said that she had not noticed any difference in abilities between the boys and girls. However, she also felt that this year's class at Greenwood was a little unusual, as the girls were more confident with ICT, while the boys were more hesitant. However, the teachers were careful to point out that ability and interest can differ from year to year and from class to class.

Beliefs about ability

Beliefs about gender and ability can be transferred to children at an early age, and this was demonstrated at the Red Oaks school. For instance, when one of the Red Oaks girls was discussing the web page she had made, one of the boys declared to all that girls cannot make web pages. The girl dismissed his claims and fervently responded, *"yes, I can actually!"*

Gender and engagement in ICT class work

Boys are stereotyped as being intrinsically interested in ICT, but there were noteworthy differences in the levels of engagement in ICT work between the girls and the boys. The boys tended to be unfocused, easily distracted and disruptive to the other students; the girls tended to be more focused on their work and frustrated by the boys' disruptive behaviour. Furthermore, Mrs Emerald felt that the Greenwood girls were more educationally mature than the boys. Mrs Pink agreed, and added that, in her experience, boys are more easily distracted from their work. This maturity was demonstrated when the boys at the coeducational schools frequently explored program features, or played with the hardware (e.g. opening and closing the CD tray), instead of completing the assigned task. The boys were also more easily frustrated, inclined to show-off or

© 2007 Kaylene Clayton

distracted from the task. During their ICT tasks, the boys entertained themselves by 'crashing' the cursor into objects, quietly screaming and making car noises. When compared to the boys, the Greenwood girls appeared to be more particular and detailed with their work and were frustrated by the boys' disruptive behaviour. Furthermore, when working in mixed-sex groups, the teams tended to be quieter and the girls frequently provided the lead to complete the work.

Gender differences in student ICT work

The Greenwood teacher commented that it took a long time for the boys to learn about the most appropriate times to use the program features discovered through tinkering, but they had now caught up to the girls in their year. Mrs Emerald felt that computer games designed for girls were not as "*flashy*" as those designed for boys, and these differences were reflected in the design of student work prepared on computers. She felt that the boys were more interested in movement and colour, and less interested in the accuracy of their work, and their designs tended to be *"the brighter, the louder, the faster, the better"*. Classroom observation of student work confirmed that the girls' designs were not as bright as the boys' designs, and that the girls carefully chose the program features used in their work. During the observations at the three schools, the girls were more inclined to complete their work and decorate it when it was finished.

Gender differences in ICT use

The Year 4 girls and boys were observed manipulating the outcomes of the educational computer games that they played for differing reasons. At times, the Pink Hill girls deliberately failed to solve the puzzles to make the female characters in the game succeed and the male characters fail. At Red Oaks, some of the boys discovered that they could manipulate the game that they were playing by clicking on the back button on the browser. They manipulated the game in order to complete it so they would be allowed to have 'free time' on the computer and because they were not interested in the underlying concept being reinforced. In particular, a Red Oaks boy manipulated his game and then tried to disrupt the girl who was sitting beside him playing the same game. She assertively stopped him from interrupting her game by elbowing him away and telling him *"don't touch mine!"* In contrast, other Red Oaks girls also completed the game properly and still managed to have computer 'free time'.

5.3.6 ICT Stereotypes

Stereotypical reasons for ICT career decisions

The students' opinions about the reasons for engaging in ICT work appeared to be influenced by their parents' occupations. For instance, the Pink Hill girls associated ICT work with typing,

and stressed the importance of being able to type quickly. They also generally believed that people wanted to work with computers because they had the ability, thought using computers was fun, or because of the Internet. Conversely, the Pink Hill girls felt that people avoided ICT-enabled careers because of the frustrations caused by hardware and software failure. At Red Oaks, students were more likely to have parents who were engaged in manual, unskilled or outdoor work, and correspondingly believed that people preferred to work outdoors and that working with computers was too hard and boring. They were also concerned about breaking the computer and suffering from information overload. Like the Pink Hill students, the Greenwood students were likely to have parents involved in professional, white-collar jobs or managing their own businesses. Correspondingly, while the Greenwood students were concerned about computer failures, they identified ICT work as having a high status and were more positive about their ability to help others through computers.

Stereotypes and the Internet

Students at all of the schools identified the Internet as a key feature in the job roles of people who worked with computers. The Year 4 students felt that the main uses of the Internet in the workplace included information research and Internet-enabled commerce and business functions. This appeared to mirror the way that the Year 4 students used the Internet for schoolwork and at home. The students also associated the Internet with *"bad things"* (Pink Hill student), pornography and being *"ripped off"* (Greenwood students).

Replication of common ICT stereotypes

The students at the three schools were heard to repeat common ICT stereotypes about the appearance of ICT workers. For example, when describing an ICT worker, almost all of the students in this study assumed that the person was male. Only one Pink Hill girl said that the worker would look like her mother. A number of students also referred to the ICT worker as being a geek or nerd, while others felt that he would be intelligent, sad and tired from working long hours and after midnight. Conservative business attire and (thick) glasses completed the image of the ICT worker. When the students were specifically asked what a female computer worker would look like, a Pink Hill school student commented: *"I don't know what a girl working with computers would wear"*. This is possibly because she had not had contact with female ICT workers or through the media. After prompting, the students described the female ICT worker as wearing conservative business attire and glasses, but her image was not portrayed as negatively as the male image.

© 2007 Kaylene Clayton

5.3.7 Summary of Social Factor Key Points from the Year 4 Data

The key points from the Social Factors analysis of the Year 4 data, further discussed in Chapter Seven, include:

- Parents and other family members were seen to role-model attitudes towards ICT use, and reinforce gender stereotypes.
- There was a strong association between fun activities and computer use by fathers, especially with the students from the all-girl school. However, there was also a negative association about the amount of time fathers spent using technology and computers.
- The students tended to measure their ICT abilities against their parents' ICT skill and knowledge, and thought that their mothers had less ICT ability than their fathers.
- The students absorbed the career values and advice offered by their parents.
- The students worked cooperatively with their peers, shared ICT resources fairly, collaborated and helped each other to solve ICT problems.
- The girls praised other girls' work and offered constructive criticism, but this was not seen with the boys.
- Gender stereotypes were reproduced through computer games in the classroom, and the teachers believed that computer game design was reflected in the design of boys' work.
- While most of the students did not have contact with ICT professionals, or had experienced ICT work, they repeated common ICT and gender stereotypes.
- Family, teachers, peers and at times older students acted as positive ICT role models to the students, and the students shared ICT techniques and suggestions with their parents and teachers.
- The students at the all-girl school had access to more female ICT and professional role models than students at the coeducational schools, with the government school having the least access to professional role models.
- The students role-modelled positive ICT behaviour to their peers through technology such as SmartBoards.
- The female students were enthusiastic and confident with ICT, and in some cases more technically savvy than the boys.
- The girls felt that they currently had the same level of ICT ability as the boys, but felt that in later years, the boys' ICT ability outstripped girls' ICT ability.
- The boys tended to be unfocused, easily distracted and disruptive to the other students, while the girls tended to focus on their work and were frustrated by the boys' disruptive behaviour.

© 2007 Kaylene Clayton

- The student beliefs about ICT paralleled their use of ICT for schoolwork and at home and seemed to be influenced by their parents' use of ICT and occupations.
- The students were heard to repeat common ICT stereotypes, and their perceptions about the appearance of ICT workers followed stereotypical formats.

5.4 Structural Factors

5.4.1 Teacher

Teacher background

The background of the teacher, and their interest in ICT, can influence the implementation of ICT in their classroom. Many primary school teachers in Queensland are female, and all of the Year 4 teachers in this study were female. They had varying levels of teaching experience and prior involvement in ICT. All of the teachers used computers at home to prepare work and for leisure. Mrs Pink was mature-aged and had many years of teaching experience; she had learned through experience that computers were indispensable. The coeducational school teachers were younger and had used computers throughout their education.

Two of the coeducational school teachers had a strong ICT background. While Ms Ruby said that she had received very little training about ICT during her degree, Mrs Cherry had recently graduated from an education degree with an ICT major. Mrs Cherry said that she became interested in computers at school and *"really got into them"* when she was 17. Mrs Emerald had used computers since she was about five years old in New Zealand. Her father was the Deputy Headmaster of a school who championed the implementation of ICT at his school and at home. She claimed she had developed her passion for ICT from his influence.

Pre- and post-service teacher training

Teachers face changing expectations of their colleagues and students, and their skills need to keep pace with the abilities and skills of the students. Teachers who have not had significant exposure to ICT require pre-service and in-service training to increase their confidence with ICT in the classroom. Confident teachers are able to seek out their own training, and may only require an introduction to the new technology in order to expand their knowledge through exploration, use and technical documentation. Less confident teachers may lack the experience to know what training is available, be uncomfortable about seeking their own training, or lack the background to understand technical documentation. Access to training is also inhibited by the cost and timing of the training and poor communication of opportunities.

© 2007 Kaylene Clayton

Mrs Emerald felt that teachers lacking the skills or confidence to implement ICT in the classroom avoided using it and therefore their skills remained static. For these teachers, it was a daunting process, and they needed assistance to begin. Furthermore, according to Mrs Emerald, teachers did not like being told how to undertake tasks and some teachers resisted change. However, she felt that teacher attitudes could usually be improved with good, purposeful training. It would take time for these changes to filter through the system, and in some cases it may be impossible to transform change-resistant, old-school teachers before they retired or left the system. The Year 4 teachers also believed that they needed training in hardware and software and ongoing support, rather than being given hardware or software and expected to implement it in the classroom.

Teacher enthusiasm

One key feature in each of the Year 4 classrooms was the positive atmosphere generated with ICT. Even when the teacher made a mistake, they remained calm and positive, and anxiety was never observed. At all three schools, the teachers were enthusiastic and encouraged the use of ICT, provided a mutual learning environment and were not afraid to ask the students for help when using ICT. The teachers were involved in the creation of new ICT programs and the innovative use of ICT in the classroom. The students at all three schools were trusted by the teachers to access the Internet and computer applications without direct supervision, and they responded by using the Internet and applications responsibly. The teachers also encouraged the students to troubleshoot and problem-solve for themselves and other students. Mrs Pink also encouraged her students to explore the computer and applications and found ways to give tasks a fun and meaningful context for the students. By showing trust, encouraging peer support and allowing exploration, the teacher also acted to increase the students' ICT confidence.

Implementation of ICT in the classroom

Teachers who confidently implement ICT in their classes recognise the value and power that ICT-enabled lessons can bring to their classroom. Furthermore, the Red Oaks teachers enjoyed using and learning about ICT, but they recognised that other teachers at their school were not comfortable with using ICT. Consequently, it is possible that the SmartBoards in the other classrooms were not being used to their full capacity. Mrs Emerald was just as positive about ICT in her classroom and emphatically repeated that, *"IT is not typing, and it is not typing passwords"*. She appreciated the ability to access masses of information and resources through the computer, rather than physically visiting a library and carrying armfuls of books back to the room. Mrs Pink mirrored this opinion and loved the instantaneous nature of finding information using ICT in her class:

© 2007 Kaylene Clayton

> *Like if something comes up in the story … We looked it up in the dictionary and we couldn't find it. So I said hang on, and we went over to the Internet and we typed it in and you have the instant answer, the instant response. You don't have to say look, we will find that out tonight and see what we come up with tomorrow. In some ways that is good, and in some ways it is the instant gratification when you want to know the answer and you can get on with the lesson.*

Teacher time constraints

Teachers have limited time to prepare lesson plans, research new activities and prepare for teaching new technologies on top of their teaching, grading and reporting responsibilities. Teacher work continues outside of contact hours, and the teachers often prioritise tasks because of the time required for these competing activities. When there are competing high priority activities, it is unlikely that significant time will be spent on activities that are disliked and time consuming unless specifically directed. All of the Year 4 teachers were interested in the use of ICT in the classroom and spent a considerable amount of time preparing for their ICT classes and creating engaging work for the students. Therefore, it appears that intrinsic interest in ICT drives teachers to give preparation for ICT activities a higher priority in their workload.

Student assistance during ICT activities can be quite time consuming, and the teacher has to be mindful to share student access equally. Consequently, the availability of classroom support impacts on the amount of time that the teachers have available to spend with students during ICT activities. For instance, Mrs Pink had a teacher-aide to assist her for four hours per week in reading, mathematics and individual work. She relied on this teacher-aide to allow her time to spend with students doing ICT activities in the classroom and said, *"I can only bring kids into the computer area of the room when I have an aide. I cannot spare time to help or supervise when I am alone"*. She also had several volunteer helpers to assist during the computer laboratory time, as mentioned in Section 5.3.4. At Greenwood, Mrs Emerald had the assistance of a trainee teacher-aide with an IT qualification. At Red Oaks, many of the students had learning problems and were on individual programs, but the teachers did not seem to have additional in-class assistance for everyday activities.

5.4.2 School ICT Access

Level and type of ICT access at school

While some students had limited access to computers at home, all of the students in this study had access to computers inside the classroom and computer laboratories. Data projectors were

installed in the computer laboratories and they allowed the teacher to demonstrate techniques to the whole of the class, rather than repeating the same demonstration to small groups of students. Some schools also had specialised ICT resources in the classroom. For instance, Red Oaks used an Internet-connected SmartBoard as an integral component of their classroom activities. Red Oaks also had six ageing computers (some not Internet-enabled) in the classroom for the students to share. Both private schools had two reasonably modern Internet-connected computers in the class area, and the students at Greenwood could also access four more Internet-connected computers in a shared area between three interconnected classrooms. At the coeducational schools, it was rare to see the students using the computers outside of teaching time. However, Mrs Pink said, *"I cannot open the doors fast enough to let the girls in [to the classroom in] the mornings. They run straight to the computers"*.

Teachers also require access to computers to prepare and complete their work. The three Red Oaks teachers shared one Internet-connected computer that also runs the SmartBoard. Mrs Emerald and Mrs Pink had individual computers in their offices beside the classroom, and Mrs Emerald also used her personal laptop computer for teaching. However, since the completion of the data collection, in October 2007, the Queensland Government started a roll out laptops for every government school teacher.[14] With adequate training and support, this rollout would allow the teachers to personalise the computer, become comfortable with the use of the system and software, and the portability would allow the teacher to work from home to create innovative lessons and connect with other ICT resources in the school.

Adequacy of ICT access at school

The teachers felt that their access to ICT resources was adequate, but Mrs Emerald felt that more ICT resource access time may be required when the students are less dependent on the teacher during ICT activities. All of the teachers agreed that having more computers would be beneficial. Mrs Cherry went further, and said that she would like to see double the number of computers that are currently available, but said that she felt that this was an unrealistic expectation. Furthermore, the teachers at Pink Hill and Red Oaks manipulated their computer laboratory timetabling to allow longer access periods for their students. For instance, Mrs Pink had computer laboratory access for one hour per week, but tried to book her times before empty timeslots so that the students could continue in the laboratory into the free time block. Also, the teachers at Red Oaks chose to pool their weekly 30-minute computer laboratory allocation to allow one hour of access every two weeks. It seemed clear that, while the Year 4 teachers generally said that their access to ICT resources was adequate, their actions spoke otherwise.

[14] http://education.qld.gov.au/smartclassrooms/strategy/si_computers.html

Computer laboratories versus classroom computers

The benefit of moving to a computer laboratory is that students can work on individual computers. This was demonstrated when the Pink Hill students spoke about how they preferred to go to the computer laboratories rather than using the classroom computers. The reason for this may be because there was no need for the students to share computers in the computer laboratory as there was in the classroom. However, shared computer laboratories caused problems for the teachers and students. For instance, Greenwood shared a computer laboratory with an adjoining government school. Because the computers were isolated from the Greenwood computer network, the students required memory sticks to store and transfer their work. However, the benefit of this is that the work stored on the memory sticks could also be taken home and continued or shown to parents.

The teachers did not find primary school computer laboratories as useful as having in-class computers for a number of reasons. Firstly, it is extremely difficult for teachers to share their time amongst all of the students in a computer laboratory during the available time. For instance, a teacher supervising 30 students in a 30-minute class in a computer laboratory will have only one minute per student to teach or individually assist them. Furthermore, Ms Ruby said that, since many of her Red Oaks students were on individual programs, it was difficult to be out of the classroom for extended periods of time. Secondly, the time required to move the students between the classroom and computer laboratory also cut into useful teaching time. At all of the schools, a fair amount of time was required to shift the students between rooms, settle them into the work, allow them to pack up and then move the students back to the classroom. Thirdly, there were problems when the students arrived at the computer laboratory to find that the computers were experiencing technical problems. This occurred at both Greenwood and Red Oaks. In the case of Red Oaks, the students lost their ICT access period for the fortnight, while the teachers lost valuable teaching time. Therefore, small pods of computers in the classroom or sets of laptops sent to classrooms may be more useful in the primary schools. In particular, laptops could be taken to the students' desks, and this would reduce the need for dedicated space for desktop computers.

Reliability and quality of school ICT resources

The reliability and quality of the ICT resources were linked to the students' perception of ICT. Students at the coeducational schools were observed expressing frustration at hardware, software or network failures. In particular, the reliability of computers in the Red Oaks computer laboratory caused problems during several visits and the students were not able to complete their work. Problems with the computers in the laboratory can also create flow-on effects, such as further breakages and vandalism. For example, the Red Oaks students who did

© 2007 Kaylene Clayton

not have a working computer were observed pulling the computer towers from the desk bay and tampering with the back of the computer while the teacher was distracted with other students. During this particular outage, Red Oaks did not have an available support person to help the teacher. Furthermore, the reliability of the six ageing classroom computers at Red Oaks was questionable. While the computers at the private schools occasionally had technical problems, they appeared to be far more reliable than the ones at Red Oaks. Furthermore, at the private schools, technicians were usually able to fix any problems that occurred within a short time of being notified.

5.4.3 Home ICT Access

Early ICT access

At the three schools, the reported age of the students' first access to ICT was between 3 and 6. According to the Australian Bureau of Statistics (ABS, 2006), 87% of households with children under the age of 15 had access to a home computer in 2005–06. However, fewer households had Internet access (76%). Mrs Pink believed that the current students had more ICT access at home and were more informed than students in previous years. She felt that these students had already acquired many ICT skills at home and were only enhancing these skills at school. Mrs Emerald also believed that the students who had access at home had more ICT ability. The Year 4 students agreed with Mrs Pink and Mrs Emerald's remarks, and felt that their ICT skills were related to home computer access. Furthermore, many of the Year 4 students without access to computers at home felt that they may be more interested in ICT if they had access to computers at home.

Affordability of ICT resources

Although the affordability of computers and Internet connections was an issue, most students had at least shared access to computers at home, but fewer had Internet access. This was confirmed in the Australian Bureau of Statistics report (ABS, 2006), which stated that in households where the household income was below $40,000 per annum in 2005–06, 47% had access to a computer at home, but only 35% had home Internet access. In households where the household income was between $40,000 and $80,000 per annum, these figures climbed to 79% and 67% respectively. At the private schools, home computers were mostly located in a shared-access room, such as the study or office. However, more of the computers at Red Oaks were located in bedrooms, possibly because of the socioeconomic status of the area, meaning that their houses may not have a study or office.

© 2007 Kaylene Clayton

In this study, only two Pink Hill students said that they did not have (at least) shared home computer and Internet access, and some said that they had a computer of their own. Some of the Pink Hill students also discussed their family's plans to purchase new computers. At Red Oaks, most of the students reported that at home they had computer access (with and without Internet connectivity) that they shared with their family. The Red Oaks students also said that they used computers when they visited extended family, or accessed the computers and Internet at the community library. All of the students observed and interviewed at Greenwood had shared home computer access, but they did not like to share their access. Yet having computer access was not sufficient for the students. For instance, one Greenwood girl felt that using the computer at her friend's house is boring because of the lack of Internet access.

Use of ICT resources at home

There were similarities in the students' use of the computers at home. At all three schools, *MSN Messenger* was a commonly used application. The Pink Hill students used their computers for Internet applications such as email, games, *Google Earth*, research and instant messaging, playing games and completing schoolwork. Similarly, the Red Oaks students liked using Internet applications such as *Google Earth*, email and instant messaging, along with playing games and doing schoolwork. They frequently spoke about learning things and having fun at the same time when using ICT. The Greenwood students also preferred Internet applications such as instant messaging, games, *Skype* and *eBay*. In particular, the Greenwood students saw the Internet as a means of low-cost communication.

Forms of ICT resources used by the students

Besides computers and the Internet, the students also used other forms of ICT outside of school, such as mobile phones. Many of these mobile phones were passed down to the students by their parents and other family members following the purchase of new models. Apart from making phone calls, the phones were also used to send text messages and play games. The Year 4 students were also aware of the cost associated with mobile phone use. For instance, the students at Red Oaks spoke about wasting their father's mobile phone credit and using their phone only in case of emergency. Only one student, a girl at Greenwood, said that she did not want a mobile phone. Finally, other devices and technologies were also passed down to the students from other family members. For example, a Pink Hill girl told how she used a "mini computer" PDA, that was more than likely passed down from her parents.

© 2007 Kaylene Clayton

5.4.4 School Type

Differences between school types

There are differences between government, private and single-sex schools because of their underlying philosophies, values and priorities as well as the financial support provided by parents and the government. This can affect the quality of education, available resources and curriculum priorities. In this study, the private schools students had better access to individual ICT resources and support, while the government school was pioneering the use of SmartBoards in their everyday classroom activities. While there were many similarities in the curriculum content between these schools, students from the more affluent Pink Hill school used a greater variety of applications, including *Microsoft Excel*, *PowerPoint*, *Word* and *Publisher*, were confident Internet and email users, and were learning to touch-type. The ICT curriculum for the Pink Hill students can be found in Appendix D. There was also more extensive technical ICT and classroom support available at the private schools. In particular, Mrs Pink believed that it would have been more difficult for her students to acquire the ICT skills that they have achieved without the assistance of the classroom help.

Differences in ICT use

Although there were differences in the use of ICT observed between the single-sex and coeducational schools, the teachers at the three schools felt that there were no gender differences in ICT abilities. However, during the classroom visits some gender differences in the classroom were identified. For instance, the Pink Hill students seemed calmer, more productive and collaborative, and less competitive than students at the coeducational schools. At the coeducational schools, the students tended to form same-sex groups and pairs when given the opportunity. When working in groups, the all-boy groups tended to be noisier and more disruptive to other students than the mixed-sex or all-girl groups. For instance at Greenwood, a girl who had been trying to work suddenly stopped, cried *"Ohh"* and covered her ears because of the noise and disruption caused by the pair of boys working near her. While the teachers did not think that the gender splitting of general Year 4 classes would be useful, Ms Ruby believed that gender splitting of ICT classes could be effective.

5.4.5 ICT Related Resources

Affordability of ICT related resources in schools

ICT resources are expensive to purchase and maintain, and schools can struggle to find adequate funding to provide these resources. In particular, the cost of software licences was thought to be prohibitive, and warranty and trust of the ICT vendor is extremely important to schools. Each

school in the study had a budget and it was up to the individual school or department to decide how that money was best spent. For example, Red Oaks funded the establishment of SmartBoards in each classroom by drawing money from other budget areas. The Pink Hills students had good levels of access to hardware and software, and Mrs Pink was able to put forward a business case for new software to the ICT coordinator. At Greenwood, as the ICT coordinator, Mrs Emerald was able to purchase new software and hardware to implement innovative ICT programs. However, Mrs Emerald also encountered problems obtaining quotes from ICT suppliers for new equipment, and she missed the collaborative relationship that she had experienced between New Zealand ICT companies and schools.

Types of hardware provided in schools

As seen in Section 5.4.2, the students were believed to have "adequate" access to ICT resources at school, but the type of access and location and quality of the resources could be improved upon. Higher levels of ICT integration in the classroom could be achieved by more classroom computers or laptop computers. The Red Oaks teachers found the introduction of SmartBoards to be beneficial in the classroom as they increased student engagement. Other ICT resources used in the classrooms included a scanner at Red Oaks, digital cameras at Greenwood, and data projectors and printers at every school. However, ownership of ICT resources can be a problem. For instance at Greenwood, teachers can borrow a digital camera kit from the ICT coordinator. Mrs Emerald explained how frustrated she felt when the teachers did not remove their images from the camera, recharge the batteries or return the camera cable with the kit. This meant that the camera was often not ready to be used by the next teacher.

Internet access in schools

All three schools had Internet access available to the students, and the students knew the password to access the Internet. The trust of the students to use the Internet responsibly was high and possibly enhanced by teacher knowledge of the school's Internet filtering system. While there were no observable problems with the quality of Internet access at the private schools, at Red Oaks the Internet bandwidth caused many problems. Classroom activities that involved the viewing of some short movie clips became impossible because of the connection quality during school hours. Even though the download settings were reduced to low-speed dialup quality, the clips were extremely pixelated and unwatchable when they were finally played, after a considerable delay, through the SmartBoard screen. The teachers had trialled the download after school hours on the previous day and had not experienced these problems, possibly because of the reduced network traffic.

© 2007 Kaylene Clayton

ICT problems

At each school, the students and teachers had to cope with hardware, software or network problems. At Pink Hill it was less of a problem because there were enough spare computers in the computer laboratory for the students to move to. At Greenwood, the boys were less tolerant of computer failures than the girls. If they were prevented from doing their work because of a technical problem, the boys would explore the computer functionality and set up. Furthermore, the speed of the computer was important to students at each of the schools, and slow or old computers were viewed negatively. The network and file structures also caused problems for teachers and students. Sometimes, commonly accessed programs were deeply hidden in the menu system making access to applications difficult. Furthermore, the naming of system resources also created confusion for the students at Pink Hill. Mrs Pink responded to the girls' confusion by saying *"the computer technician cannot change it and we call it creative"*.

Technical support

Technical support is important to teachers. Teachers with low levels of ICT confidence and skill find it difficult to cope when the planned lesson has to be modified on the fly or cannot be completed because of technical difficulties. In particular, Mrs Emerald felt that the lack of ICT support *"is a huge thing that turns the teachers off because they don't want to be alone when something isn't reliable all of the time"*. Pink Hill had the best technical support, which was facilitated through an onsite technical support team. Technical issues rarely occurred at Greenwood, and while the junior campus did not currently have an onsite ICT technician, the school planned to employ a technician in the near future. Red Oaks was the largest and least affluent of all of the schools. However, it only had a part-time teacher-aide working in the support role. Unless the need was extremely urgent, requests for support usually took several days to be addressed. Requests for assistance were sent by internal mail, and phone calls were discouraged to decrease disruption to the library where the teacher-aide was located. It was highly possible that part of the support budget had been sacrificed to support the SmartBoard enabled classroom vision, and the school provided the best support possible from their budget.

5.4.6 Curriculum and Teaching

Learning styles and experiences

The students at each of the schools were keen learners and liked being challenged. They believed that learning was fun, and ICT made learning easier and less boring. In particular, the girls felt that they would enjoy learning how to make programs and games because of their ICT experiences. Mrs Emerald believed that ICT enabled different learning styles and children enjoyed doing things in different ways. However, using ICT in lessons required the student to

put more effort into interpreting the information. At Red Oaks, the teachers felt that the SmartBoard had made a significant difference in the students' learning experience because children are visual learners, and it allowed the class to share each student's learning experience. Because the curriculum and units of work were not available from all three school types, a direct comparison cannot be made between the ICT curriculum content at the schools. However, during a comparison of the Year 4 and Year 8 ICT curriculum at Pink Hill (Appendix D) against the activities that the Year 4 students were engaged in, it was noticed that the Year 4 students were already proficient in many of the skills expected of the Year 8 students.

Integration of ICT into the curriculum

ICT was integrated and implemented in a variety of ways in the different school types, and while there were similar core ICT skills being taught, some of the schools taught more advanced skills. For instance, the Pink Hill students used graphing features in Excel and were learning to touch-type. The teachers agreed that ICT should be integrated across the curriculum in primary school as *"ICT is integrated in the world and it should be at school too"* (Ms Ruby). All of the students at the three schools had email accounts and were learning email skills. The teachers agreed that Year 4 was the most appropriate age for the students to be able to absorb and implement email skills, but exposure at younger ages was also reasonable. However, integrating email into the curriculum at Pink Hill was not without difficulties. At Pink Hill, this was the first year that email and typing skills had been taught to the Year 4 students, and to secure email accounts for the students, Mrs Pink had to justify the need for email accounts. Touch typing has now been added to the curriculum in Years 5, 6 and 7 at Pink Hill. While typing may not be viewed as a pure ICT skill, it facilitates the teaching of future ICT skills. Table 5-4 provides an overview of the activities and skills being learnt in the class during the observations.

Pink Hill	**Red Oaks**	**Greenwood**
Email used without direction	Students learning to use email	Email use not observed
No other applications or technologies observed	Use of SmartBoard applications	Use of other applications and technologies (e.g. digital cameras)
Computer games used in teaching and as a reward	Computer games used in teaching and as a reward	Computer games not used in teaching and as a reward
Medium level formatting skills using Word, Publisher, PowerPoint and Excel	Basic formatting skills using Word	Medium level formatting skills using Word, Paint and PowerPoint
Touch typing encouraged	Touch typing not taught	Touch typing not taught
Internet used in activities	Internet used in activities	Internet used in activities
Good understanding of network access and storage	Good understanding of network access and storage	Good understanding of network access and storage

Table 5-4 Summary of skills and activities observed in the Year 4 classrooms

© 2007 Kaylene Clayton

Using ICT to deliver the curriculum

While using ICT to deliver the curriculum can require more effort from the teachers and the students, it can also increase student engagement and decrease behaviour problems in the classroom. Mrs Pink felt that it was becoming increasingly difficult to capture the attention of students using traditional teaching methods and that she had to put on a show to compete with the bright colours and fast movement of computer games. However, the teachers also believed that computer games were a useful tool for reinforcing curriculum content and as a reward in free time; however, balance was needed. The students also liked to use games as a reward or break, but did not want to play them every day. They felt that if computer games were used every day, they would lose their value as a reward.

Mrs Emerald emphasised that, when ICT was used routinely as part of normal classroom activity, more time was able to be spent working on the actual activity rather than it being treated as a novelty. Yet, even when it is a novelty, ICT increases the engagement of students. At Red Oaks, the teachers felt that, since the SmartBoards had been introduced, they had noticed a reduction in "*zoning out*" by students, and they attributed this to the engaging and interactive nature of the SmartBoard. Furthermore, the Red Oaks principal confirmed a decline in behaviour problems since the introduction of the SmartBoards, with the number of students requiring disciplinary attention at the office becoming almost non-existent.

Inhibitors to using ICT in the curriculum

Inhibitors to using ICT in the curriculum include the time required to create and deliver curriculum material, and the lack of appropriate and timely training in the hardware and software. For example, Mrs Emerald intended to start a school-based television station, but she lacked the time to arrange the technology and organise the students on top of her normal teaching load. Furthermore, the preparation of ICT teaching material also takes longer than for other subjects, but preparation is the key to providing the students with a rewarding and engaging ICT experience. This preparation needs to include strategies to deal with technical failures and other problems that may be encountered. Restrictions can also be placed on the use of ICT applications and hardware, such as chat and webcams, because of safety concerns and administration directives. However, two of the schools used digital cameras in their activities.

Teachers in this study sourced other ICT resources to use in their classrooms, but they thought that less motivated teachers may feel that doing this was too difficult or too much trouble. According to Mrs Emerald, some teachers made excuses for not implementing more innovative ICT activities. They became stuck on web-based and Internet activities because of a lack of confidence with ICT. These teachers would like an 'out of the box' solution that they could

© 2007 Kaylene Clayton

confidently use in their classroom. They did not understand that this was not always possible because of curriculum restrictions and changes in ICT. Furthermore, the teachers cited lack of user friendliness and convenience issues as the reasons for not using the curriculum tools and resources provided by the educational authorities. It is very possible that this has also discouraged less skilled or confident teachers from accessing them.

Standardisation of the ICT curriculum

The teachers were divided about whether there should be standardisation of the ICT curriculum. While some teachers believed that standardisation of the ICT curriculum would make things easier in the classroom, Mrs Emerald felt that the standardisation may lead to the teacher only covering the minimum requirements and not being adventurous because of lack of time or motivation. However, Mrs Pink experienced problems when students with low-level ICT skills transferred into her classroom, as they required extensive assistance to catch up. She attributed the ICT skill deficiencies to the students' lack of ICT access, teacher resources and classroom support at their previous school. Mrs Emerald did not perceive differing skill levels to be as much of a problem. She believed that students did not have the same level of ability in other subjects, so it would be foolish to believe they would all be at the same level with ICT. In her classroom, Mrs Emerald used peer support to overcome the problem of differing skill levels. However, Mrs Emerald conceded that it could be difficult for less confident, skilled or experienced teachers to cope with the differing ICT skill levels of students.

5.4.7 Summary of Structural Factor Key Points from the Year 4 Data

The key points from the Structural Factors analysis of the Year 4 data, further discussed in Chapter Seven, include:

- The background of the teacher and their intrinsic interest in ICT can influence the implementation of ICT in their classroom.
- Teachers face competing priorities for the time required to research and prepare for new activities and the other elements of their teaching responsibilities.
- The availability of classroom support impacts on the amount of time that the teachers have available to spend with students during ICT activities.
- Inhibitors to using ICT in the classroom included the time required to create and deliver curriculum material, and the lack of appropriate and timely training in hardware and software.
- Teachers with low ICT confidence and skill find it difficult to cope when the planned lesson has to be terminated or modified on the fly because of technical difficulties.

© 2007 Kaylene Clayton

- Teachers without significant exposure to ICT require pre-service and in-service training to update their skills and increase their ICT confidence, but this is limited by their willingness to seek and undertake the training.
- A paradigm shift is required to change some teachers' teaching and attitudes, but this will take time and it may be impossible to change resistant teachers in the short term.
- The teachers encouraged the students' use of ICT, provided a mutual learning environment and were not afraid to ask the students for help when using ICT.
- By showing enthusiasm, trust, encouraging peer support and allowing exploration, the teachers also increased the students' confidence in ICT and engagement.
- All of the students in this study had access to computers at school and, although the affordability of computers and Internet access was an issue, most students had at least shared access to computers a home, but fewer had Internet access.
- Outside of the classroom, the students used mobile phones (often recycled from family), Internet-enabled communication, Internet applications and computers for homework.
- The differences in underlying philosophies, values, priority and financial support can affect the quality of education, available resources and curriculum priorities.
- At the coeducational schools, it was rare to see the students using the computers outside of teaching time, while at the all-girls school, the students were eager for after hours use.
- In the early middle-school years, computer laboratories were not believed to be as useful as in-class computers due to student supervision difficulties and disruptions caused by moving between rooms and computer failures.
- Schools can struggle to find adequate funding to provide and maintain ICT resources, and ownership of the resources reduced their usefulness.
- All three schools had Internet access (high and low quality) and the teachers trusted the students to use the Internet responsibly.
- The computers at the private schools seemed to be far more reliable than at Red Oaks, and the private schools had access to teams of ICT technicians to fix problems within a short time of being notified.
- Due to early access to computers at home, the students were believed to have already acquired many ICT skills and were only enhancing these skills at school.
- The girls from the female single-sex school tended to be calmer, more productive and collaborative, and less competitive than students at the coeducational schools.
- At the coeducational schools, the students tended to form same-sex groups, and the all-boy groups tended to be noisier and more disruptive to other students than the mixed-sex or all-girl groups.

© 2007 Kaylene Clayton

5.5 Individual Attributes

5.5.1 Individual Aptitudes, Personality and Attitudes

ICT aptitude of the Year 4 students

There were differing ICT aptitude levels observed at the schools and between individuals, which confirmed Mrs Emerald's comment that, as with other subjects, there will be differing levels of student skill in ICT. In general, when new ICT skills were being learnt or demonstrated, the students were quickly able to replicate it by themselves. The students at the three schools had beginner to intermediate level skills in *Word*, *PowerPoint* and *Internet Explorer*, and the Pink Hill students also used *Outlook*, *Publisher* and *Excel*. All of the Pink Hill students were able to complete assigned ICT tasks of varying levels of difficulty and to a high quality standard, while the girls at Greenwood and Red Oaks tended to complete their work faster and with more skill than their male peers. However, Mrs Emerald felt that her current Year 4 students did not display as much ICT aptitude as her past students in New Zealand. Furthermore, the availability and quality of ICT infrastructure and the quality of past teaching impacted on the current Year 4 students' ICT skills.

The Year 4 students tended to judge their ICT aptitude by comparing themselves to their peers and their family, and believed that their peers had similar levels of ICT skills and knowledge. Specifically, the Red Oaks students rated their ability with computers using a traffic light scale: red being not competent; amber meaning they still required assistance; and green meaning that they were competent. Most students felt they were at the amber or green level. Additionally, one Red Oaks boy was referred to as a "*computer expert*" by another boy. While most of the girls at Pink Hill appeared competent and confident with ICT, two girls who had recently transferred from another school and were not as advanced as the other students were receiving additional help from the teacher and their peers. At Greenwood, one of the boys appeared to be quite frustrated with the assigned ICT tasks, and told other students that *"I'm bad with computers"*. He also attempted to get Mrs Emerald to complete his ICT work for him because did not want to be the last one finished in the class. However, he was proud of his effort when he persisted and finished the task.

Student confidence with ICT

Most of the students displayed a confident attitude, and were usually keen to attempt new tasks and learn new ICT skills. Furthermore, when the students had difficulties with an ICT task, they had no hesitation in collaborating and problem-solving with their peers. With the support of their teachers, the Greenwood students were willing to attempt unfamiliar ICT tasks, and Red

Oaks students gained confidence when learning new tasks. This was reflected in a Greenwood student comment when he said that not knowing how to use a computer did not stop him from attempting ICT tasks, as the teachers were able to help. While the Greenwood girls were more confident than the boys with ICT, the Red Oaks girls tended to be a little more hesitant than their male peers. Mrs Emerald also commented that the confidence level of the girls with ICT this year was unusual. Finally, the Pink Hill girls felt that they could learn new ICT skills by setting their mind to it.

Personality – openness to experience

The students were generally content with the software that was available and were happy to use it; they were not usually driven to create or improve software or technology, with the exception of games. One notable exception was a Red Oaks girl who was a frequent user of ICT at home and was quite outspoken about her interest in ICT. She said that she would like to create something that would connect computers to television. She was not perturbed when some of the other students told her that some computers could already display television. Furthermore, for show and tell, she created a pretend robot "analyser" to detect reality, which contained a television, phone and remote. The girls at Red Oaks and Pink Hill also liked to personalise their computers, to make them look attractive and customise application interfaces. The Pink Hill students also said that they would be interested in creating websites and games, in particular mobile and Internet games. To make the work more appealing to girls, Mrs Pink created tasks with socially oriented themes, such as making thank you cards and using animal themes. This reflected the girls' interest in the way ICT could help them present and display their work and their enthusiasm for social themes.

Personality – conscientiousness and agreeableness

The Year 4 students had a strong sense of justice and fairness when using the computers, but also demonstrated competitiveness, assertiveness and the need to control. For example, the Red Oaks students did not approve when they felt a girl tried to have more than her share of the time on the SmartBoard; they joined forces to tell the teacher that she was "*cheating*". Additionally, the Year 4 students negotiated fairly with each other about access to computers and other technologies. For instance, the Greenwood students worked out between themselves about how long a person could use the computer for, and regularly swapped chairs to allow other students to have their turn at the computer. However, one of the Greenwood boys appeared to be quite competitive and, rather than being the last student to finish an ICT task, would avoid working on the computer. The Year 4 students also liked to exhibit control over their ICT environment, applications and hardware that they were using. For instance, some of the Pink Hill students controlled the outcome of their games by manipulating the puzzles to allow the outcome that

© 2007 Kaylene Clayton

they wanted. The Red Oaks students also liked to control how they learned ICT skills; they liked the freedom to move ahead or spend more time on a task, especially if they were able to intuit the steps that would be required.

Personality – extraversion

In general, the students seemed to see and use computers as a tool to complete their work, rather than as a toy. The students and teachers generally enjoyed using computers in the classroom and computer laboratories, and said that ICT made schoolwork more interesting. They also enjoyed playing games, but this was only a small amount of the total use of ICT. At Red Oaks, the SmartBoards have tended to have had a substantial impact on the students' opinions about ICT. There was a sense of excitement when the SmartBoard was in use, they were always eager to answer questions and were disappointed when SmartBoard activities finished. Furthermore, some of the Red Oaks boys were overheard saying *"I love computers"*. However, while the girls appeared to enjoy using the computers and the SmartBoard, similar statements were generally not heard from the Red Oaks girls. In general, the Greenwood students were enthusiastic ICT users and would hurry to the computers when it was their turn. The Pink Hill students also were eager participants in class and said that they loved to create things with ICT.

Personality – neuroticism

At times, the Year 4 students displayed disappointment, frustration and even aggression with ICT. The Year 4 students unanimously agreed that they disliked and were frustrated by computer failures, slow computers and access rates, and difficulties with controlling the actions of the mouse during complex activities. In particular, the Greenwood boys displayed more frustration and aggression towards the computers than did students at the other schools. This generally happened when there was a computer problem or they did not have the ability to complete the task. However, the Red Oaks boys sometimes displayed similar attitudes. Although there were times that the Year 4 girls were also frustrated, it was rare to see them be aggressive or display their frustration in this manner. A common theme throughout the interviews and observations was that frustrations with the computers led to disengagement of the student, and possible future interest in the ICT field.

5.5.2 Interpretations of Experiences

Positive interpretations of ICT experiences

Overall, the students and teachers commented positively about their ICT experiences. In particular, some of the Year 4 girls had healthy beliefs about their ICT ability and were able to ardently defend denigration of their aptitude by boys. For example, a Red Oaks girl confronted a

boy who was commenting to the other students that girls were not good with computers. It is highly possible that the boy was repeating the beliefs of his socialisers, as the girls and boys in his class believed they had relatively equal ICT abilities. The Pink Hill girls also displayed positive attitudes about using computers and software applications at their school. They believed that they were learning new and useful skills in class, and that ICT made learning fun. Similarly, Mrs Pink said that she had only been introduced to ICT when she returned to the workforce and had since learnt that computers were indispensable. The students also used observations of the way that their family, peers and teachers used ICT, media representations of ICT professionals and their personal ICT experiences to form their impressions about the role of ICT professionals. Common student impressions of ICT professionals included that they type a lot, access the Internet for information, install programs and play games. These impressions closely matched with the students' personal experiences with ICT.

Negative interpretations of ICT experiences

The Year 4 students also had negative interpretations of their ICT experiences. The students frequently referred to ICT problems, including slow computers and Internet access, viruses, computer failure and the expense of hardware and software. They believed that people would not want to work with computers because of these problems and implied that they also would not want to work with computers in the future. The Year 4 students also believed that ICT workers were tired and sad from working extended hours. Some of the more advanced Year 4 students also expressed frustration because they already knew how to complete the task being taught, and felt that they were being held back to keep pace with the average level of their class. Although the teachers of these Year 4 students were relatively confident and comfortable with ICT, teachers usually aim their teaching at the middle level of students. While struggling students receive remedial assistance, the more advanced students also need to be extended and stimulated to maintain their interest. This can be difficult for teachers who are already struggling to provide interesting and engaging ICT activities for the average student.

5.5.3 Goals and General Self-Schemata

Short- and long-term goals

The Year 4 students associated using ICT in the classroom with achieving their short-term goals, and saw it as a means to complete their schoolwork and make the learning process easier. Some of the students were anxious about breaking the computer and felt that they could reduce this anxiety by learning to use computers properly. Furthermore, the teachers recognised that ICT helped the students to express themselves. The students agreed and said, *"computers make me better at creative writing, but I don't know why"* (Greenwood student). The Year 4 students

also believed that ICT would help them to achieve their long-term goals. They felt that learning to use ICT properly would be useful for when they were working, or when they were in tertiary studies. They understood that ICT was involved in most jobs or professions and they described how ICT would be used in their preferred occupation. These assumptions appeared to be based on ICT use in their socialisers' occupations and in media portrayals.

Self-concept – actual self

The Year 4 students expressed representations of self-concept during the interviews and observations. Attributes of actual self were seen when students described themselves as having the ability to develop web pages. For example, a Red Oaks girl strongly believed that she had the ability to create web pages, despite being told the contrary by one of the boys. A number of the Greenwood students were quite confident in their abilities with ICT, and said, *"I know what to do"*, *"I'm really good at computers"* and *"Oh that's easy! I can do more than that!"* when asked to complete some work on the computer. Others, although they were more hesitant, felt proud when they completed tasks and disappointed or frustrated when the task was not completed. For instance, a Greenwood boy declared, *"I'm bad with computers"*. However, when he successfully completed a task at the insistence of the teacher, he was visibly pleased with himself. Continued experiences like this could improve his positive self-worth with ICT skills.

Self-concept – ideal self and ought self

The Year 4 students' ideal and ought self were represented through their ideal careers. Furthermore, many of the students discussed negative ICT stereotypes and said that they did not want to be thought of that way. They also did not want to experience the frustration due to computer problems that they felt was endemic in ICT. Nonetheless, the students also felt that learning new skills was important. A number of the students also felt obliged to listen to their parents' ideas and beliefs about the careers that were appropriate for them, and they expected to be guided by their parents' experience.

5.5.4 Subjective Task Value

Incentives for learning ICT skills

The students understood the need to be skilled in ICT use and how these skills would be useful to them in the future. They believed that learning keyboarding and information searching skills, as well as how to use computers, were important skills for when they will be working or studying. In general, the Year 4 students felt that they would be using computers in their job role in the future, and gave examples about what ICT skills would be used. Other incentives for

learning ICT skills included being able to help others, increasing their independence, decreasing their reliance on other people, allowing them to perform tasks more quickly, and to make money. One Greenwood student recognised the status and salary associated with ICT when he said, "*when you get [an ICT] job, then you get more money*".

Rewards and costs associated with learning ICT skills

The incentive for the teachers to allocate more time to prepare ICT material in the classroom was based on the understanding that ICT can increase student engagement and interest and is a skill that the students will need throughout their education. Personal interest in ICT was another reason for teachers to allocate a larger proportion of their valuable time to prepare ICT activities for their classroom. Games were also seen as a reward for the Year 4 students for completing their work. The students and teachers also recognised the disadvantages of working with ICT, and spoke about the cost of using or working with ICT in a financial and temporal manner. For example, students and teachers referred to the expense of computers and the cost of training.

5.5.5 Summary of Individual Attributes Key Points from the Year 4 Data

The key points from the Individual Attribute analysis of the Year 4 data, further discussed in Chapter Seven, include:

- In general, when new ICT skills were being learnt or demonstrated, the students were quickly able to replicate them.
- The students tended to judge their ICT aptitude by comparing themselves to their peers and their family, and believed they had similar levels of ICT ability as their peers.
- Most of the students displayed a confident attitude, were keen to attempt new tasks and learn new ICT skills and when the students had difficulties with an ICT task, they had no hesitation in collaborating and problem-solving with their peers.
- The students were generally content with the software that was available and were not usually driven to create or improve software or technology, with the exception of games.
- The students had a strong sense of justice and fairness when using the computers, but also demonstrated competitiveness, assertiveness and the need to control.
- The students unanimously agreed that they disliked and were frustrated by computer problems and slow computers, and access rates which led to disengagement and the loss of interest in the ICT field.
- The students used observations of the way that their family, peers and teachers used ICT, media representations of ICT professionals and their personal ICT experiences to form their impressions about the role of ICT professionals.

© 2007 Kaylene Clayton

- The use of ICT in the classroom was seen in the short-term as a way to complete their schoolwork and develop skills for when they will be working or in tertiary studies in the long-term.
- Attributes of actual-self were seen when students described their ICT abilities and achievements, while their ideal- and ought-self were represented through their ideal careers and the obligation they felt to listen to the career advice offered by their parents.
- The students understood the need to be skilled in ICT use for their future careers and to help others, increase their independence and efficiency and make money.
- Personal interest in ICT and interest in increasing student engagement and skills were reasons for teachers to allocate more time to prepare ICT activities.

5.6 Socioeconomic Status

Socioeconomic background of the students

As mentioned in Section 4.5.1, there were some distinct differences between the socioeconomic backgrounds of the students at each of the schools. For instance, the unemployment rate was higher than the Australian average in the suburb where Red Oaks is located. In the suburbs where Greenwood and Pink Hill are located, the unemployment rate was less than half of that in the Red Oaks suburb and less than the Australian average. Correspondingly, the median weekly income in the Red Oaks suburb was only $437, while in the Pink Hill suburb it was $520 and in the Greenwood suburb it was $602. The Red Oaks suburb also had the highest percentage of single-parent households. In the Greenwood and Pink Hill suburbs, the top three occupations were clerical and administrative workers, professionals and technical and trades. However, in the Red Oaks suburb they were labourers, machinery operators and drivers and technical and trades, with only 5.7% working in professional occupations.

Socioeconomic status and school ICT facilities

There were some differences noticed in the school facilities in relation to the locality of the school and the socioeconomic status of the students it served. The school environment and resources available to the students were different and individual to each school. At the two private schools the facilities were in good condition and well maintained, while at Red Oaks, the facilities were basic and ageing. The computer laboratories at Red Oaks and Greenwood were located in the library, but at Pink Hill they were in a dedicated room. The computers in the Pink Hill and Greenwood classrooms and computer laboratories were in good condition, while the ones at Red Oaks were much older and at times unreliable. However, Red Oaks had made a significant investment in SmartBoards. According to the Red Oaks principal, the school sacrificed other areas of the school budget, such as replacing individual computers and some

© 2007 Kaylene Clayton

maintenance, in order to provide SmartBoards in each double classroom. There was no evidence of malicious damage to the computers or facilities at any of the schools.

School fees and uniform requirements

The Red Oaks students did not pay tuition fees, but were required to pay a reasonably small levy that contributed towards consumables and classroom supplies. Red Oaks had a relatively relaxed school uniform policy, and the students were asked to wear, at a minimum, a shirt and pants/skirt in the school colours, socks and closed-in shoes and a sun hat[15]. The Red Oaks teachers dressed in smart casual outfits. The students at Greenwood paid an annual tuition fee of $5300[16] and wore a more complex, compulsory dress and sports uniform. They were required to wear a broad-brimmed hat to and from school and in the playground. The school also stipulated how their hair should be worn. The Greenwood teachers wore a corporate uniform and were smartly presented. The annual tuition fee for Pink Hill is $6484[17], and the students were expected to participate in many cocurricular activities at additional cost. Like Greenwood, the Pink Hill students wore a complex and compulsory uniform, and a strict dress and presentation code was enforced. The uniform included a dress and sports uniform, hat and school-branded bag. Full school uniform, including hat, was required to be worn to and from school. The teachers at this school did not wear a corporate uniform, but wore smart business attire and were immaculately groomed.

Presentation of the students and student diet

There was a noticeable difference in the presentation of the students at the three schools, which may be linked to their socioeconomic background. At Pink Hill, the students were always well groomed and presented and the uniform code was enforced. They were well mannered and, in comparison to the coeducational schools, there were fewer behavioural problems observed in the class. At Greenwood, the students were also well groomed and presented in their school uniform, but not quite to the same high standard at Pink Hill. The Greenwood and Pink Hill students brought well-balanced packed lunches, or purchased lunch from the school tuckshop. At Red Oaks, while the majority of the students were neatly dressed and groomed and wore at least partial school uniform, some of the students were unkempt and scruffily dressed. The students at this school also tended to have simpler lunches, and fewer pre-packaged lunch items were seen.

[15] The school enforces a strict "No Hat, No Play" policy, where the students are not allowed to play outside if they are not wearing a hat.
[16] The 2007 annual tuition fee for Years 4-6 – source suppressed to protect the identity of the school.
[17] The 2007 annual tuition fee for Year 4 – source suppressed to protect the identity of the school.

© 2007 Kaylene Clayton

Socioeconomic issues in the classroom

The Pink Hill teachers did not seem to have any issue with students missing school requirements such as pencils or books, while at Greenwood, at times the students had to be asked to replace items that had been consumed. At Red Oaks, the teachers kept a stock of spare items that the students could access temporarily, and it was quite common for students to be missing pencils or other items. Sometimes the Red Oaks teachers became annoyed because of the drain on their supplies, and stopped the students from borrowing their materials to encourage them to replace their own items. While student results are not always linked to socioeconomic status, the outcomes from the Years 3, 5 and 7 literacy and numeracy tests conducted in 2006 corresponded with the level of education achieved in the suburb (see Table 4-2). At Red Oaks, the school scored below the Queensland average in each year level for reading, writing and numeracy. At Greenwood, the school scored above the Queensland average for reading, writing and numeracy in the Year 3 and 5 tests, but the Year 7 results were below the Queensland average for numeracy, number and space. Finally, Pink Hill scored above the Queensland average in each year level for reading, writing and numeracy.

5.6.1 Summary of Socioeconomic Status Key Points from the Year 4 Data

The key points from the Socioeconomic Status analysis of the Year 4 data include:

- The student's presentation, access to consumables and the results of the Years 3, 5 and 7 literacy and numeracy tests reflected the socioeconomic background of the students and the school.
- The socioeconomic status of the school's location influenced the quality and reliability of the ICT resources and support at the school, but Red Oaks had made a significant investment in their SmartBoard classroom vision at the cost of other budget items.

5.7 Study and Career Choice

In this section, elements of Gottfredson's (2002) theory of Circumscription, Compromise and Self-Creation are used to help understand the process of career choice. The model comprises three main processes: the process of self-creation; the process of circumscription and the process of compromise. Elements of the self-creation process are generally discussed within Section 5.5. The process of compromise is not discussed in this chapter as "the principles of compromise apply to people just launching their adult life" (Gottfredson, 2002, p. 107). Year 4 is too early in students' development to consider the impact of compromise on their career choices. The process of circumscription starts in early childhood, and individual differences, in

terms of mental ability and maturity, at given ages mean that some children will reach each stage earlier or later than their peers.

5.7.1 Orientation to Size and Power

Between the ages of three to five, children categorise people by basic attributes, associate occupations as adult roles and stop wanting to fulfil fantasy roles. However, in the Year 4 classes studied, some students still reported wanting to be in fantasy roles. These students saw themselves in fantasy or idealistic careers in the future, and most of these occupations involved fame and wealth. The idealistic careers included being a Princess or Queen, being a famous singer, rock star, composer or actress. Other idealistic occupations were sporting in nature and included V8 Supercar driver, famous horse rider, gymnast, football player or swimming coach. These idealistic careers appeared to be based in part on their life experiences.

5.7.2 Orientation to Sex Roles

Associating sex roles with careers

Between the ages of six to eight, children begin thinking more concretely and begin to recognise sex roles, but focus on visual attributes such as activities and clothing. Vocational aspirations reflect what they feel is suitable to their sex, and they often feel that their sex is superior. For instance, the Red Oaks girl who said that she wanted to be a V8 Supercar driver faced an attack by one of the boys who told her in no uncertain terms that "*girls don't drive*". He appeared to have absorbed through his socialisation experiences and/or media reports that driving race cars was a male occupation. The students also compared their parents' ICT abilities to their own ICT abilities and used the results to decide whether girls or boys were more adept with computers.

Exclusion of occupations that do not fit with sex role

Gottfredson (2002) believes that at this stage children rule out occupations that are not perceived to be appropriate to their sex type, but the prestige of the occupation is not important. Throughout the study, the Year 4 students expressed interest in following similar occupational pathways as their parents or family members. Examples of this were seen both with the students and the teachers. For instance, the Pink Hill girls wanted to follow in their mothers' career area by becoming a paediatrician, model, flight attendant or childcare worker, and at the private schools, the teachers spoke of following parents into teaching careers. Other occupations that were popular with the female students at the schools included waitress, hairdresser, chef, teacher, nurse or veterinary nurse. Most of the girls expressed the desire to work in predominantly pink-collar or humanitarian occupations. None of the Year 4 boys showed any interest in these occupations, with the exception of teaching.

© 2007 Kaylene Clayton

Interest in male-dominated occupations

Conversely, girls expressed the desire to work in the same occupation as their father. One girl wanted to be a "*lawyer like Dad*" (Pink Hill student), while another wanted to manage a coffee shop like her father. Furthermore, some boys and girls nominated masculine occupations as their ideal career. Significantly, one Pink Hill girl identified that ICT is male dominated, but it did not deter her from saying "*I want to be one of the computer guys*". It is possible that this girl's father is the ICT professional who assisted the students in the computer laboratories, but this was unable to be confirmed. Another Year 4 girl said that she would like to work with computers in conjunction with other occupations. There were a number of male-dominated occupations mentioned, which seemed to have been influenced by family members or the media, including: butcher; army, FBI or police; scientist; specialist doctor; and sports star, such as jockey, race car driver, and cricket, soccer or football player. The Year 4 students also spoke about their interest in gender-neutral careers, including photographer, artist, actor, TV reporter, or simply working in an office.

5.7.3 Orientation to Social Valuation

The students in this study were at the cusp of the orientation to sex-role and orientation to social valuation stages of circumscription. Between the ages of nine and thirteen, children move on to become sensitive to social valuation by society and their peers, and they begin to reject lower status occupations. Evidence of the increase in sensitivity to social valuation was seen with the Pink Hill girls when they rejected some parents' occupations when they worked in low-status occupations. The girls at Pink Hill generally had good access to professional role models, and many said they had aspirations of working in an occupation that would make them wealthy. For instance, a Pink Hill girl said that she wanted to be a lawyer, as they are well remunerated. Conversely, two Greenwood girls said that they did not want to work in a restaurant or as a maid like their mothers, as they wanted to earn lots of money. Wealth and status also featured amongst the preferred attributes of occupations at the coeducational schools. Other Year 4 students were only concerned about earning a good salary and were non-specific about the occupation. For instance, one Pink Hill girl just said that she wanted to be "*famous and rich*". Only one Pink Hill girl identified that ICT was a high-paying occupation, while a Red Oaks girl believed that working in ICT made the person important.

5.7.4 Summary of Study and Career Choice Key Points from the Year 4 Data

The key points from the Study and Career Choice analysis of the Year 4 data, further discussed in Chapter Seven, include:

- Some of the students were still in the first stage of circumscription and saw themselves in fantasy or idealistic careers involving fame and wealth.
- Most of the students appeared to be in the second or third stage of circumscription, and some were beginning to develop an appreciation of the wealth and status associated with certain occupations.
- Most of the girls were interested in working in pink-collar or humanitarian occupations, but apart from teaching, none of the boys showed any interest in these occupations.
- Throughout the study, the students expressed interest in following similar occupational pathways as their parents or family members, but rejected occupations that they felt had low status or remuneration.

5.8 Conclusion

This chapter outlined the collective results from three representative Year 4 classes gathered from a government school, a coeducational private school and a single-sex female school in metropolitan Brisbane. The results from the analysis of interview data and observational data from these three Year 4 middle-school classes involved in the research are presented under subheadings as summaries of collated and analysed data. The key factors involved in the ICT experiences of these students and their teachers were identified and assigned to thematic categories to provide a collective understanding of the influence that these factors and experiences have on students' ICT career choices at the Year 4 level. Chapter 6 then presents a similar analysis of the Year 8 data.

The results revealed three main thematic categories: Social Factors, Structural Factors and Individual Differences. These occurred within the cultural context of the student, and Socioeconomic Status overlaid some of the sub-categories of the Social and Structural Factors. In particular, the influence of Social Factors, including family, peer group, media, role models and ICT and gender stereotypes, was found to be important. Parents were seen to role-model behaviour and reinforce gender and ICT stereotypes to their children. Teachers also role-modelled ICT behaviour to the students, and students acted as positive ICT role models to their parents, teachers and peers. Gender stereotypes were also observed in relation the students' intention to engage in careers seen to be masculine or feminine. Both boys and girls were enthusiastic and confident with ICT, and in some cases the girls were more technically savvy than the boys. The Year 4 students referred to ICT workers as geeks or nerds, and generally assumed the worker to be a male who wears thick glasses, and is tired from working long hours. These gender and ICT stereotypes appear to have been reproduced from images portrayed by family and the media.

© 2007 Kaylene Clayton

An exploration of the Structural Factors, including teacher, ICT access at school and at home, school type, technology resources and curriculum, yielded a number of key points. The background of the teachers and their interest in ICT can influence the implementation of ICT and the curriculum in their classroom. The Year 4 students had frequent access to ICT at school; however, the socioeconomic status of the school influenced the quality and type of ICT resources and assistance available. Most of the students had access to various forms of ICT outside of school, and these students were already reasonably ICT literate. Private schools had better access to individual ICT resources and support, and there was also a noticeable difference in the socioeconomic status of the students at the different schools. The reliability and quality of the ICT resources were linked to the students' perception of ICT, with students expressing frustration at hardware and software failures. Some inhibitors to using ICT in the classroom for teachers were the time required to create and deliver curriculum material, and the lack of appropriate and timely training for teachers in hardware and software.

The exploration of Individual Attributes involved identification of the students' personality and attitudes, goals and self-schemata, interpretations of experience and subjective task value. In general, the students were confidently and quickly able to replicate new ICT skills, and they frequently collaborated and problem-solved with their peers. They also demonstrated a strong sense of justice and fairness towards other students. The Year 4 students generally enjoyed using computers and referred to them as being fun and helpful for building skills. However, disappointment, frustration and aggression towards the computers were sometimes displayed by the students, more often the boys. The students unanimously agreed that they were frustrated by computer failures, slow computers and Internet speed. Furthermore, ICT was associated with achieving their short- and long-term goals, and they believed that it would be useful in the future when they are working or studying. The incentives for learning ICT skills included being able to help others, increasing their independence and efficiency and earning money. Personal interest in ICT was the motivation for teachers to learn new ICT skills, improve school ICT infrastructure and prepare ICT activities for their classroom.

© 2007 Kaylene Clayton

Chapter 6 Year 8 ICT Experiences

6.1 Introduction

Chapter Five presented an analysis of the Year 4 interview and observational data collected from the three school types in metropolitan Brisbane as described in Chapters One and Four. Similarly, the purpose of this chapter is to explore ICT experiences at the Year 8 level, identify key factors involved in these experiences, and understand the influence that these factors and experiences have on students' ICT career choices. The findings in this chapter were analysed using the thematic framework described in Section 4.5.5 and are organised through the use of the factors and sub-factors of the Model of Girls' ICT Study and Career Choices described in detail in Section 7.8. Rather than using the structure of the preliminary conceptual framework, I felt that using the structure of the new model would assist the reader in understanding the reasons why the resultant factors and relationships were important to the new model.

Section 6.2 explores the influence of the cultural context on ICT career choice factors, while Section 6.3 explores social factors that influence ICT career choice. These social factors include family, peer group, media, role models, gender stereotypes and ICT stereotypes. Section 6.4 explores structural factors including teacher, school and personal access, school type, ICT resources and curriculum. Section 6.5 explores and expands on how individual attributes influence ICT career choice, while Section 6.6 discusses the effect of socioeconomic status on the schools and the students. Section 6.7 further explores and expands on factors associated with career choice.

6.1.1 The Year 8 Schools and Participants

The government coeducational school caters to students coming from an extremely broad range of cultural and ethnic groups. It has a large special education unit supporting students with disabilities including intellectual impairments, autistic spectrum disorders and speech/language disorders. The secondary school has a strong vocational education focus with a nationally recognised work education program and is a school of excellence for Rugby League.

The female single-sex school boasts extensive facilities, including purpose-built art rooms, sports and music centres, swimming pool, golf driving range and tennis and netball complexes. The students have a wide choice of other cultural and sporting cocurricular and extracurricular activities, from beginner to elite levels. There is an underlying expectation that the students will

© 2007 Kaylene Clayton

progress into well-respected professional or semi-professional careers, rather than vocational education.

The private coeducational school's senior campus, which caters to Years 7 to 12, is located several kilometres away from the junior campus. It operates in partnership with the government school that it borders, and a new resource centre has been built in partnership with the adjoining government school. The school encourages both vocational and professional education. A summary of the key points about the school demographics is provided in Table 6-1 below.

	Government coeducational (Red Oaks)	**Private coeducational (Greenwood)**	**Female single-sex (Pink Hill)**
Established	1987	1995	1901
Student enrolment	1550	Over 1100 (Prep to Year 12)	Over 1100 (Prep to Year 12)
Facilities	Run down	Well maintained	Well maintained
School fees	Book or equipment levy	$5200 to $6950	$4844 to $9000
Percentage of students in special education classes	Secondary – 6.5%	Not disclosed	Not disclosed
Results of Year 3, 5 and 7 reading, writing and numeracy tests	Below QLD average in all years and skills	Year 3 and 5 above QLD average in all skills Year 7 below QLD average for numeracy	Above QLD average in all years and skills
Dress code	Not strict	Reasonably strict	Strict
Socioeconomic status of suburb	Low	Middle	Middle to high

Table 6-1 Summary of school demographics

For each Year 8 class, observations lasting one lesson block were collected during weekly classroom visits over a single school term (9 to 11 weeks), and interviews were usually conducted at the end of the term. Information about ICT artefacts in the classroom and school environments was collected such as type and availability of ICT resources and infrastructure. Semi-structured interviews with the consenting teachers and students in each school lasted for approximately thirty minutes each. Documents which provided information about curriculum, subject availability and subject selection options were also collected as they became available; for instance, the all-girl school ICT curriculum can be found in Appendix D. In this chapter, the term 'student' may refer to either a male or a female student, while 'boy' refers to a male Year 8 student and 'girl' refers to a female Year 8 student. Table 6-2 overleaf summarises the participants in this study and the number of interviews conducted at each school.

© 2007 Kaylene Clayton

School Type	Year Level	Teachers	Class/Students
Government coeducational (Red Oaks)	Year 8 (ages 12/13)	0 of 1 teachers interviewed **Mr Maroon**	20 students (8 boys and 12 girls) **Interviewed students** One interview with 4 students (girls)
Private coeducational (Greenwood)	Year 8 (ages 12/13)	1 of 1 teachers interviewed **Mrs Jade**	24 students (11 boys and 13 girls) **Interviewed students** One interview with 4 students (3 boys and 1 girl)
Female single-sex (Pink Hill)	Year 8 (ages 12/13)	1 of 1 teachers interviewed **Mr Rose**	19 students (girls) **Interviewed students** 2 interviews with 12 girls

Table 6-2 Summary of research participants

6.2 Cultural Context

Cultural background of the students

Due to the geographic proximity and collocation of the Year 4 schools to the Year 8 schools, the background of students and cultural composition of the classroom at the Year 8 schools was similar to that found in the Year 4 schools. A summary of the 2006 census Quickstats[18] for the suburbs of the school's location is provided below, in Table 6-3.

	Red Oaks	Greenwood	Pink Hill
Unemployment in school suburb	7.7%	3.5%	3.4%
Percentage of single-parent families	25%	16.2%	18.7%
Median weekly individual income for suburb	$437	$602	$520
Percentage of indigenous residents	3.9%	1.4%	1.6%
Percentage of foreign-born residents	31.6%	35.5%	21.4%
English as first language at home	79.9%	79%	92.6%

Table 6-3 Summary of school suburb demographics

Cultural background of the teachers

At all three school types, the Year 8 teachers and Red Oaks teacher-aide appeared to have a white Australian background, with English as their first language, and were older than 30 years of age. The Pink Hills teacher had a strong scientific/mathematical background and had taught at Red Oaks prior to coming to Pink Hills. He attended a regional Queensland school and held a Bachelor of Science. The Greenwood teacher had taught business studies and typing for many years and did the accounts and administration for her husband's business. The Red Oaks teacher

[18] Available from the Australian Bureau of Statistics – reference suppressed to protect the identity of the schools.

and teacher-aide belonged to the business department, and the male teacher fell into teaching the ICT subject because of school need. The teacher-aide appeared to be provided only to assist Aboriginal and Torres Strait Islander students, as they were asked to identify themselves to her at the beginning of the term.

6.3 Social Factors

6.3.1 Family

Parents' use of and capability with computers and technology

Observations of parents' use of and their perceived capability with ICT impacted on the ICT perceptions of students. The Year 8 students said that their parents were frequent users of ICT at work, but some of these students were unsure of how their parents actually used ICT at work. The Year 8 boys believed that their father was more skilled with computers than their mother, while the girls felt that their parents and family were proficient with ICT or good "*at everyday [ICT] things*" (Greenwood student). The Pink Hill girls felt that their mothers generally used computers for games and the Internet at home. However, they tended to talk more about their father's proficiency with ICT. For instance, one Pink Hill girl said "*my Dad fixes everything except Word; he is kind of wonderful*" (Pink Hill student). As with the Year 4 students, the Year 8 students measured their level of ICT abilities against their family and friends. For example, a Greenwood boy believed that all of his family members were more skilled with ICT than he was.

Encouragement in ICT by parents

The amount of parental encouragement to use ICT varied from school to school and between mothers and fathers. Some fathers provided practical encouragement by asking their daughters to assist them with administration tasks in the family business. For instance, a Pink Hill student felt that she had increased her ICT knowledge during her work in the family business. While the Pink Hill students generally felt that their parents encouraged them with computers, the Red Oaks girls felt that they had little encouragement from their parents. For instance, one Red Oaks girl said that her parents "*don't really care if I am good at computers*". Some of the parents also did not see the benefit of the Year 8 ICT subject. For instance, one Pink Hill student told how her mother believed that the ICT subject in Year 8 was easy and required little effort.

Transference of career values

Parents' perceptions and preconceived ideas about careers can be transferred to their children, and this can have a positive or negative influence on the students' career planning decisions. For

instance, one Pink Hill girl emphasised how her mother advised her not to follow her hairdressing career path because it was not a good environment, while another repeated the negative views that her mother had about an occupation. Observation of their parents' occupation can also influence the students' career decisions. For example, a Pink Hill student expressed a keen desire to follow her mother into law, as she observed that law is a lucrative occupation. However, most students did not want to work in the same occupations as their family, even though they could not explain what was involved. They generalised that the work was boring or they did not like the work environment. Furthermore, children judge the achievements of their parents, and this can be a problem if the child does not have the same level of ability as their parent. For instance, Mr Rose believed that children are afraid of being seen as a failure if they did not attain the same standard as their parents.

Career advice

The parents of the Year 8 students also offered career advice to their children. A number of students spoke about how their parents advised them that job satisfaction is very important and their career should reflect something they are good at and enjoy. According to the students, their parents also suggested occupations that were felt to be appropriate and worthwhile, such as being a pilot, an interpreter or a dentist. The Pink Hill students also felt that their parents would intervene if they did not approve of the career choices they were making. For instance, one Pink Hill student said that her mother was worried that she would follow her father in a business career path to gain his approval. The girl was confused because she was interested in business and wanted to enrol in a business studies course, but she worried about her mother's reaction. On the other hand, most of the Greenwood students believed that career choice was an individual decision and that their parents' career opinions were less important. For example, a Greenwood student said "*It's [your parents'] choice to have an input into your life because you're their kid, but if you don't want to do [that career], what's the point, because you are just going to fail it if you don't have the nerve for it*".

Sibling and extended family influence on ICT beliefs and career choice

The students also heard of the ICT experiences of their siblings and extended family, and interpreted these experiences in terms of themselves. For example, one Greenwood boy thought that web page development would be too difficult because of his brother's experiences, while a Red Oaks girl had seen what her sister did at work and would also like work in that area because she believed it to be easy. Extended family can also influence the students' career beliefs. Both boys and girls mentioned the ICT influence of an uncle. For instance, one Greenwood boy saw his uncle as a computer role model, while a Pink Hill student spoke about an uncle who taught ICT subjects and "*does fun things*". Grandparents can also have an influence on the student's

© 2007 Kaylene Clayton

career choices. For example, one Greenwood boy would like do the same type of work that his grandfather did, while a Red Oaks girl said that her grandmother wanted her to be a teacher.

6.3.2 Peer Group

Peer influence on ICT perceptions

Along with family, peer groups play a role in the socialisation of students and can influence their perceptions of ICT. One group of Greenwood boys in particular seemed very interested in ICT and spent a reasonable amount of time discussing how to do more complex tasks not covered in the Computer Studies curriculum. They also shared a sense of accomplishment when they found new ways of doing things. For example, one of the Greenwood boys turned to the boy sitting beside him and announced, "*I have found a cheat way of doing that*". A boy sitting in front turned around and excitedly said, "*I want to see that!*" During the classroom visits, some Year 8 boys were observed being scornful of another student's work and were reprimanded by the teacher when observed. For instance, a Greenwood boy who had finished his work was admonished by the teacher because he was deriding the work of the boy sitting beside him who was having problems. The Year 8 girls were not observed being contemptuous of other students' work, and the Pink Hill girls praised their peers who did well.

Collaboration of peers and sharing of knowledge

When the Year 8 students were working with ICT, they were frequently observed collaborating with their peers. For instance, when the Greenwood students were asked to perform an action in *Excel* that they had not done before, the students turned to their neighbours to work out how to do it, without being told by the teacher. One girl knew how to do the task and shared the information with those sitting around her, and eventually with others around the room. The teachers at Pink Hill and Greenwood encouraged this collaborative relationship and urged the students to help their peers who were having problems.

Collaboration was facilitated at Pink Hill and Greenwood as the students had the freedom to choose their seating arrangements and move around the room during class time. However at Red Oaks, the students were usually assigned to seats and were not allowed to move around during the class. Collaboration was more restrained and only occurred between neighbouring students. Furthermore, when the coeducational school students were given the opportunity, they tended to sit in same-sex groups and only deviated from this when directed to by the teacher. Furthermore, when allowed the freedom to complete their work as they chose, boys at the coeducational schools tended to work independently, while girls were more inclined to collaborate on their work, share solutions and solve problems.

© 2007 Kaylene Clayton

Peer interactions enabled by ICT applications

The students commonly used ICT as a means of communication with their peers. In particular, the Year 8 students frequently talked about using *MSN Messenger* to communicate with their friends and classmates. They appreciated that it was a synchronous method of communication and preferred to use this rather than the telephone because it was free. Students also liked to play computer games as a leisure activity, and these games encouraged communication between the boys. For instance, when the Greenwood students were given 'free time' in the ICT classroom, the boys accessed online games. While they were not multiplayer games, the boys collaborated about strategies and watched each other play the game. Finally, Mr Rose believed that the students faced a great deal of peer pressure to have the newest and best technology 'toy'.

6.3.3 Media

Computer games and the Internet

Throughout the interviews and classroom observations, it became apparent that the media had an impact on the Year 8 students, especially through computer games and the Internet. Playing computer games and using the Internet were seen as fun, leisure activities and were not usually associated with schoolwork by the students. Furthermore, the Year 8 students frequently spoke about watching their parents play computer games and use the Internet at home for leisure. The Red Oaks students were not easily able to access the Internet when they had free time, unlike the Greenwood students who were able to play online games and access *Google Earth*. Furthermore, when the students accessed online games at school, the boys had a propensity to choose action games, such as motorbike racing, while girls tended to play puzzle games.

One of the first ICT experiences that students remembered involved playing computer games. For example, the Pink Hill girls enthusiastically remembered playing games based on television shows, movies and books such as *Rug Rats*[19], *The Lion King*[20] and *Blinky Bill*[21]. Incidentally, none of these games provide a strong female role model as all of the primary characters in these computer games are male, with female characters playing secondary roles. The Red Oaks girls also enjoyed playing online games and *The SIMS* for escapism, because you "*can leave everyday life behind and have things you can't have in your normal life*". In *The Sims*, the player creates or chooses a pre-made virtual character and controls all of the aspects of his or her life in an interactive, virtual world. As with the Year 4 students (see Section 5.3.3), the favourite game for both genders at Greenwood was also *The SIMS*. The Pink Hill students also enjoyed playing

[19] http://www.rugratonline.com/rrgames3.htm
[20] http://www.lionking.org/games/
[21] http://www.forestinteractive.com.au/forest/pages/CDRomContent.html

The SIMS and online games at home, and educational games with their friends during lunch breaks.

6.3.4 Role Models

Parents and family as role models

The main influencers of the Year 8 students were their parents, family, teachers and peers. They spoke about family, including mothers, sisters and uncles, who acted as positive ICT and career role models. For instance, at Pink Hill, a number of the mothers had returned to study. This provided a positive role model and showed them that they could change careers or update their skills as an adult. Furthermore, one Red Oaks girl also observed the attitudes and career values and role of her sister and wanted to work in a similar occupation. Uncles were also seen to be ICT role models by two students. For instance, a Pink Hill girl's uncle was an ICT teacher, while a Greenwood student had an uncle who was believed to be very skilled with ICT. Another Greenwood boy specifically referred to his uncle as his ICT role model and, as a consequence, the boy was very enthusiastic about ICT and wanted an ICT career.

Teachers as role models

The Year 8 students observed the differing levels of ICT confidence, ability and interest of the teachers at their schools. Teachers who were perceived to have low ICT confidence and skills were not highly regarded and were often mocked in private by the students. Conversely, confident and skilled teachers were respected by the students. Furthermore, Mr Rose believed that a confident teacher led to engaged students, and he applied his standpoint to his practice. He also provided his students with a positive ICT role model, as he was not afraid to tinker or make mistakes when using ICT. He loved technology and displayed an attitude that it was fun to learn. He also made light of any technical problems and told the Pink Hill students "*we will have some fun and learn from our mistakes*". The Pink Hill girls responded to this positive attitude. Of the three schools, the Pink Hill students generally displayed the most enthusiastic behaviour towards ICT. Mr Rose was also the only Year 8 teacher to identify a personal ICT role model (a male teaching colleague).

Peers as role models

The students were also observed acting as ICT role models to their peers. For instance, a Pink Hill girl declared to her classmates that robotics was fun and spoke enthusiastically about the robotics that her uncle was involved with. The Pink Hill students showed more than polite interest and asked many questions about her uncle's work. Furthermore, another Pink Hill girl was impressed by the programming ability of a male friend. The Year 8 students were also

© 2007 Kaylene Clayton

heard using stereotypical ICT terms to describe peers. For instance, Pink Hill students referred to male peers (at a nearby school) as "*super nerds*" in a complimentary, rather than derogatory, manner. They admired that these boys were able to do complex things with computers and bypass teacher controls. Moreover, enthusiasm and ICT knowledge were highly regarded by peers. For instance, the Pink Hill students admired peers who accomplished difficult tasks and helped others to solve ICT problems. A boy and a girl from Greenwood, both with advanced ICT skills, were enthusiastic ICT users and respected for their freely offered assistance. By being enthusiastic and knowledgeable, these students modelled positive attitudes and values to their peers.

6.3.5 Gender Stereotypes and Differences

Gender differences in the use of ICT

Generally, the girls tried to focus on and complete their work and did not like the disruptions of their male peers. For instance, one of the Greenwood girls turned around to a boy who kept interrupting her work, said "*shh*" and waved her hands in a shooing motion at him. At Red Oaks, the boys were more disruptive than the girls, and a fair amount of Mr Maroon's time was lost disciplining the boys. Furthermore, the Year 8 boys were often disengaged and tinkered with applications not required for the task, unlike the girls. For example, several boys at Red Oaks were observed playing with "*Clippie*", the *Microsoft Office* help avatar, as a diversion from their task. At Greenwood, the boys also explored the computer, and one of the boys was given immediate attention by his peers when he announced: "*I have found a cheat's way of doing this*". Another Greenwood boy also amused himself by making 'car noises' when printing out his work, and another made exploding noises when moving text boxes around in a document, much to the amusement of the other boys.

Gender differences in the ICT classroom

The Year 8 students tended to sit in same-sex and friendship groups, unless directed by the teacher. This was most obvious at Red Oaks, where the students would separate into distinct groups on entry to the computer laboratory. The girls sat on the far side of the room, while the boys chose the side closest to the door. The Red Oaks students would only sit in mixed-sex groups when there were no seats left in their preferred side or the teacher directed them to sit alternately girl/boy. At Greenwood, the students also tended to sit with their same-sex peers, but boys frequently moved around the room to talk to other students or help their peers. The Greenwood girls were not as mobile and tended to stay at the same work area while they finished their work.

© 2007 Kaylene Clayton

The Year 8 boys also said that they preferred to work individually. However, one Red Oaks boy volunteered to share with another boy and give his computer to a girl when there were not enough working computers for individual use. The boys also tended to be less inhibited when exploring the computer and attempting new work; they did not seem to be afraid to make mistakes or test limits. Furthermore, one Pink Hill girl reported that, in her experience, boys tended to take over the computer when they were fixing it, did not explain what they were doing and pretended to be knowledgeable. She believed boys frequently tinkered with the computer without knowing what they were doing, and this could cause more harm. It is unclear where this belief was developed as she attended a female single-sex school. It is possible that she had observed this at home or at a coeducational primary school. However, a number of the students felt that it was difficult to explain to someone how to solve a computer problem, and that they preferred to help in a hands-on manner.

Expectations of ability, confidence and interest

The Year 8 teachers believed that there was no real gender difference in ability, but there were differences in the way that boys and girls completed their work. For instance, Mrs Jade believed that boys completed their work in a rush and then returned to fix the mistakes, while girls completed the work first and then decorated it. For instance, during an Excel exercise, the Greenwood boys simply transcribed plain text into their spreadsheet and appeared to be genuinely surprised when the formatting was pointed out to them. Generally, the girls transcribed the text with most, if not all, of the formatting. Furthermore, male domination of the ICT classroom was not seen in this study. Mr Rose also believed that attitudes were changing; girls could now dominate just as much as the boys and their attitudes were becoming "*can do*." Contrary to his opinion, the Pink Hill girls tried to hide their ability and knowledge from their friends.

Student perception of gender differences in ICT ability

Like the teachers, the students generally felt that there was no real difference between the ICT abilities of boys and girls. However, the students who did believe that there was a difference felt that their gender was superior. For example, the Pink Hill girls believed that boys were "*bigger geeks*" than girls, but girls were better at using the computer. However, a Red Oaks boy believed that boys had more ICT ability than girls. This was based on his experiences with his brother and his friends, who were knowledgeable about computers. Other students thought that there were no real gender differences in ICT skills and ability, but just depended on whether they were interested enough in learning how to do ICT things.

© 2007 Kaylene Clayton

Reinforcement of gender stereotypes

The teachers were heard expressing a number of common gender stereotypes. For instance, Mrs Jade said that "*girls are more loving*" and more interested in friendship than the boys. Mr Rose had similar opinions, and said that girls were "*chitty chatty*" and more affectionate than boys. He had seen how girls would hug their friends before separating to go to different classes and when they regrouped after those classes. During the observations this was confirmed, as the girls were observed demonstrating more overt caring behaviour towards their peers than the boys. For example, when a Pink Hill girl said that she felt left out because nobody sent her text messages or called her mobile phone, another girl immediately offered to text her to make her feel better. There also appeared to be subtle differences in the way that Mrs Jade acted towards the boys and girls in her class. For example, when a boy was experiencing problems with an application, she said, "*what virus did you bring with you?*", which made the boy and his friends laugh. However, she did not seem to make comparable comments to the girls when they had similar problems. Finally, Mr Rose believed that the stereotype that girls can multitask was incorrect.

6.3.6 ICT Stereotypes

Stereotypical descriptions of ICT professionals

There are many stereotypical images associated with the ICT field and workers, many of which are products of the media. For example, the students believed that ICT workers were unattractive, male, intelligent, 'square-eyed', wore glasses and had pens in their pockets. In particular, the students associated the wearing of glasses with ICT professionals. However, the Pink Hill students clarified their comments about wearing glasses. They said that wearing glasses was not bad; it is just that 'computer nerds' wore unfashionable ones, as appearance was not important to them. Another student also described her cousin who made computer games as a 'nerd'.

Although most of the students used unappealing terminology to describe ICT professionals, some described ICT professionals as being everyday people. The students seemed to base these descriptions on their experiences of people working in the ICT field, but they appeared to seize upon extreme examples, rather than the average. For example, while Pink Hill employs a number of ICT technicians, one student commented only about one of them, saying, "*the computer technician here… looks like a real nerd and wears glasses*". Furthermore, while the students did not at first associate women with working in the ICT field, when prompted they described female ICT professionals as being intelligent and beautiful, and dressed in business attire, high heels and perfect makeup.

© 2007 Kaylene Clayton

Stereotypical reasons for ICT career decisions

The students mentioned various ICT stereotypes when discussing why people do or do not want to work in the ICT field. For instance, the Pink Hill students believed that ICT jobs were solitary occupations for individuals who used "*sophisticated languages*", while another Pink Hill girl said that working in the ICT field meant working for long hours in a sedentary occupation. A number of the students also felt that working in ICT led to an unhealthy lifestyle. For instance, a Greenwood student described one of his father's ICT team as being young, unattractive and unhealthy because he smoked. However, the students felt that the main factor that discouraged people from working with computers was the frustrations caused by the unreliability of hardware and software and ICT failures. The students felt that people would want to work in the ICT area for a number of reasons including: computers were their hobby or they had a penchant for ICT; they were proficient or talented with ICT; and ICT skills were useful.

Replication of common ICT stereotypes

When the students were asked about job roles in ICT, many of their descriptions were based on their own experiences that they had seen and heard about the ICT things that their family, or other people known to the family, did in their work. The students identified that ICT staff worked with firewalls and networks, repaired or improved the performance of computers, created computer games or did web design. They identified the use of ICT in other professional areas such as photography, teaching and advertising. For instance, one Pink Hill student cited a family friend who used computers in advertising and said, "*he's like really rich now*". ICT work was also believed to have negative effects on the home and social lives of people. For instance, a boy related the experiences of his brother who, he said, avoided owning a laptop or mobile phone so that he did not have to work from home after hours. There was also a strong association between keyboarding and ICT work, and this was reinforced by the teachers. For instance, in the Computer Studies class, Mr Maroon stressed the importance of speed and accuracy in keyboarding exercises, and told the students "*we are rehearsing work*".

6.3.7 Summary of Social Factor Key Points from the Year 8 Data

The key points from the Social Factor analysis of the Year 8 data, further discussed in Chapter Seven, include:

- Family, teachers and peers demonstrating ICT confidence and skills were respected by the students and the students responded with increased interest in ICT.
- The students thought that their mothers had less ICT ability than their fathers.

© 2007 Kaylene Clayton

- Most of the students believed that their parents' career advice was important, but that this advice could be biased by the parents' perceptions and preconceived ideas.
- The students worked cooperatively, shared ICT resources fairly and collaborated to solve ICT problems, but classroom layout and teacher-imposed restrictions impacted on in-class collaboration and the sharing of knowledge amongst peers.
- The boys tended to work independently and could be contemptuous of other students' work, while girls were more inclined to collaborate and offer constructive criticism.
- The students tended to sit and work in same-sex groups in the classroom unless directed otherwise by the teacher.
- The students frequently used Internet-enabled communication such as *MSN Messenger* and computer games to interact with their peers and as a form of escapism.
- The students were believed to face a great deal of peer pressure to have the newest and best technology 'toy'.
- The teachers and students generally believed that there was no gender difference in ICT ability, but that there were differences in their willingness to make mistakes and test limits.
- The girls tended to focus on their task and did not explore the computer, while the boys tended to be disengaged and disruptive and tinkered with the computer.
- Peers with high levels of ICT skill and ability were referred to in stereotypical terms used in a positive manner to show their admiration.
- The students believed that ICT workers were intelligent, unattractive males, and ICT work was perceived to be a sedentary and unhealthy occupation.
- While the students did not initially associate women with working in the ICT field, when prompted, they described the women as being attractive and intelligent.
- The stereotypical images of ICT workers and work appeared to be a product of the media and extreme examples of the students' (or students' family) experiences.
- The teachers reinforced a strong association between keyboarding and ICT work.

6.4 Structural Factors

6.4.1 Teacher

Teacher background

The Year 8 teachers came from a variety of teaching backgrounds. For instance, Mrs Jade, the Greenwood Computer Studies teacher, said that she had been teaching typing/keyboarding and business topics for 32 years at secondary schools. Approximately the last eight years of her

career had been spent at Greenwood. She did not agree with the school's decision to withdraw keyboarding from the curriculum in the following year and she was not interested in the school's ICT vision. She stated that she was an "*old fashioned*" teacher and appeared to be marking time until she was able to retire.

The Red Oaks Computer Studies teacher, Mr Maroon, was a mature-aged English, Business Education and Social Studies teacher. He was an experienced teacher who had been teaching at Red Oaks for five years. He did not teach the Computer Studies course by choice, but had been assigned to teach this subject by the school. It was felt that, because he "*could touch-type and had some ICT in-service training*", this would be sufficient to deliver the subject. However, he identified that it was not an optimal situation when he said, "*my main problem is that I am not a trained Computer Studies teacher; I am just conversant in Word*". In the classroom, he appeared to just deliver a standard, unembellished lesson plan, but he was open to new ideas.

In contrast, Mr Rose, the Pink Hill mathematics teacher in his thirties, held a Bachelors degree in Science majoring in Mathematics, Chemistry and Computer Science. He entered teaching after completing a graduate diploma of teaching because of the job prospects and his love of science and mathematics. He had completed a number of university level computer science subjects and had used computers since his secondary education in a regional Queensland school. Prior to his recent move to teach at Pink Hill, he had taught mathematics at Red Oaks. He worked from 7am to 5pm at Pink Hill and continued to research work and prepare teaching material after hours and during the school holidays. Mr Rose was highly skilled with ICT and was a positive and confident role model to the students and other teachers.

Implementation of ICT in the classroom

The teachers had mixed views about implementing ICT in the classroom. For instance, the coeducational school teachers were generally unenthusiastic about teaching ICT to the students, while Mr Rose embraced it. In particular, Mrs Jade did not enjoy using computers and reiterated that the computer was a tool and not a toy. She viewed ICT as analogous to using applications and keyboarding. Her students were initially enthusiastic about learning new skills, but this quickly waned as learning stagnated. Mr Maroon also believed that ICT was a tool, and stated that "*I am not here to entertain the students. They can be entertained anywhere. I am here to teach them*". He seemed to teach to the lowest level and consequently assumed that the students would have difficulty learning ICT skills. For instance, he told the students "*You are learning something new and when you are learning something new you sometimes get confused*". The students responded by rolling their eyes. Conversely, Mr Rose liked to tinker and try new things, and his enthusiasm carried through to the upbeat atmosphere in his classroom. He

© 2007 Kaylene Clayton

believed that the way ICT was used in the classroom was more important than how new the ICT resources were and their availability. He also believed that "*teachers need to be comfortable with it [ICT] as well. If they are comfortable they will use it all of the time. If they are uncomfortable … They won't want to use it*".

Teachers' response to change

Teachers are expected to change and implement new technologies in their teaching practices, but they need the motivation and desire to change their practice and adopt the new technology. It is not enough to order teachers to change; it is important that the teachers embrace change. Some teachers resist change and do not want to change teaching techniques and lesson plans which have worked in their classrooms in previous years. For example, Mrs Jade admitted that she did not like change and this was reflected in her teaching practice. She relied on resources and tactics that she had used in the past and did not want to go outside of well-established boundaries. She believed that the students were teaching themselves tricks and coping mechanisms for ICT, but she also appeared to be trying to force the students to fit within her established methods and beliefs.

Mutual collaboration between teachers and students

The teachers acknowledged and generally encouraged collaborative learning between students and the teacher. For instance, a mutual learning environment was observed at Greenwood when Mrs Jade said to the students: "*we will be helping each other out because I have to relearn this program each year for this term*". Mr Rose also placed a strong emphasis on participatory learning and promoted a mutual learning environment in the classroom. He acknowledged that his students may at times know more than he does and he used the girls to problem-solve and assist other students.

Influence on student perceptions and attitudes towards ICT

Teachers can have a strong influence on students' perceptions and attitudes towards ICT. Furthermore, Mr Rose believed that the teacher's confidence in implementing ICT led to engaged students. In the classroom, he actively encouraged his students, and his demonstrated philosophy of having fun and learning from mistakes helped to demystify ICT. His students were generally enthusiastic about ICT and there was an air of excitement when ICT was being implemented in his classes. Moreover, Mrs Jade and Mr Rose seemed to be more trusting of the students in their use of the ICT resources, and the students generally responded to this trust by being respectful of the equipment and did not waste the resources. Furthermore, teachers who were not seen as being skilled or confident with ICT lacked student respect. For instance, the

© 2007 Kaylene Clayton

Greenwood students mocked one of their female teachers, as she was not skilled or confident with ICT.

Conversely, the underlying atmosphere in the Red Oaks computer laboratory was of distrust of the students, and the teacher was observed alienating students and discouraging their ICT interest. For instance, during the first lesson, Mr Maroon asked the students to identify parts of the computer. One Red Oaks boy supplied the correct answer to the question, but was corrected by Mr Maroon who then went on to tell the students the incorrect answer. Following his censure, the student lost interest in the lesson, became disruptive and was eventually sent to the office. Mr Maroon also made a point of identifying the students who had technical skills. The two boys who hesitantly responded when Mr Maroon asked the class about who knew how to fix computers were told: "*I will have to watch you. You are not allowed to change any settings*". After being told this, the boys' raised hands collapsed to the desk and they appeared to shrink in their seats. Furthermore, the students in Mr Maroon's class were not allowed to sit down or touch the computers until directed to. He then instructed the students to log in to the computer "*without destroying the hardware*".

Time constraints

Time constraints impact on a teacher's efficacy in teaching ICT, and the teacher has to be willing to devote a considerable part of her or his own time for preparation of ICT lesson plans and research. As well as their class contact time, teachers often spend many hours outside of the classroom preparing lesson plans and resources and marking student work. Unlike subjects where the subject knowledge is relatively well established, ICT lesson plans often cannot be used continually over many years because of changes in technology. ICT lessons can also take more time to create than in more traditional and stable subjects like mathematics and English. Parts of the ICT lessons may require research into the technology and investigation of how to use applications, and they need to contain alternative plans in case the technology fails. Mr Rose added that there was a lack of time to tinker and learn new things and that manuals were often unhelpful.

In-service training

There were differences in the amount and quality of in-service ICT training that the teachers received. For instance, Mrs Jade had not had any recent ICT in-service training. Furthermore, she indicated that she was not interested in undergoing training, as she was content with her current skills and said that she did not have the time. Conversely, Mr Rose delivered in-service training for his colleagues at Pink Hill, and believed that in-service training and the sharing of knowledge between teachers were important. Mr Rose had also experienced differences in in-

© 2007 Kaylene Clayton

service philosophies between the private and government school systems. He said Pink Hill provided good levels of in-service training, and had a push philosophy for in-service training, while the government system operated on a pull philosophy where "*you have to want to do it*". Mr Rose identified the three inhibitors to training in the government system as: after hours scheduling, the cost of the course and the lack of funding. He also wanted formal recognition of the time that teachers spent during their "*holidays*" on curriculum preparation and training.

6.4.2 School ICT Access

Level and type of ICT access at school

Each school had different ICT configurations and resources for student and teacher access. For instance, Red Oaks had several computer laboratories, each with approximately 25 ageing computers, and a number of pods of 5, 10 or 15 computers located throughout the school. Many of the Red Oaks computers suffered from technical issues, which decreased the number of usable computers.

The Greenwood students had access to 26 reasonably modern and maintained computers with CRT monitors in their computer laboratory. Moreover, the Greenwood secondary campus was rapidly expanding and new computer laboratories were being commissioned. Due to the expansion, technical support was being stretched and the older, general-purpose laboratories, including the one in this study, were regarded as low priority.

The Pink Hill students had access to a computer laboratory as well as 16 laptop computers that could be brought into the classroom. However, the safe transport to and from class and the secure storage of the laptops was a problem for the teacher. While the classroom in this study did not have a fixed data projector, a roll out of data projectors and surround-sound speakers into each classroom was under way. Each Pink Hill student had, as a trial, a programmable calculator that was able to connect to Mr Rose's programmable calculator and laptop computer via a wireless network. He often demonstrated actions on the calculator via an overhead projector, his laptop and software tools. Mr Rose believed that the level of ICT resources available was sufficient; but he conceded that, if there were more resources available, they would be used.

Disadvantages of computer laboratories

Problems with the layout of the computer laboratories were observed at each school. At each school, the computer laboratory layout was such that computers were lined up along benches that ran around the perimeter of the room or projected into the room from the wall. These

computer laboratory layouts did not support group work or when students had other resources, such as books. For example, the Greenwood students used the keyboard and the monitor to prop up the book that they were transcribing from to create more space. Furthermore, when the Red Oaks students worked in groups, both chairs had to be angled to allow students to fit into the bench space and caused the typing student to contort. Mr Rose agreed that the layout of computer laboratories needed to be revised, as more space was needed when his students used books and their calculators with the computers. Laptop computers may solve the problem by allowing general classrooms and various desk configurations to be used.

Provision of ICT resources to early-secondary students

The computers and applications that the Year 8 students at the coeducational schools had access to did not seem to be high priority for the schools. For instance, Mrs Jade said, "*Year 8 is not when we are serious about the powerful stuff. I am the starting point of their journey … I am happy with it and I think most of the students are too*". However, the students did not appear to be entirely happy, as boredom, frustration and disengagement were observed in the classroom. Furthermore, considering that this is the beginning of students' secondary school journey, the experiences and interpretations that the students make about these experiences can affect their future subject choices and career directions. As such, the teacher also may be the end point in the student's journey, as the student may choose other career paths because of negative experiences in the Computer Studies classroom. Moreover, it is not clear how the students can understand the possibilities that specialist computer classes hold when they have not been exposed to them.

Reliability and quality of school ICT resources

Technical problems, which prevented access to resources, occurred at all of the schools. However, the differentiating feature was the timeframe for rectification. For instance, at Red Oaks, computers remained unusable for weeks at a time, and at one stage 25% of the laboratory computers were inoperative. Mr Maroon reinforced his negative attitude to computers to the students when he told them: "*don't get frustrated if you are having technical problems; it happens all of the time with computers. You have to figure out how to fix it or get someone to fix it*". Ironically, Mr Maroon had also told the students that they were not allowed to tamper with the computer. The technical problems experienced at Red Oaks were compounded by the lack of technical support, lack of respect for the computers and vandalism.

There were far fewer computer problems at Greenwood and Pink Hill, and these were usually rectified within a short time. Mr Rose also asked the Pink Hill girls to help him troubleshoot any problems with the wireless network for the calculator and demonstrated a mutual learning

© 2007 Kaylene Clayton

environment. However, problems with the laboratory printer at Greenwood caused minor inconvenience in the classroom for several weeks. Furthermore, there was no obvious evidence of vandalism of the ICT resources at Greenwood and Pink Hill. Mrs Jade added that a sense of ownership of the resources by the students caused the students to have a deeper respect of the resources in specialist computer laboratories (such as CAD computers).

Access to the school network and the Internet

The students at each of the schools had access to the school network and the Internet, but the quality and speed of access differed. The private school students knew their passwords to access the resources and did not experience access issues. However, at Red Oaks there were a number of school network and Internet access problems because of password problems and non-payment of the school levy. While Mr Maroon had a generic login that the students could use if necessary, he was not willing to share it with the students. Furthermore, the lack of network storage restricted the type of resources that could be accessed by the students, and the speed of network access frustrated the students. Concurrent access to a relatively simple website was not possible in the Red Oaks class because of inadequate Internet bandwidth. The Red Oaks students also had problems completing their work because of excessive and sometimes inappropriate Internet filtering. The students and teachers at Greenwood and Pink Hill did not have problems with the quality and speed of Internet or school network access. However, the Pink Hill students complained about the speed of the wireless network that was being trialled for their programmable calculators.

Use of the school email system

The students at each school had a school email account. In Education Queensland schools, all students have an account created when they enter the system, and they are able to use the same account when they transfer schools, including from primary school to secondary school. However, many of the Red Oaks students were unaware that they had an email account and email was not used during the Computer Studies class. Conversely, the Pink Hill students were confident email users, and email was used as a communication method between the students, teachers, parents and administration. In particular, the teachers at Pink Hill were able to email work home to the students and communicate directly with the students' parents, and vice versa. The Greenwood students were also competent email users, but Mrs Jade did not think that it was necessary for the students to have email access, or to be taught to use it at school. However, the usefulness of school email accounts was demonstrated when the students emailed unfinished work home to be completed and when the printer in the computer laboratory failed.

© 2007 Kaylene Clayton

6.4.3 Home ICT Access

Accessibility of ICT at home

Young people tend to be comfortable and confident with ICT because of the accessibility and pervasiveness of ICT at home and throughout their everyday lives. For instance, the Australian Bureau of Statistics (ABS, 2007) reported that in 2006–07, 73% of Australian households had access to a home computer and 64% had home Internet access. This had increased by 3% and 4% respectively since 2005–06. However, while there are many technologies and applications that students can access, the affordability of the item affects their uptake, especially in homes with a low disposable income. Furthermore, Mr Rose believed that even parents of students at the private schools had problems with their children wanting to have the latest technology "*toy*" because of peer pressure.

Types and availability of home ICT resources

Most of the interviewed students had at least shared access to computers at home. These computers were usually located in a shared access room, such as the study or lounge room, and a few were located in a bedroom. The Greenwood students who were interviewed had their own home computers and most had broadband Internet connectivity. Two of these students had purchased the computer themselves out of their savings. Furthermore, while the Greenwood boys were conversant with Internet terminology, the girls were not as familiar and appeared confused about what the boys were discussing. At Red Oaks, most of the students interviewed shared computer access with their family, and only one student had home Internet access.

Several of the Pink Hill girls had their own home computer and did not have to share it with family. For example, one girl purchased her computer out of her savings while another received it as a Christmas gift. However, Mr Rose believed that many of the Pink Hill girls shared their home computers (some without Internet connectivity) and had to compete for ICT resources with their siblings and parents. The Pink Hill students backed Mr Rose's comment and spoke about sharing computer access with their mothers and siblings. However, none of the girls mentioned having to share computer access with their father.

Early ICT access

The students reported that their first computer access happened between the ages of 3 and 8 and their first experiences usually involved playing games. Their use had evolved, and they now used their home computer for Internet banking and to surf the Internet, play online and computer games, download music and communicate with their friends. The students were early adopters of *MSN Messenger*, with some students having used the application since Year 2. They

© 2007 Kaylene Clayton

appreciated that they could use it like a phone, but without the associated call costs. A Red Oaks boy also felt that *MSN Messenger* had helped his keyboarding skills as "*you have to learn to type fast, otherwise you get lost*".

While *MSN Messenger* was one of the most common applications used by students, mobile phones were also popular. Many of the students had their own mobile phone; these had frequently been passed on to them by a family member after the purchase of a new model. The students recognised the expense of using mobile phones, and most had prepaid cards to help moderate their use. However, the mobile phones were not only used to make calls, the students also made use of the multimedia capabilities of the newer mobile phones. Quite a few students at Red Oaks also spoke about access to gaming platforms such as Xbox, Playstation or Wii, with more boys than girls using these to play games.

6.4.4 School Type

Differences between school types

There can be significant differences in the quality of teaching and types of skills taught between schools because of differences in the values and priorities of the schools, individual teacher qualities and teacher education and financial support provided by parents and the government. Prestigious government schools and private schools are able to attract high calibre teachers because of an established culture of success and benefits to the teacher's career, and private schools are not limited to the set salary structure of government employees. Private schools can also be attractive because of fewer students with behaviour problems (students not conforming to private school expectations are asked to leave), the perception of better working conditions and availability of teaching resources. Mr Rose, who had previously taught at Red Oaks, confirmed that the quality of teaching is often better in private schools.

There can be vast differences in the budgets of government and private schools, which can affect the quality and quantity of available resources. Government schools, such as Red Oaks, receive government funding and work with a very restricted budget supplemented by fundraising and a very modest contribution from parents. Privately run schools such as Greenwood and Pink Hills receive government funding and at times considerable fees paid by parents. Finally, the individual nature of each class, class members and teacher means that there will always be differences in the way that the curriculum material is delivered and understood.

© 2007 Kaylene Clayton

Differences in student aptitude and behaviour

Even within schools there can be vast differences in the composition of a class and the way that the curriculum is delivered. For instance, the Year 8 teachers had to deal with a wide variety of skills and abilities, more so than the primary school teachers or in the more senior years of secondary school. This was caused by the students entering the secondary school from a wide variety of feeder schools with differing values and priorities and teaching outcomes. For instance, many of the Pink Hill girls were continuing Pink Hill students, and they appeared to have a more advanced and homogenous ICT skill set than their coeducational school peers.

There were differences in the culture and expected behaviour of the students at each school. For instance, the Greenwood and Pink Hill students were always well groomed and smartly dressed, while a number of the Red Oaks students attended school dressed in an unkempt and sloppy manner. There were also differences in the manners and general behaviour of the students between the schools. At the private schools, the students were well mannered and respectful of others and property, while at Red Oaks many students were sometimes rude and disrespectful of their peers and the teacher. For instance at Greenwood, the students waited for adults to enter the room and then entered the room in an orderly manner, while at Red Oaks, the students often jostled and pushed past their teachers and each other when entering the room.

Gender and school type

There was some evidence that the gender splitting of schools and classes at the Year 8 level may be beneficial to both the students and teachers. Although the Pink Hill students belonged to a mainstream class, they seemed to be more advanced and confident in their ICT skills than their peers at the coeducational schools. This could be partly because of similarities in their educational background, but the cooperative and collaborative classroom environment and lack of disruptive behaviour could also contribute. The private school teachers also believed that gender splitting of classes may be beneficial for the student and the teacher. For example, Mr Rose believed that gender-splitting classes can help, as the teacher can tailor specific materials and tasks to the girls' and the boys' groups. At the coeducational schools, the students instigated a form of gender splitting of classes when they chose to sit in same-sex groups. For instance, at Greenwood and Red Oaks, the students would sit in same-sex groups wherever possible in the computer laboratories.

© 2007 Kaylene Clayton

6.4.5 ICT Related Resources

Types of hardware provided in schools

As seen in Section 6.4.2, the students at each of the schools had access to computers, printers and at times data projectors in computer laboratories. At Pink Hill, the students were supplied with a new Texas Instruments TI84Plus graphics calculator, and the school also had some spare calculators available as backups. These calculators connected to the teacher's laptop computer and calculator through a wireless hub under trial to allow troubleshooting and transfer of work. The calculators also came with a link cable to allow the students to connect to a computer that was not on the wireless network, download, manipulate and display the data. While the wireless hub offered some time savings in data transfer, some lesson time was lost in setting up and packing away the equipment.

Affordability of ICT related resources in schools

The priorities and vision of the school drive the quality, quantity and type of resources available; decisions about these resources are usually made at a higher level than the teacher who delivers the curriculum. For instance, the head of the IT department at Pink Hill controlled the ICT budget and made the strategic decisions about purchases. Furthermore, while the cost of software licences was also an issue, Mr Rose believed that the cost of installing the infrastructure was the most expensive part of the school's ICT resources. The cost of ICT consumables, such as toners, also caused problems at some schools. For instance at Greenwood, the printer toner ran out mid-term and was not replaced. The reason Mrs Jade gave was "*[Greenwood] doesn't give them [toner cartridges] to me. They are rationed as they are expensive*".

Types of software provided in schools

The schools provided access to the *Microsoft Office* suite of applications and a variety of other educational applications and course specific software. At Red Oaks, the students used *Word* for typing drills and to create business stationery and *PowerPoint*. The Greenwood students used a typing tutor program for their typing drills, worked on teacher-created *Excel* exercises and completed mathematics and English assignments in *Word*. For many of these students it was their first exposure to *Excel*. The Pink Hill students used the calculator software and *Excel* to display their results. The Pink Hill students already had basic *Excel* skills gained in previous classes and years. At Pink Hill, the students also used a soft copy of their mathematics textbook. This allowed Mr Rose to project their textbook onto the screen and interact with the students.

© 2007 Kaylene Clayton

The students also liked the fact that did not have to carry a heavy book home to complete their homework.

Problems with ICT resources

A number of problems with the school ICT resources were identified, including CRT monitor settings and peripherals. For instance, the Greenwood students complained that the CRT monitors "*hurt their eyes*" due to the refresh rate. The students said that they did not report the issue to the school due to their previous experiences with contacting the technical support team. Furthermore, the coeducational school students had many problems with lint and dirt clogging the computer mouses and preventing them from completing their work. It is unclear why the schools persisted with repairing the mouses rather than moving to optical mouses. The printers at the coeducational schools also caused problems. For instance, the Red Oaks printer was rarely used, but when it jammed, the location of the printer (on a high and awkward to get at shelf) meant that the teacher and teacher-aide were unable to remove the toner to clear the jam. Furthermore, privacy and safety concerns meant that there were restrictions on the digital recording of lessons (for playback of work) and Internet access.

Technical support and assistance

Budget constraints meant that the schools had differing levels of technical support and assistance. For instance, although Red Oaks was a large school, it had only one full-time computer technician who, according to Mr Maroon, was working at capacity to maintain the computers and networks at the school. Mr Maroon and some other teachers, who had appropriate skills, assisted the technician with small tasks if a request was urgent and the technician was unavailable. However, this meant that some computers remained unusable for weeks at a time. However, it was unclear whether this was due to the lack of technician time or lack of components. Mr Maroon said that the unreliability of ICT resources took "*time away from teaching the curriculum*" and caused frustration and disengagement of the students, leading to disruptive and destructive behaviour in the classroom. Conversely, the private schools had onsite maintenance teams that were able to repair computer problems within a short timeframe. Furthermore, Mr Rose provided technical support for the graphics calculator, and Pink Hill teachers could send students to his classroom if they had problems that they could not solve.

None of the teachers or students accessed application help files when they were having problems using an application. Instead, the students and teachers supported each other in the problem-solving process. Furthermore, Mr Rose identified the need for good quality training

© 2007 Kaylene Clayton

manuals for ICT hardware and software that were specifically tailored to teachers needs. He would like to produce technical manuals, but found that this was not economically feasible.

6.4.6 Curriculum and Teaching

The Computer Studies content

While the Computer Studies subject falls under the New Technology Syllabus (QSA, 2003), the naming of the subject led to mistaken beliefs of what the subject involves. While the name implies that it is the study of computers, the actual content consists of typing drills and using *PowerPoint*, *Excel* and *Word* to create business documents. Due to this, many of the Computer Studies tasks were perceived by the students to be tedious and were completed without enthusiasm. For example, one Red Oaks student said, "*we are doing the same thing all of the time and if we did something different it would be more interesting*", while another said, "*I know everything about it, basically what they are trying to teach us anyway*". Another problem with the Computer Studies class at Greenwood was that time that could have been spent learning about ICT was spent completing work from other teaching areas such as English and mathematics. This reinforced the view that Computer Studies classes were less important than other subjects.

Because the curriculum and units of work were not available at all of the schools, a direct comparison cannot be made between the schools, and the findings are based on observation of classroom activities. Many of the exercises involved transcription of information into *Word* or *Excel* and reformatting it in various ways, and keyboarding drills. These skills the students were being drilled in could have been taught as part of other subjects, enabling time for an introduction to the computer subjects in Years 9 and 10. Furthermore, while Mrs Jade was disappointed about the withdrawal of keyboarding from the Year 8 curriculum, she also felt that keyboarding skills should be taught in about Year 4 so that they could be practised over the years in various subjects. The boys at Greenwood agreed that they would prefer to learn more about computers and how they worked in the Computer Studies classes, rather than learning to use applications and keyboarding skills. Furthermore, at Pink Hill, the girls responded positively to the use of ICT in the mathematics classroom and were enthusiastic about writing programs for their calculators. While the Pink Hill Computer Studies class was not observed, comments from the students pointed to similarities between the Computer Studies teaching and curriculum (see Appendix D) at Pink Hill and the coeducational schools. However, according to the curriculum, the Pink Hill Computer Studies class was introduced to some ICT concepts and applications.

© 2007 Kaylene Clayton

Fears about learning ICT

While the students did not mind a challenging subject, they feared information overload. For instance, the Greenwood students were concerned about the amount of information and learning required for ICT subjects. They felt they would never understand everything because there was just too much to understand. However, Mrs Jade believed that the students were teaching themselves tricks and coping mechanisms with ICT. Mr Rose also believed that the student expectations were changing and students were picking up ICT skills faster because of their exposure to ICT at home and in their everyday lives.

Benefits of self-paced ICT learning

The students advocated the use of self-paced learning with ICT. They felt that, at times, the teachers covered some topics too quickly and they needed to slow down, but at other times, they were bored with the content because they had already attained the skills being taught. For instance, the Greenwood students confirmed that they preferred to teach themselves how to use computer applications by tinkering and at their own pace, rather than having structured lessons to step them through applications. At Pink Hill, Mr Rose encouraged self-paced learning to some degree and for the students to think for themselves. For instance, he instructed them "*if you are ahead, keep going*". The atmosphere in the classroom was productive and cooperative as they shared knowledge and solved problems; there were no comments heard about their inability to complete the task.

ICT as a tool for the classroom

All of the teachers appeared to view ICT as a tool, and did not consider the involvement of their students in future ICT occupations. Furthermore, the teachers were careful to emphasise that ICT was only a means to deliver learning. For instance, Mr Rose believed that ICT was just another medium which should be used to emphasise learning. He also felt that teachers could get caught in providing the "*wow factor*" with ICT in the classroom. Mrs Jade also felt that technology was a diversion and that students were missing out on basic, core skills. She accepted the inevitability of the integration of ICT in the curriculum, but emphasised the need to teach core knowledge before applying the knowledge using ICT.

Using ICT to increase student engagement

Mr Rose recognised that the students were generally interested in using ICT. Because of this, he used ICT as a method of engaging the students and making his classes interesting for the students. While the coeducational school students frequently expressed disenchantment with the Computer Studies classes, the students at Pink Hill were exposed to new tools and techniques and responded enthusiastically to learning them. Student engagement in the classroom also

© 2007 Kaylene Clayton

increased at the coeducational schools when they were given a task that had meaning or involved learning new skills. Furthermore, the Greenwood teacher seemed to be out of touch with the skills and abilities of her students at times. For instance, while the Greenwood students were unenthusiastic about using *PowerPoint* and appeared to endure the reiteration of skills learnt in previous years, Mrs Jade felt that *PowerPoint* was an exciting program that the students enjoyed using.

Use of games in the delivery of the curriculum

The teachers were split on whether they thought games were a useful teaching tool in the classroom. For instance, Mr Rose originally believed that using games in the curriculum was not useful, but he changed his opinion and now thinks that games could assist with building thinking and problem solving skills. However, Mrs Jade did not believe in the use of games in teaching, especially the keyboarding component, as she said that she was unable to observe the students well enough to determine if their technique was correct. However, the students felt that using computer games to teach skills would make the task more interesting and would provide a welcome break from normal class routine.

Elective subject choices

From Year 9 onwards, students may choose an elective subject from a number of subject groups of subjects, for instance, performance arts, vocational studies or business. Subject selection sessions were held at some schools to help the students with their choice, but these were not seen as useful by the students. For instance, the Pink Hill students believed that only the fun parts of the subjects were described in these sessions and the work would be more difficult than described. Consequently, the students frequently chose a subject based on the brief subject description of a few sentences, and many students did not really understand what was involved in the subject. At times, the students also had to choose a subject by default, as they were not interested in any of the subjects in that group, or had to choose between two favoured subjects in the same group. For instance, several students at Pink Hill chose an elective ICT subject in Year 9 because "*I didn't want to do any other subjects for that section*".

Interpretations of difficulty and opinions about teachers also influenced elective subject choice. The students made interpretations about the difficulty of a subject according to the abilities of other students who enrolled in it. For instance, when a student who was perceived to be smart enrolled in a subject, that subject was interpreted as being difficult. Consequently, the students looking to avoid the more difficult subjects would avoid that subject without consideration of the content. The students also said that they sometimes made subject choices based on the teachers who were assigned to deliver the subject. If the subject was a favourite and the student

© 2007 Kaylene Clayton

did not like the teacher, the student might still take the subject, but if the subject and teacher were not well liked, it was unlikely that the student would choose that subject. Some students felt that the subjects taken in Years 8, 9 and 10 prepared them the future, while others felt that they had time to learn things that were important to their careers in Years 11 and 12.

6.4.7 Summary of Structural Factor Key Points from the Year 8 Data

The key points from the Structural Factors analysis of the Year 8 data, further discussed in Chapter Seven, include:

- The background of the teacher, their intrinsic interest, enthusiasm and confidence in ICT influenced ICT implementation and was reflected in the attitudes of their students and the classroom atmosphere.
- Teachers faced competing priorities for the time required to research and prepare for new activities and other elements of their teaching responsibilities.
- The amount and quality of in-service ICT training differed between teachers, and this was impacted by the teacher's willingness to seek and undertake the training.
- A paradigm shift is required to change some teachers' teaching and attitudes, but this will take time and it may be impossible to change resistant teachers in the short term.
- The differences in underlying philosophies, values, priority and financial support from parents and the government can affect the quality of education, available resources and curriculum priorities.
- All of the students in this study had access to computers at school and most students had at least shared access to computers at home, but fewer had Internet access.
- The students and teachers at the more affluent schools had access to and used a larger range and quality of ICT resources at school.
- All of the students had a school email account, but many of the government coeducational school students were unaware that they even had an email account.
- The computers and applications that the coeducational school students had access to did not seem to be a high priority for the schools.
- Computer laboratories where computers were closely spaced along benches running around the perimeter of the room or projecting into the room from the wall did not support group work or when students had to use other resources, such as books.
- Technical problems occurred at all of the schools, but the differentiating feature was the timeframe for rectification, and recurrent or long-term problems led to disruptive and destructive behaviour in the classroom.
- Technical problems at the government coeducational school were at times compounded by the lack of technical support, lack of respect for the computers and vandalism.

© 2007 Kaylene Clayton

- The students reported their first computer access happened between the ages of 3 and 8, and their first experiences usually involved playing games.
- The students used their home computer for Internet banking and to surf the Internet, play online and computer games, download music and communicate with their friends.
- Mobile phones were popular and were used for calls and for their multimedia capabilities.
- Gender splitting of schools and classes at the Year 8 level may be beneficial as the teacher can tailor the materials and tasks to the group of students.
- The individual nature of each class, class members and teacher meant that there would always be differences in the way that the curriculum material was delivered and received.
- The naming of the Year 8 Computer Studies subject led to mistaken beliefs about its content, and the Year 8 students based their decision to enrol in the Year 9 ICT subject on a brief subject description, perceptions of the teacher and previous ICT experiences.
- Many of the Computer Studies subject tasks were perceived to be tedious and were completed without enthusiasm, and the teachers reinforced a strong association between keyboarding and ICT work.
- While the students did not mind a challenging subject, they feared information overload and advocated the use of self-paced learning with ICT.

6.5 Individual Attributes

6.5.1 Individual Aptitudes, Personality and Attitudes

ICT aptitude of the Year 8 students

The students in this study displayed varying levels of ICT aptitude. For instance, the Pink Hill students appeared to understand the programming instructions reasonably quickly, were able to pose and answer relatively advanced questions about the work, and progressed to creating and modifying their own programs for the calculator. However, student perceptions of their abilities generally ranged from self-descriptions of being computer illiterate to being able to quickly pick up skills. At Red Oaks, some of the students had reasonable levels of ICT knowledge and skills, with a number of students being self-taught about computer hardware and software. At Greenwood, one boy accessed the networking tools and administrative functions on a school computer and remotely accessed his father's server. He was quite interested in ICT and explained that he helped a family friend to set up this server. This student demonstrated Mrs Jade's comment that home ICT access, in association with individual attributes, had an impact

on the students' ICT skills. Mr Rose agreed, and said that students' ability and interest in ICT depended on their home environment, their exposure as well as the individual factor.

Interest in ICT

While the students were interested in using ICT, very few interviewed students expressed interest in enrolling in elective ICT subjects in Year 9. Only one boy from Greenwood was interested in working in the ICT field in the future. However, when the students were asked about their preferences, if they did decide to work in the ICT field, many students said that they would like to work in design in areas such as game design and web design.

The students also expressed an 'I can, but I don't want to' attitude towards ICT or being involved in the ICT field. For example, one of the Greenwood boys said that he could design web pages. However, when it came to implementing those skills in his future occupation, he said he was not interested in that and he would pay someone else to do it for him. Furthermore, while Mr Rose believed that girls were acquiring a "*can do*" attitude, one of the Pink Hill girls commented that during the subject selection session "*[the ICT teachers] showed us what they do, to make sure we can do it, but I don't think I will be doing IT*".

Aptitudes driving subject choice

The Pink Hill girls demonstrated that aptitude drives choice of a subject. For example, when discussing subject selection and ICT, one Pink Hill girl made a comparison between ICT and Dance subjects and said, "*if you were uncoordinated, you wouldn't do [a dance subject]*". The Pink Hill girls believed that the ICT subject in Year 9 and 10 would be hard work as "*all the smart people do that subject*". Furthermore, because they were not in an extension class, they believed that they were not intelligent. However, under Mr Rose's instruction they managed to write a program, install it on their calculator and modify the program with little difficulty. Furthermore, although the Pink Hill students said that they did not mind studying a challenging or difficult subject, the students spoke about choosing the core mathematics subject because it was the easiest option.

Personality – conscientiousness

While some of the students demonstrated self-discipline and planned behaviour and aimed for achievement, at times the teachers felt that the students' conscientiousness could be improved. For instance, Mrs Jade felt that they did not aim to achieve in their work and showed low levels of precision when transcribing the information required for a test. She believed that the students were more intent on copying the content and did not seem to notice formatting of the work being copied. Furthermore, some of the students had undertaken thorough research into the

© 2007 Kaylene Clayton

prerequisites for their future careers, while others were still undecided about their preferred career and had not begun to investigate the available options. For instance at Greenwood, the boys displayed a conscientious attitude as they carefully planned their Year 9 subject decisions based on future career preferences. However, the Greenwood girls tended to choose their subjects based on enjoyment rather than what is required for their future careers.

Personality – openness to experience

The students particularly liked the changing and evolving nature of ICT and demonstrated their imagination and curiosity. The students related how they liked tinkering and exploring the computer, and teaching themselves how to use applications. Exposure to other technologies also inspired interest. For instance at Pink Hill, one of the girls enthusiastically discussed the robotics taught by her uncle with her peers, who listened attentively. Furthermore, the Greenwood students said that they liked to learn useful things in computer classes and not just how to type their assignments. At Pink Hill, the students were continually learning new skills when using the calculators, and the students were interested and enthusiastic. However, when a Pink Hill girl commented about how excited she was to use the calculators, another girl told her "*wait a few weeks, you'll be over it*". This matched with the observed behaviour of Greenwood students, where interest in new areas of the curriculum quickly waned after a few lessons.

Personality – extraversion

The students demonstrated energy and enthusiasm when they discussed using ICT for leisure activities, sought the company of their peers during class and continued to communicate with them after hours using *MSN Messenger*. However, absenteeism in the Red Oaks Computer Studies class was a problem with approximately 60 to 80% attendance each week. Furthermore, one of the Red Oaks girls explained and said, "*this [Computer Studies] is the only [subject] that I have missed*". From the absenteeism and the student comment, it was apparent that attending this class was generally not a high priority for the students. One Red Oaks boy even removed himself from the Computer Studies classroom saying, "*I want to go to the planning room*". The planning room is meant to be a behaviour management strategy for students sent to the office for bad behaviour, but this student used it as a means of avoiding the Computer Studies class. The coeducational school students also displayed competitive behaviour at times. For instance, the Red Oaks students created speed challenges, while the Greenwood students would compare their speed and accuracy with students sitting around them. Furthermore, a number of the girls were concerned about falling behind their peers when they had problems with the computers.

© 2007 Kaylene Clayton

Personality – agreeableness

When the students were working with ICT, they were frequently observed collaborating with their peers. For instance, when the Greenwood students were asked to perform an action in *Excel* that they had not done before, the students turned to their neighbours to work out how to do it, without being told by the teacher. One student knew how to do the task and shared the information with those sitting around her, and eventually with others around the room. Moreover, the private school students, especially the girls, were observed praising their peers who performed well in their work. However, at times the boys would be scornful of another student's work, but if the teacher saw them they would be reprimanded. The Pink Hill girls were also observed demonstrating caring and compassionate behaviour to their peers. For instance, when a girl said that she felt left out because nobody sent her text messages or called her mobile phone, another girl immediately offered to text her to make her feel better.

Personality – neuroticism

Of the students, the girls tended to be less likely to demonstrate anger towards the equipment and teachers than the boys. For instance the Red Oaks boys directed anger and frustration at the computer when there were hardware or software issues. Furthermore, when a boy at Red Oaks correctly responded to Mr Maroon's question about the name of a computer component, Mr Maroon told him that he was wrong. The boy became quite angry and disruptive and eventually had to be removed from the class. Several other boys also stated that they were able to fix computers and were alienated by Mr Maroon because of this.

6.5.2 Interpretations of Experiences

Positive interpretations of ICT experiences

The students liked to access new forms of technology, reacted positively when successfully completing a new or difficult task and were eager to repeat their successes. For example, the Pink Hill students were keen participants in the trial of the wireless hubs for their calculator and acted excitedly when using the calculators through the wireless hub. Mr Rose even had to check their enthusiasm at one point so they would complete the task by the end of the class. He offered his students small rewards when they solved a particularly difficult problem, and this seemed to encourage them to try harder. In particular, there was an upbeat air of achievement as their programs ran on their calculators. When the Pink Hill girls were asked if they were enjoying the task the girls bounced around on the spot and responded, "*yes, it's fun!*" The students also offered enthusiastic suggestions about how to modify the program and when the program ran, one Pink Hill girl was heard to exclaim, "*that's awesome!*"

© 2007 Kaylene Clayton

Negative interpretations of ICT experiences

Although some of the activities in the Computer Studies classes sparked the students' interest, in general the classes were believed to be boring and repetitive. In particular, the students did not like being bored in their classes, the frustration from hardware or software failures and being stepped through computer tasks. Furthermore, a number of students discussed their concern about viruses and falling victim to social engineering through the Internet. The students also responded negatively to subject marketing for ICT, felt that the course descriptions did not accurately reflect the content, and that the work would be difficult and not as fun as had been described. Furthermore, the Pink Hill students felt that they did not fit their perceived intellectual image of the ICT subject.

Socialisers can also transfer their negative interpretations of the ICT subject. For instance, a Pink Hill student said, "*Mum thinks computer lessons are a total bludge [involves little work of value]*". Furthermore, the students spoke about the frustrations of their family members when using ICT, and attributed them to hardware and software failures. These experiences were seen to be a prime contributor to the negativity felt by the students towards ICT. Given these experiences, it is not surprising that only a small percentage of students said that they planned to enrol in elective ICT classes in Year 9.

Repetition of negative ICT stereotypes

The students also repeated negative ICT activity and gender stereotypes. Some of these seemed to be repeated interpretations of things that they had heard or seen in the media, or by their family and peers. One boy related his brother's experiences with ICT in the workplace and associated ICT with employer control over the worker and loss of work/life balance. Furthermore, the students observed people working in ICT occupations and associated the terms unhealthy, unattractive, geek and nerd to the observations of these people. Had these people worked in other occupations and possessed similar traits, it is possible that the labels and stereotypes may have been similarly applied, but it is unlikely. Mr Maroon also contributed to the negative perceptions of ICT work when he commented during the typing drills that "*we are practising work*".

6.5.3 Goals and General Self-Schemata

Short-term goals and ICT subject choice

Many of the students' short-term goals involved the subjects that they planned to enrol in over the next few years, but very few interviewed students expressed interest in enrolling in elective ICT subjects in Year 9. For instance, one of the Pink Hill students considered enrolling in Year

9 ICT subjects, but after learning about the content said, "*I already know how to do that*". At Greenwood, only one boy chose to enrol in elective ICT classes for Years 9 and 10 to prepare for specialist ICT subjects in Years 11 and 12. However, another student believed that subject choices in Years 8, 9 and 10 were not important and that there was plenty of time to learn things relevant to careers in Years 11 and 12. At Red Oaks, two girls chose an elective ICT subject for Years 9 and 10 as they did not like any of the other subjects that were available. They thought that the ICT subject would be easy and did not believe they would learn new skills.

Long-term goals

A common long-term goal of students who were interviewed was to attend university and run their own business. For instance, a Greenwood girl had made plans to study specific subjects in secondary school in order to enrol in a physiotherapy degree at university, and then start a business. Moreover, one of the Greenwood students talked about the importance of attending university in order to "*get ahead*". A number of the Greenwood students also spoke about running large corporations. The Greenwood students also believed that the material being learnt in the Computer Studies class would be useful in their future jobs. For instance, one Greenwood boy was planning to enrol in ICT subjects in Year 9 and 10, because he felt that it would be useful for when he is in business. The Pink Hill students had similar views and stressed the importance of choosing elective subjects wisely as "*you are making your career decisions in Year 8 rather than in [Year] 11 and 12, but you really don't know it*".

Self-concept

Both positive and negative representations of attributes of self-concept were demonstrated by the students. For instance at Red Oaks, two boys said that they had the ability to fix computers, while another at Greenwood felt that he had the attributes required to work in the ICT field. However at Pink Hill, some of the girls believed that they were not smart because they were not in the extension mathematics class. Many of the students would like to follow sporting, acting or entertainment based on the attributes they felt, or had been led to believe, that they possessed. Furthermore, Mr Rose believed that children were afraid of being thought of as a failure if they did not achieve the same level of standing as their parents.

6.5.4 Subjective Task Value

Incentives for learning ICT skills

The students said that they liked to use ICT to complete their work as it was a time saver, they could use tools like spell check, and it was easier. Mr Rose also reiterated the need to learn ICT skills to the Pink Hill students and said, "*these are the things that you will need to know how to*

do for the rest of your lives". The Red Oaks students felt that access to the Internet at school acted as an incentive in their ICT classes. *MSN Messenger* and online games also acted as an incentive for the students to learn how to type quickly. For instance, one Red Oaks boy had taught himself to type and was working on improving his typing speed to play online games and chat as "*you have to learn to type fast, otherwise you get another message and you are lost*". Some of the teachers tried to give the work topics a real-world context, but the topics did not act as an incentive for all students. For instance, when Mr Maroon instructed the students to make a *PowerPoint* presentation of their favourite sport, one of the Red Oaks girls responded, "*but I don't like sport*".

Incentives for ICT subject enrolment

Enrolment in elective Year 9 ICT subjects was done to allow the students to follow their preferred career path or to learn skills that would be useful in their future careers. Some of the students also recognised the value of the subjects chosen in Years 9 and 10 in providing core knowledge and acting as a precursor to the Year 11 and 12 subjects. Other students enrolled in ICT classes because of their parents' advice or because they enjoyed ICT. Conversely, a number of the girls believed that the Year 9 Computer Studies subject was difficult, and it would require a great deal of effort for them to be successful. Although keyboarding was not a popular part of the Computer Studies curriculum, a number of students recognised the value of being taught keyboarding skills because of the rapid rate of integration of ICT into everyday life.

Incentive for teaching with ICT

There are many reasons that motivate teachers to learn new ICT skills, improve ICT infrastructure and prepare innovative ICT activities for their classroom. For instance, Mr Rose's incentive was that he enjoyed using technology and thought that it was fun, liked to be busy and had a thirst for knowledge. He said that it was also his choice to assist and support the other Pink Hill teachers and students with the programmable calculators and find innovative ways to use technology in the classroom. He tried to make his classes fun and interesting to engage the students and make them feel special, and he believed that the girls were responding to this methodology. This was confirmed during the classroom observations at Pink Hill.

Costs of working in the ICT field

One inhibitor for completing ICT qualifications was the perception that the students would be unable to find a job when they finished. For example, one Greenwood student believed that there was currently a dearth of jobs in the ICT area. Conversely, another Greenwood boy believed that he could get a job in the ICT field, and intimated that ICT workers were well remunerated for their work. Many students felt that ICT was an unhealthy, sedentary occupation

© 2007 Kaylene Clayton

involving long hours where they would lose their fitness. However, one of the Greenwood boys remonstrated that at the end of the workday the person could always go for a run.

6.5.5 Summary of Individual Attribute Key Points from the Year 8 Data

The key points from the Individual Attribute analysis of the Year 8 data, further discussed in Chapter Seven, include:

- The students displayed varying levels of ICT aptitude, and self-descriptions of their ICT ability ranged from being computer illiterate to being able to quickly pick up skills.
- The students believed that ICT ability just depended on whether the person was interested in learning about ICT.
- The students liked to access new forms of technology, learn new skills and were keen to repeat their successes when completing new or difficult tasks.
- Frustrations with ICT led to loss of interest in the task, disengagement of the student, and loss of future interest in working in the ICT field.
- While the students were interested in using ICT, the students also expressed an 'I can, but I don't want to' attitude towards ICT or being involved in the ICT field.
- When the students were working with ICT, they were frequently observed collaborating with their peers and sharing ICT knowledge and skills.
- While the students often became frustrated with the tasks or equipment, the girls were less likely to demonstrate anger towards the equipment and teachers than the boys.
- A strong association between keyboarding and ICT work was reinforced by the Computer Studies teachers, and at times, the students believed that the subject was just something to be endured.
- The students responded negatively to the Year 9 ICT subject marketing and the unreliability of hardware and software.
- Many of the Year 8 students based their subject choices on prerequisites for their career or enjoyment of an area; most were not interested in studying Year 9 ICT subjects and some only chose it when other subjects were deemed unsuitable.
- University education and managing their own businesses were common long-term goals of the interviewed private school students.
- The students understood the need for ICT skills in their future study or careers and to help others, increase their independence and effectiveness and make money.
- Inhibitors for working in the ICT field included their perception that they lacked the required cognitive skills, would be unable find an ICT job, and ICT stereotypes.

© 2007 Kaylene Clayton

6.6 Socioeconomic Status

Socioeconomic background of the students

As mentioned in Sections 4.5.1 and 5.6, there were distinct differences between the socioeconomic backgrounds of the students. For instance, the suburb that Red Oaks was located in was a disadvantaged, blue-collar area with a higher than average rate of unemployment and a number of single-parent families. While the Greenwoods and Pink Hill schools were within a reasonably close distance to Red Oaks, they were located in middle to upper-middle class suburbs with a lower than average unemployment rate and predominantly white-collar workforce.

Cost of attending the schools

The Greenwood and Pink Hill parents paid between $6600[22] and $9000[23] per annum for tuition, or were in receipt of a scholarship, and the cost of their more complex uniforms and required equipment would add a significant amount to this tuition cost. Mr Rose said that many of the Pink Hill parents sacrificed a great deal to pay the school fees, but there was also a competitive scholarship scheme available for students entering Years 8 and 11. The parents of the Red Oaks students only paid a small levy of a few hundred dollars (the cost depended on the subjects undertaken) to cover textbook hire and some consumables and classroom supplies. Although the levy was relatively small, the non-payment of it caused problems with some of the students being unable to log onto the network, as they had not been issued with an identification card. The Red Oaks uniform was simple and cost significantly less than the private school uniforms.

Presentation of the students and their diet

While each of the schools had a compulsory school uniform, there were differences between the presentation of the students as well as their diet. The Pink Hill and Greenwood students wore a complex school uniform, including a summer and winter uniform with blazer, school hat, school-branded bag and sports uniform. The Pink Hill students followed a strict dress and presentation code and were always dressed in full uniform with their hair worn neatly off their face. The Pink Hill teachers did not wear a corporate uniform, but wore smart business attire and were immaculately groomed. At Greenwood, most of the students were well presented and wore their full school uniform in a tidy manner, and the Greenwood teachers wore a corporate uniform and were smartly presented. While it is not known whether the students at the private schools ate breakfast, they were generally seen to eat relatively nutritious and sustaining lunches.

[22] The 2007 annual tuition fee for Years 7-9 – source suppressed to protect the identity of the schools
[23] The 2007 annual tuition fee for Years 8-12 – source suppressed to protect the identity of the school

© 2007 Kaylene Clayton

Conversely, the Red Oaks students were expected to wear a basic school uniform of school shorts/skirt and shirt, socks and black lace-up shoes. While the Red Oaks students wore the basic uniform, the uniforms were frequently creased or damaged, and a number of the students attempted to wear partial uniforms and were generally unkempt. The teachers wore smart casual outfits and were tidily presented. The diet of the students at Red Oaks also tended to be the worst of any of the schools, and Mr Maroon blamed some of the behaviour problems that he was experiencing in the classroom on the students' poor diet. For example, when asked by the teacher, over one-third of the students in this class had not eaten breakfast that morning, while other students stopped at the local takeaway shop and ate hot chips before school. Furthermore, some of these students complained about stomach pains after morning tea, and when they were asked what they had eaten at morning tea, this included pies, pizza rolls, lollies and cans of coke.

Socioeconomic issues in school environment and ICT classroom

The school environment and resources available to the students were noticeably different at each school type and reflected the tuition fees charged by the schools and the socioeconomic status of the school's suburb. Red Oaks was the largest of the schools and was noticeably run-down in comparison to the well-maintained and appointed Pink Hill and Greenwood schools. For example, the general school facilities at Red Oaks were in poor condition with graffiti on the buildings and inadequately maintained and malodorous girls' toilets. In comparison, there was no visible evidence of graffiti seen at Greenwood and Pink Hill, and the toilet facilities at the private schools were clean and well maintained.

Socioeconomic issues in school environment and ICT classroom

The computer laboratory at Red Oaks was clean and functional, but run-down. For example, the small, window-fitted air-conditioning units in the room required maintenance. When they were turned on, one of the units sprayed black water over the computers and students sitting below it, and caused an unpleasant odour. Furthermore, the computer equipment and facilities at Red Oaks showed signs of malicious damage and significant wear and tear. At Greenwood, the computer laboratory was one of the older, low-priority laboratories. While it was in relatively good condition, it did need some maintenance/repairs. For example, the back wall of the room had been damaged by chairs, but this was repaired during the term. Pink Hill was by far the best maintained and resourced of the three schools. Furthermore, at the private schools there was no evidence of malicious damage to the computers or facilities.

© 2007 Kaylene Clayton

6.6.1 Summary of Socioeconomic Status Key Points from the Year 8 Data

The key points from the Socioeconomic Status analysis of the Year 8 data, further discussed in Chapter Seven, include:

- The socioeconomic status of the school's location influenced the quality and reliability of the ICT resources and support at the school.
- The presentation of the students and their diet also reflected the socioeconomic status of the school suburb.
- In contrast to the ICT facilities and resources at the private schools, the ICT facilities and resources at the government coeducational school were of a lower standard, run-down and showed evidence of malicious damage.

6.7 Study and Career Choice

In this section, elements of Gottfredson's (2002) theory of Circumscription, Compromise and Self-Creation are used to help understand the process of career choice. Elements of the self-creation process are generally discussed in Section 6.5. Furthermore, the process of circumscription starts in early childhood, and individual differences, in terms of mental ability and maturity, at given ages mean that some children will reach each stage earlier or later than their peers.

6.7.1 Orientation to Size and Power

Whilst the orientation to size and power usually occurs between the ages of 3 and 5, there was still some trivial evidence of fantasy careers amongst the students, but they were infrequent and more related to real-life roles. A number of the students said that they would like to have a career as a sportsperson or in the music or entertainment industry. While it is possible to secure one of these prized careers, there is far more competition for these roles than in everyday occupations and as competition increases the chances of being one of the elite declines.

6.7.2 Orientation to Sex Roles

There was evidence of students having reached stage two of the circumscription process in terms of linking vocational aspirations to the appropriateness of the occupation to their sex type. A number of girls expressed a desire to work in jobs with stereotypical female sex roles. Some of these roles included owning and running a beauty shop, paediatrics, teaching, fashion design and nursing. Other careers included law and architecture, which are increasingly being

perceived to be acceptable occupations for women, possibly because of the influence of the media. Some of these jobs related to similar occupations that their parents were involved in, including medicine and law. Furthermore, a Pink Hill girl received the following career advice from her mother: "*Mum says to me every single day, if you want to become a hairdresser, don't ever do it*". There was also evidence of generational job influences, with a Red Oaks girl's mother and grandmother working as cleaners. However, the Red Oaks girl said that she does not want to follow her mother and grandmother in this occupation. Other girls and boys were interested in job roles that were less gender specific, such as business. Only one boy specifically spoke of wanting to work in the male-dominated field of ICT.

6.7.3 Orientation to Social Valuation

Student evaluation of the social valuation of jobs

There was evidence that the students were at least beginning to evaluate the social valuation of their preferred occupation. Remuneration was important to the girls at Pink Hill, and this regulated what they believed was an appropriate career path. For instance, one of the Pink Hill girls identified that she would like to be a litigator, as she had discovered through observation of her mother's career as a litigator that litigators earned approximately $500 per hour. Furthermore, a Greenwood boy, who was interested in an ICT career, also identified that ICT professionals were relatively highly remunerated. Other students saw the prestige linked to owning large corporations and cited this as their ideal career path. Essentially, many of the preferred occupations of private school students were in professional or respected fields, matching the primary occupations of the suburbs where the schools are located.

Family advice about occupations

While the students identified tertiary study as a way to increase their occupational prestige, a Greenwood boy also said that he had been advised by his family that attending university was important if you wanted to "*get ahead*". However, other students commented that their parents advised that they should choose their job based on enjoyment, not only on remuneration and prestige. Other students also observed the prestige of their family's occupations and many of them decided, or were advised by their parents, not to work in that area. For example, a Red Oaks girl did not want to work as a cleaner like her mother and grandmother, while a Pink Hill student was advised not to go into hairdressing because of the conditions. Only one student expressed a desire to work in the ICT area, while many other students discounted it because they felt that ICT subjects and jobs were too difficult.

© 2007 Kaylene Clayton

6.7.4 Orientation to the Internal, Unique Self

Some of the students were entering stage four of the circumscription process. These students were reflecting upon their likes and dislikes and strengths and weaknesses in order to make their subject choices for Year 9. For instance, a Greenwood boy found that he enjoyed learning about ICT and wanted to work in the field, so he had chosen elective ICT subjects in Years 9 and 10. These would also lead into his senior secondary school subjects and subsequently into his career. Many of the other students had chosen not to take ICT subjects in Year 9 because they did not like what was being taught in Year 8 and in the predicted Year 9 ICT curriculum, or they felt that they would not be able to cope with the learning required. Many of the students felt that ICT subjects were difficult, while a Pink Hill student said that "*all of the smart people do that subject [ICT]*". This related to the stereotype that ICT is a difficult career suited to highly intelligent people.

6.7.5 Summary of Study and Career Choice Key Points from the Year 8 Data

The key points from the Study and Career Choice analysis of the Year 8 data, further discussed in Chapter Seven, include:

- There was still some trivial evidence of fantasy careers amongst the students, but they were infrequent and more related to real-life roles.
- There was evidence of students having reached stage two of the circumscription process as they were linking the appropriateness of vocational aspirations to their sex type, in particular with girls preferring pink-collar or humanitarian occupations, such as nursing.
- There was evidence that students were at least beginning to evaluate the social valuation of their preferred occupation through an examination of its status and remuneration.
- Students observed the prestige of family members' occupations and many decided, or were advised, not to work in that area when it was believed to be a low prestige role.
- Some of the students were entering stage four of the circumscription process and were reflecting upon their likes and dislikes, and strengths and weaknesses to make their subject choices for Year 9.
- Many of the students chose not to take ICT subjects in Year 9 because they did not like the curriculum content or they felt that they did not have the required cognitive ability.

© 2007 Kaylene Clayton

6.8 Conclusion

This chapter explored the collective results from three representative Year 8 classes gathered from a government school, a coeducational private school and a female single-sex school in metropolitan Brisbane. The results from the analysis of interview data and observational data from these three middle-school classes involved in the research are presented under subheadings as summaries of the collated and analysed data. The key factors involved in the ICT experiences of these students and teachers were identified and assigned to thematic categories to provide a collective understanding of the influence these factors and experiences had on students' ICT career choices. Chapter Five presented a similar analysis of the Year 4 data.

The results revealed three main thematic categories: Social Factors, Structural Factors and Individual Differences. These occurred within the cultural context of the student, and Socioeconomic Status overlaid some of the sub-categories of the Social and Structural Factors. In particular, the influence of Social Factors, including family, peer group, media, role models and ICT and gender stereotypes, was found to be important. Family member perceptions and preconceived ideas about ICT and careers can be transferred to the students and this can have a positive or negative influence on the student's career planning decisions. Media reinforced stereotypical images and impacted the student through computer games and the Internet. The boys tended to be disruptive and off-task in the classroom, while girls generally tried to focus on and complete their work. Based on their socialisers and personal experiences, the students believed that people who worked with computers were male, intelligent and unattractive, while ICT was perceived to be a sedentary, unhealthy occupation.

An exploration of the Structural Factors, including teacher, ICT access at school and at home, school type, technology resources and curriculum, yielded a number of key points. The teachers' enthusiasm when teaching ICT was reflected in the attitude of their students. The Computer Studies classes appeared to mainly consist of typing drills and using *PowerPoint*, *Excel* and *Word*; these tasks were perceived by the students to be tedious and mundane and were completed without enthusiasm. Differences in the types and quality of ICT access, support and applications were linked to the socioeconomic status of the school, with the private schools having better access to individual ICT resources and support. The technical problems observed at Red Oaks were compounded by vandalism and lack of respect for the computers, possibly due to the frustrations that the students had with the computers. The students frequently communicated through *MSN Messenger*, and playing computer games increased communication between peers.

© 2007 Kaylene Clayton

The examination of Individual Attributes involved identification of the students' personality and attitudes, goals and self-schemata, interpretations of experience and subjective task value. The students and teachers displayed varying levels of ICT ability, with some being skilled and confident while others were less sure. The students universally disliked being bored in their classes, computer failures and being stepped through using an application. The students also responded negatively to subject marketing for ICT, felt that course descriptions did not accurately reflect the content and that the work was harder and not as enjoyable as had been described. In particular, the Year 8 students did not identify with ICT subjects as they felt that "*smart people*" enrolled in ICT subjects and they felt that they did not fit the image. Few interviewed students expressed an interest in enrolling in elective ICT subjects in Year 9, and only one boy expressed an interest in working in the ICT field in the future. Personal interest in ICT was one motivation for teachers to put effort into learning new ICT skills, improving ICT infrastructure and preparing ICT activities for their classroom. The students were at least beginning to evaluate the social valuation of their preferred occupation in terms of remuneration and the prestige of the occupation, while others were reflecting upon their likes and dislikes, and strengths and weaknesses in order to make their subject choices for Year 9. Chapter Seven now discusses the collective middle-school findings from Chapters Five and Six to give a holistic view of the findings in terms of middle-school students, and proposes a Model of Girl's ICT Study and Career Choices.

© 2007 Kaylene Clayton

Chapter 7 Model of Girls' ICT Study and Career Choices

7.1 Introduction

This chapter systematically discusses the findings of the analysis of the data collected from interviews with the middle-school students and their teachers and participant observation of their classrooms. The findings were analysed using a thematic framework created from a synthesis of the literature detailed and explained in Chapters Two and Three. The Year 4 and Year 8 findings were described in Chapters Five and Six respectively. Chapter Seven discusses the collective middle-school findings from Chapters Five and Six to give a holistic view of the findings in terms of middle-school students, including individual concepts and the relationships between the concepts, in terms of their influence on ICT study and career choices. The result of the following discussion is a new Model of Girls' ICT Study and Career Choices.

This chapter is organised into several parts. The middle-school findings, in terms of Cultural Context, Social Factors, Structural Factors, Individual Attributes and Socioeconomic influences, are discussed in Sections 7.2, 7.3, 7.4, 7.5 and 7.6 respectively. The process of elimination of occupations deemed to be unsuitable by the middle-school students is discussed in Section 7.7. In Section 7.8, these results are summarised and integrated into the Model of Girls' ICT Study and Career Choices.

7.1.1 The Schools and Participants

The government coeducational schools cater to students coming from an extremely broad range of cultural and ethnic groups. They have a large special education unit supporting students with disabilities including intellectual impairments, autistic spectrum disorders and speech/language disorders. The primary school has a strong ICT focus, with each classroom being equipped with a SmartBoard (interactive whiteboard). The secondary school has a strong vocational education focus with a nationally recognised work education program and is a school of excellence for Rugby League.

The female single-sex school boasts extensive facilities including purpose-built art rooms, sports and music centres, swimming pool, golf driving range and tennis and netball complexes. The students have a wide choice of other cultural and sporting cocurricular and extracurricular activities, from beginner to elite levels. There is an underlying expectation that the students will

© 2007 Kaylene Clayton

progress into well-respected professional or semi-professional careers, rather than vocational education.

The private coeducational school's junior campus focuses on Prep to Year 6 and is located several kilometres away from the senior campus, which caters to Years 7 to 12. The campuses operate in partnership with the bordering government schools. The school also has an international program enabling international students to study primary and secondary preparation courses. The school encourages both vocational and professional education. A summary of the key points about the school demographics is provided in Table 7-1 below.

	Government coeducational (Red Oaks)	**Private Coeducational (Greenwood)**	**Female single-sex (Pink Hill)**
Established	Primary – 1978 Secondary – 1987	1995	1901
Student enrolment	Primary – 850 Secondary – 1550	Over 1100 (Prep to Year 12)	Over 1100 (Prep to Year 12)
Facilities	Run-down	Well maintained	Well maintained
School fees	Book or equipment levy	$5200 to $6950	$4844 to $9000
Percentage of students in special education classes	Primary – 8.2% Secondary – 6.5%	Not disclosed	Not disclosed
Results of Year 3, 5 and 7 reading, writing and numeracy tests	Below QLD average in all years and skills	Year 3 and 5 above QLD average in all skills Year 7 below QLD average for numeracy	Above QLD average in all years and skills
Dress code	Not strict	Reasonably strict	Strict
Socioeconomic status of suburb	Low	Middle	Middle to high
Unemployment in school suburb	7.7%	3.5%	3.4%
Percentage of single-parent families	25%	16.2%	18.7%
Median weekly individual income for suburb	$437	$602	$520
Percentage of indigenous residents	3.9%	1.4%	1.6%
Percentage of foreign born residents	31.6%	35.5%	21.4%

Table 7-1 Summary of school demographics

The Year 4 classroom observations typically lasted from several hours up to a full day depending on the type of activities planned over a school term (9 to 11 weeks). For each Year 8 class, observations lasting one lesson block were collected during weekly classroom visits over

a school term (9 to 11 weeks). Information about ICT artefacts in the classroom and school environments was collected, such as type and availability of ICT resources and infrastructure.

Semi-structured interviews with the consenting teachers and students in each school lasted for approximately thirty minutes each and were usually conducted at the end of the term. The interview questions were reworded and tailored to meet the understanding of the student, became more focused as the understanding improved and were used to clarify events and actions that were observed in the classroom. Documents that provided information about curriculum, subject availability and subject selection options were also collected as they became available. For instance, the all-girl school ICT curriculum can be found in Appendix D. In this chapter, the term 'student' may refer to either a male or a female student, while 'boy' refers to a male student and 'girl' refers to a female student. Table 7-2 summarises the participants in this study and the number of interviews conducted at each school.

	Year Level	**Teachers**	**Class/Students**
Government coeducational (Red Oaks)	Year 4 (ages 8/9)	2 of 3 teachers interviewed **Mrs Cherry** **Ms Ruby**	45 students with an approximately even representation of girls and boys **Interviewed students** 4 mixed gender interviews with 25 students
	Year 8 (ages 12/13)	0 of 1 teachers interviewed **Mr Maroon**	20 students (8 boys and 12 girls) **Interviewed students** One interview with 4 students (girls)
Private coeducational (Greenwood)	Year 4 (ages 8/9)	1 of 1 teachers interviewed **Mrs Emerald**	21 students (14 boys and 7 girls) **Interviewed students** One mixed gender interview with 8 students
	Year 8 (ages 12/13)	1 of 1 teachers interviewed **Mrs Jade**	24 students (11 boys and 13 girls) **Interviewed students** One interview with 4 students (3 boys and 1 girl)
Female single-sex (Pink Hill)	Year 4 (ages 8/9)	1 of 1 teachers interviewed **Mrs Pink**	27 students (girls) **Interviewed students** 2 interviews with 16 girls
	Year 8 (ages 12/13)	1 of 1 teachers interviewed **Mr Rose**	19 students (girls) **Interviewed students** 2 interviews with 12 girls

Table 7-2 Summary of research participants and data collection

7.1.2 Initial Conceptual Model for Girls' ICT Study and Career Choices

Based on a search of the available literature, various themes and factors were identified as being relevant to the selection of an educational or career pathway in the ICT field. The literature search identified several main factors that could be grouped as social or structural factors. A

number of researchers (e.g. Adya and Kaiser, 2005; Eccles, 1994; Trauth et al., 2004) also suggest that individual attributes, rather than social or biological factors, influence the ICT pipeline. As with the Eccles et al. model (1999) and Adya and Kaiser's model (2005), discussed in Sections 3.2.1 and 3.4, the cultural context overlies all of these factors. However, Eisenhardt (1989) cautions that not all factors identified early in theory creation are guaranteed to be included in the final version of the theory. Further information about the creation of the initial conceptual model (Figure 7-1) can be found in Section 3.5.

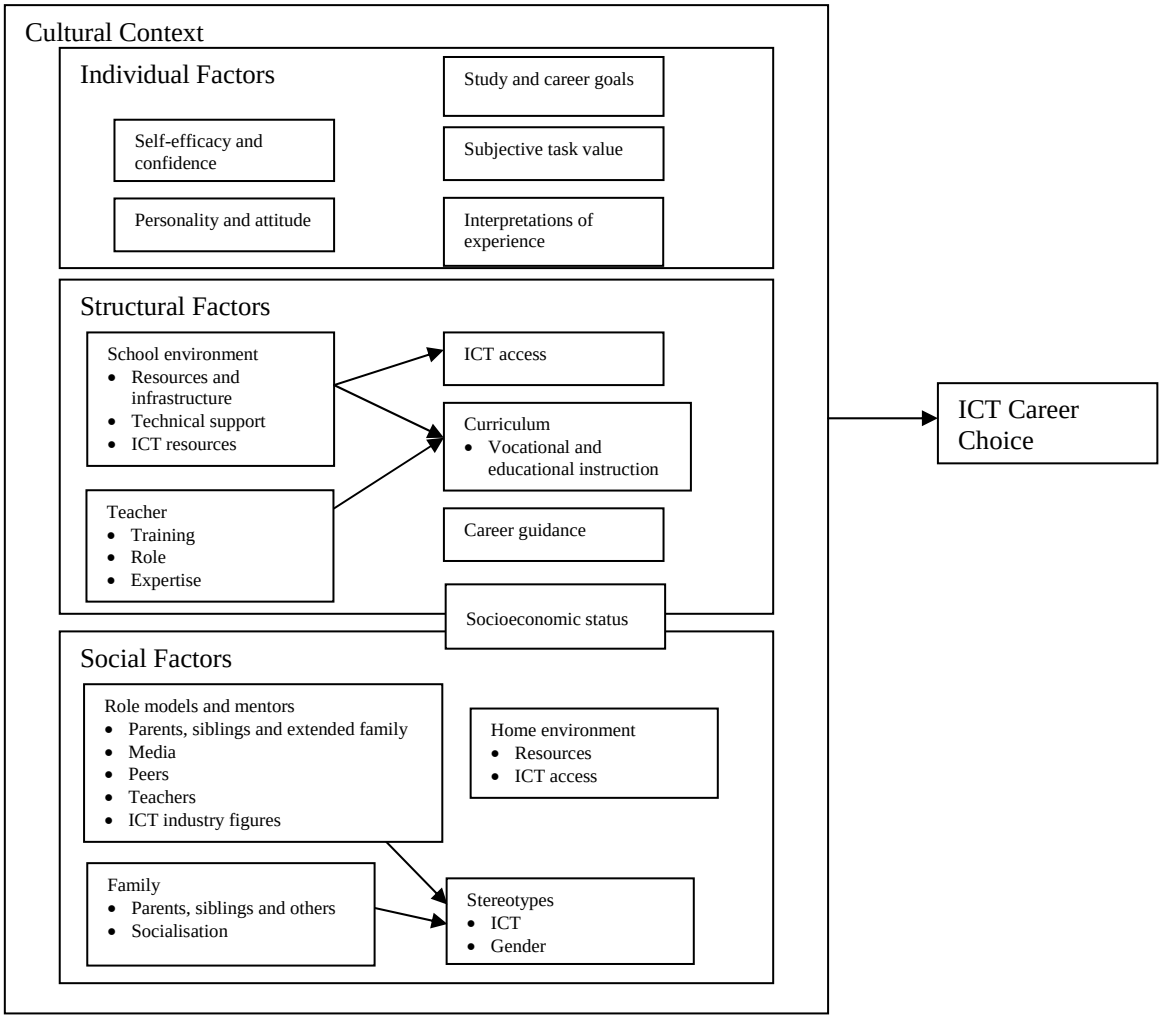

Figure 7-1 Initial conceptual model for the study

7.2 Cultural Context

Background of the participants

Cultural factors, unique to each nation and developed through early life experiences in the family and at educational institutions, partially condition our thinking (Hofstede, 1983). Australia is recognised as a young, culturally diverse nation, whose population includes people from a variety of backgrounds including Indigenous, Islander, European, Middle Eastern,

African and Asian, amongst others. These groups have their own cultural beliefs and values which may be passed on through the family or other socialisers. When the group members interact with other groups within schools and other organisations, their values and beliefs can also be shared amongst members. According to Adya and Kaiser (2005, p. 232), "ethnic culture can strongly influence social and structural variables or at least emphasize differences for samples across several cultures".

The cultural context was seen at all of the schools in the study, with students coming from varying backgrounds. The majority of the students in the Pink Hill classes had a homogeneous, white Australian background and spoke English as their first language, while approximately 30% of the Greenwood students had an international background, and Red Oaks had a large percentage of students from a diverse range of cultural backgrounds. This is similar to the 2006 Census results for the location of each school. It is highly possible that the cultural background of the family has influenced the parents' study and career expectations, which are transferred to the student. Furthermore, the Year 4 Greenwood students have been exposed to a variety of cultures through the background of their teacher, Mrs Emerald, a recent emigrant from New Zealand, and a trainee teacher-aide, a recent emigrant from India who holds an Indian IT degree. The other teachers participating in this study were born in, or have resided in Australia for a considerable length of time.

Differences in ICT education between New Zealand and Australia

While New Zealand is one of Australia's closest geographical neighbours and shares many similarities with Australia, Mrs Emerald commented about differences between the two countries in terms of ICT, as well as perceived cultural differences in teacher work ethic. She believed that the majority of Queensland teachers were not as driven to achieve and excel in their field, and that Australia lagged behind New Zealand in terms of ICT in the classroom and school infrastructure. While Australia is currently experiencing an economic boom, the economic benefits of this boom have not yet filtered through to the school system. Many government schools are running on shoestring budgets and have prioritised the way that their budget is allocated. However, she felt that while the schools in New Zealand and Australia had similar budgetary constraints, the schools in New Zealand were more flexible and open to change.

7.3 Social Factors

7.3.1 Family

Career expectations of parents

Family is an important influence on study and career choices during childhood and into adolescence (Barker and Aspray, 2006), and family expectations contribute towards girls' decisions to enter ICT study or career pathways (Lang and McKay, 2006). The findings in Sections 5.3.1 and 6.3.1 support these assertions. Even at the Year 4 level, there was evidence of students absorbing the career values and advice offered by their parents. The Year 4 and Year 8 students' parents offered suggestions about the occupations that they felt were appropriate or suitable. For example, a Pink Hill Year 4 student said, "*They [Mum] have already helped me choose mine [career]*", while a Red Oaks Year 8 girl said that her mother suggested that she should be an interpreter. While most of the Year 4 students believed that their parents' opinions about their career choices were important, the Year 8 Greenwood students tended to feel that career choice was an individual decision, and that their parent's opinions were not so important.

Following similar career paths to their parents

Observations of the parents' occupations can influence career decisions. For example, a Year 8 student wanted to follow her mother into law, as she had observed that it was a lucrative occupation. Yet, many Year 8 students saw their family members' occupations as boring, and had no desire to work in similar jobs. According to Dryler (1998), children often make vocational and occupational choices in the same area as their parents' expertise because of the belief that they would have more chance of obtaining their assistance in this particular area. This was demonstrated in this study; for example, a Red Oaks Year 4 student was interested in following the same career path as their parent, because he felt that field specific career advice and insider knowledge would be available. Furthermore, the Red Oaks Year 4 students associated parental career advice with financial support during their studies.

Observing their parents' ICT use and beliefs

Children are keen observers and notice the role that their parents take in everyday life (Margolis and Fisher, 2002, p. 21), including ICT use at home and in the workplace. The students frequently related how their parents used computers at home (study, playing games and the Internet). In general, the fathers played games and accessed the Internet, while the mothers used the computer for study and accessing the Internet. The students at the private schools tended to have parents who used ICT in a professional capacity, such as medicine, law and engineering. The parents of the government school students were less likely to work in professional roles or

© 2007 Kaylene Clayton

use computers at work. However, students were often unsure of how ICT was actually used in their parents' occupations.

Gender differences in parents' ICT use and ability

According to Downes (2002, p. 188), "the resident computer expert in the home is usually male (father or older brother) and the least involved in the family is usually female (mother or younger sister)". This study confirmed Downes' finding. Mothers tended to share a computer with the family, while fathers often had their own computer and were seen as the main computer user. The Year 4 boys also believed that their fathers had more ICT skill than their mothers, while the girls said that their parents were proficient with ICT, or their family was good "*at everyday [ICT] things*" (Greenwood student). Similarly, the Year 8 students generally identified their fathers as being the most proficient with ICT, with uncles and brothers also rating a mention. The students also tended to measure their ICT abilities against their parents and other family, and interpreted the ICT experiences of siblings and extended family in terms of themselves. Margolis and Fisher (2002) also found that parents, usually fathers, were more likely to be more actively engaged in ICT activities with their sons than with their daughters. However, in this study, fathers frequently featured in the girls' first experiences with ICT.

7.3.2 Peer Group

Social interaction with peers

In this study, the students worked cooperatively with their peers and shared the ICT resources fairly. This reflects the findings from the *Women in IT, Tasmania* report (Young, 2002). Students were seen collaborating, sharing ICT knowledge and helping each other to solve ICT problems. The students usually did this with and without teacher encouragement and were not afraid to ask their peers for help when needed. *MSN Messenger* and mobile phones were frequently used to communicate with their peers outside of the classroom. The students preferred to use *MSN Messenger* because, unlike mobile phone use, there are no ongoing costs (apart from an Internet connection). The students also enjoyed playing computer games. In the classroom, the girls tended to play games by themselves, and the boys were seen collaborating about strategies and watching each other play the game. These interactions with their peers are important, as peer networks can influence an individual's academic motivation by being a source of social interaction, allowing them to observe interactions of others and engage in activities (Pintrich and Schunk, 2002).

Influence of peers on subject selections

Peers exert a powerful influence on a child's beliefs and behavioural choices (Barker and Aspray, 2006; Henslin, 1999), and this in turn plays a role in student course selection decisions (Margolis and Fisher, 2002). This was confirmed in this study. For example, one Greenwood boy was very interested in ICT and spent a reasonable amount of time discussing topics not covered in the Computer Studies curriculum with his peers. He was intending to study ICT at a tertiary level and he (and his peers) chose to enrol in the Year 9 ICT subject. The students were also seen to make decisions about the difficulty of a subject according to their perceptions of the abilities of their peers taking that subject. For example, some of the Year 8 Pink Hill students were not planning to enrol in ICT subjects because they believed ICT subjects are for smart students.

7.3.3 Media

The influence of media on the students

The Internet, television, movies, music, magazines, computer games and newspapers can play a large role in producing and reproducing inaccurate or stereotypical views of ICT (Gürer and Camp, 2002), and reinforce cultural expectations of gender stereotypes (Henslin, 1999). Moreover, according to Helwig (1981), "the media, including the Internet, is a constant source of information about what is desirable, with values and status levels assigned to most everything". The students in this study were exposed to various forms of media in their home and school environments, and frequently commented on computer games and the Internet. In Year 8, playing computer games and using the Internet were seen as fun, leisure activities and not generally associated with schoolwork. While the students were not given much opportunity for "free time" on the computers in the classroom, they often accessed online games and the Internet when given the chance.

Computer games

One of the first ICT experiences the students remembered involved playing computer games. The Pink Hill girls enthusiastically remembered playing games based on television shows, movies and books such as *Rug Rats*, *The Lion King* and *Blinky Bill*. Incidentally, all of the primary characters in these computer games are male, with female characters playing secondary roles. The playing of *The SIMS* was another common link between year levels, genders and schools. A Red Oaks Year 8 student highlighted a reason for its popularity when she said that you "*can leave everyday life behind and have things you can't have in your normal life*".

Gender differences in computer games

Many computer games have been designed by males catering to male tastes (Scott, 1996), and these games involve time pressures, hand-eye coordination and competition (Huff, 2002). Games designed for girls tend to focus more on conversation and goal-based learning (Huff, 2002). Huff's findings about computer game design were observed in the Year 4 classroom. For instance, when playing the online motorbike racing game, the boys faced time pressures and had to skilfully manoeuvre the motorbike around the dirt track using the keyboard and mouse, while *The SIMS* was popular amongst the girls. Furthermore, when the students accessed online games, the boys chose action games, while girls completed puzzle games.

Media transmission of stereotypes

Mass media, such as television, movies and magazines, play a large role in influencing people's impressions of ICT (Gürer and Camp, 2002). Moreover, according to Goode et al. (2006, p. 99), "for students living in a media-saturated society who have no access to people in the field, the Hollywood image translates into a perceived reality". As such, the media appear to have had an influence on the development and transmission of gender and ICT stereotypes. For instance, while most of the students did not have experience with ICT work, or extensive exposure to ICT professionals, the students repeated the same ICT and gender stereotypes. When asked about the appearance of an ICT professional, they said that ICT professionals were male, wore glasses, and they referred to them as nerds and geeks. It is unlikely that these shared perceptions would have developed solely from their personal experiences, and were most likely sourced from television or movies.

7.3.4 Role Models

Role models of the students in this study

Role models tended to be parents, older siblings and teachers, whose beliefs about appropriate topics of educational interest, social norms and gendered behaviour are communicated both explicitly and implicitly (Barker and Aspray, 2006). Moreover, teachers, parents and peers acting as role models in association with past experience can influence educational and vocational decisions (Eccles, 1994). Correspondingly, the main influencers of the students in this study were their parents, family, teachers and peers.

Family as role models

Children are keen observers, assimilating the behaviours and attitudes of their parents and family and modelling their own behaviour on them. Examples of family members acting as positive ICT role models were observed a number of times. For instance, the father and aunt of

© 2007 Kaylene Clayton

two Year 4 Pink Hill students volunteered their time to assist in the computer laboratory. In particular, the father, who was an IT professional, demonstrated a confident and comfortable attitude when interacting with the students and the computers, encouraged the students and praised their achievements. The students in this study were also ICT role models to their parents, with a number of students discussing teaching their parents ICT skills.

Family as professional role models

"Role models may provide vicarious learning experiences that increase the likelihood of choosing a specific career" (Quimby and DeSantis, 2006, p. 298) or course of study (Ogan et al., 2006). The students spoke about mothers, sisters and uncles who acted as positive role models in terms of careers or ICT. For instance, a Greenwood boy referred to his uncle as his ICT role model; this boy was interested in ICT and was planning an ICT career. Furthermore, many of the private school students had parents who acted as professional role models, such as paediatrician or lawyer. However, the students were more likely to express an interest in following their parents into occupations that they believed had a high status. Other students had mothers who had returned to study, which role-models the ability to update skills or change careers as an adult. While there was no mention of fathers studying, the students in this study saw their fathers as being technically competent, computer game players.

Peers as role models

Students who are enthusiastic and knowledgeable about ICT role-model positive attitudes and values to their peers. In this study, the students were seen admiring their peers who had accomplished complex tasks, and helped others to solve ICT problems. For instance in the Year 4 classes, the students were encouraged to demonstrate ICT tasks completed at home and school to their peers and assist each other when they had difficulties. Furthermore, one Year 8 Pink Hill girl enthusiastically described, to a rapt audience of her peers, the robotics activities that her uncle taught. As such, the students role-modelled interest and confidence with ICT to their peers. A Red Oaks Year 4 teacher also believed that the students were being modelled to each time the SmartBoard was used. Students can also act as positive role models to the teacher, and students in this study were usually encouraged to share ICT techniques and suggestions with the teachers. Mrs Pink described this mutual exchange of ICT knowledge as a win-win situation.

Teachers as role models

Due to the amount of time teachers and students spend together, in addition to the authority relationship that is in place (Barker and Aspray, 2006), teachers are a particularly important role model for students (Downes, 2004). Furthermore, teachers who role-model the use of ICT in their teaching practices help their students to build confidence and competence as ICT users

© 2007 Kaylene Clayton

(Matthew et al., 2002). The students in this study observed the teacher's confidence, ability and interest in ICT, and mocked teachers whom they perceived to be less confident and skilled with ICT. Furthermore, the teachers who were confident and enthusiastic about using and learning about technology not only provided their students with a positive ICT role model, but had more engaged students. All of the Year 4 teachers in this study were enthusiastic about incorporating ICT in the classroom and displayed a positive attitude to attempting new ICT tasks. In contrast, only one of the Year 8 teachers was a positive ICT role model to the students and the students responded to this. For instance, Mr Rose's attitude was that "*we will have some fun and learn from our mistakes*", and the girls were generally enthusiastic about learning to program their calculator. During his lessons, Mr Rose fostered a pleasant and encouraging classroom environment, was seen to be comfortable with the technology and was not perturbed by any technical problems encountered.

7.3.5 Gender Stereotypes and Differences

Gender stereotypes

According to Barker and Aspray (2006, p. 20), "teachers' beliefs and attitudes about appropriate behaviors and roles for boys and girls, combined with their attitudes and beliefs about technology can subtly influence girls not to study computers". During the study, the Year 8 teachers were heard to express a number of common gender stereotypes, such as, "*girls are more loving*" (Mrs Jade), while Mr Rose added that girls are "*chitty chatty*" and more affectionate than boys. Mr Rose also recounted how the girls hugged their friends before separating to attend different classes and when they returned. In his experience, boys would not do that. In this study, there also appeared to be subtle differences in the way that the teachers acted towards boys and girls at times. For example, the coeducational Year 8 teachers seemed to expect the worst from the boys and tended to be more helpful towards the girls. Furthermore, contrary to Mr Rose's belief that girls' attitudes are becoming "*can do*", his students bowed to peer pressure to make themselves appear less knowledgeable in front of their friends. Eccles, Barber and Jozefowicz (1999, p. 178) confirm this and say that "girls and young women feel caught between their need to be 'nice' and their need to achieve".

Gender differences in ICT ability

Gürer and Camp (2002) believe that gender differences in ICT education become more pronounced over time, as most students in early education appear not to be influenced by gender, and maintain positive attitudes towards computers. In this study, some of the Year 4 girls confirmed that, although their peers currently had similar ICT abilities, the boys' ICT skills overtook the girls' ICT skills in later years. Furthermore, while the middle-school students and

teachers in this study generally agreed that there were no gender differences in students' ICT ability, the Year 4 girls were enthusiastic and confident with ICT, and in some cases more technically savvy than the boys. However, there were differences in the ways that work was undertaken. For instance, the boys rushed to complete their work, and returned to fix mistakes, while the girls completed the work correctly, then made it attractive. The students in this study also linked ICT ability to the motivation to learn ICT skills.

Gender differences in ICT engagement

In this study there were some noteworthy gender differences in ICT engagement. Mrs Emerald commented that middle-school girls were more educationally mature than the boys. For instance, the boys tended to show-off and be unfocused and were easily distracted and disruptive to the other students. The girls were more focused on their work and frustrated by the boys' disruptive behaviour. This disruptive behaviour caused problems for the other students and the teacher as valuable class time was wasted while the students were disciplined. In this study the boys treated the computer as something to tinker and play with, while the girls used it as a means of completing their work. This confirms Harrelson's finding that women use the computer as a tool, while men see it as a toy (Harrelson, 1999).

Gender differences in playing computer games in the classroom

There were also gender differences in the types and ways that computer games were played. For instance, the Year 4 boys were observed "cheating" to finish an educational game, so that they could move on to activities that interested them. Conversely, the girls usually played the game as it was designed to be played. One exception to this was when a Year 4 girl manipulated the masculine-themed game to enable the female characters to succeed and the male characters to fail.

Gender differences in working together and completing ICT tasks

In this study, there were gender differences in the way students worked together and completed their work using ICT. For instance, in mixed pairs, the girls tended to create the work on the computer while the boys left to talk to other boys. However, in male pairs, the boys were keen to actively use the computer. Female pairs shared the task and collaborated about the design and layout of the work. The Year 8 students would also, when possible, sit and work in same-sex or friendship groups. Furthermore, students who had the freedom to move around the room or choose their seats were more likely to collaborate with and help their peers. The Year 8 boys also tended to work independently, while the girls collaborated and solved problems in groups. In general, the girls offered constructive criticism to other students and praised their work, while the boys tended to demonstrate what they had found or show-off to their peers. These findings

© 2007 Kaylene Clayton

support Gürer and Camp's (2002) recommendation that girls should be placed in single-sex groups to provide them with a support mechanism.

Gender differences in exploring and using ICT

According to Fisher, Margolis and Miller (1997, p. 107), for girls "there seems to be less tinkering, less unguided exploration and less obsession". This was confirmed in this study. The boys seemed to be less inhibited than the girls when exploring and testing the limits of the computer and attempting new work, and they were also unafraid of making mistakes. For instance, the boys were frequently observed exploring program features or playing with the hardware (e.g. opening and closing the CD tray) instead of completing the assigned task. Although the boys increased their technical knowledge and discovered new features during the exploration, Mrs Emerald felt that the Year 4 boys had only recently understood the appropriate use and time to apply this knowledge. At times the boys also displayed a false sense of mastery. For example, one girl observed that boys pretended to know what they are doing, but could cause more problems by tinkering.

7.3.6 ICT Stereotypes

Origin of ICT stereotypes

According to Peiris, Gregor and V (2000), many stereotypical images start to take effect during childhood. There are many stereotypes (see Section 2.3.6) associated with IT including characteristics of workers, their environment and the type of work they do. It is highly possible that some, if not most, of these images of ICT professionals have not been witnessed first-hand, and are the product of socialisation and the media. Correspondingly, Adya and Kaiser (2006, p. 283) state that "media enhances gender stereotypes that emphasize physical image". However, the Year 8 students also seemed to base some of their descriptions of ICT professionals on extreme examples of people that they knew working in the ICT field or at school.

ICT stereotypes repeated by the students

The students almost always associated ICT professionals with being male, intelligent and tired from working long hours. They also referred to them as nerds or geeks or wearing conservative business attire and thick glasses. However, some Year 8 girls clarified their comments and said that wearing glasses was not bad; it was just that "computer nerds" did not wear fashionable ones, as appearance was not important to them. There was also an association that nerdy people were usually smart, unattractive or unhealthy. However, some Year 8 students used the terms nerd and geek with both negative and positive connotations. This confirms the *Reality Bytes* report (Multimedia Victoria, 2001, p. 56) findings which stated: "within certain youth cultures,

the word 'geek' is taking on an ironic coolness". While almost all of the students in this study did not at first associate women with working in the ICT field, when prompted, they described the women as being intelligent, beautiful and wearing business attire, high heels and perfect makeup. One student based her description on her mother, while one Pink Hill girl said, *"I don't know what a girl working with computers would wear"*.

Stereotypes motivating interest in ICT work

According to Gottfredson (2002), occupational stereotypes involve the personalities and lives of people working in these occupations, the work performed and rewards given, the conditions of the workplace and how appropriate the occupation. In this study, the students also associated various ICT stereotypes with the reasons that people do or do not want to work in ICT. The students generally believed that people wanted to work in the ICT area because: computers were their hobby; they had a penchant for ICT; they were proficient or talented with computers; and ICT skills were useful. Some students identified that ICT was a high status occupation and felt they could help others through ICT. In particular, one Year 4 student felt that people wanted to work with computers as there was minimal risk of injury; it is probable that the student's working-class background influenced this belief. The students agreed that the problems with hardware, software and the Internet and the associated frustrations discouraged people from working with computers.

Interpretations of ICT and work

When the students were asked about job roles in ICT, many of their descriptions were based on what their family, or people known to the family, did in their work in relation to ICT, or on their own experiences. The students identified that ICT work involved firewalls and networks, repairing or improving the performance of computers, creating computer games, or web development. They also felt that ICT work was difficult, boring and information intensive, and associated the importance of being able to type quickly with ICT work. Furthermore, they were concerned about the loss of boundaries between work and home life because of ICT. The students also identified the use of ICT in other professional areas such as photography, teaching and advertising. For instance, one Pink Hill girl spoke about a family friend who used ICT in advertising and said, "*he's like really rich now*". For many students, the Internet was a key feature in ICT job roles and was used for research, Internet-enabled commerce and business functions.

7.4 Structural Factors

7.4.1 Teacher

The teacher's background

The teacher's background and interest in ICT can influence the implementation of ICT in the classroom. The teachers in this study came from a variety of backgrounds and had differing levels of ICT experience, skills and interest. Of the Year 8 teachers, Mrs Jade had taught typing for 32 years and was not interested in ICT. Mr Maroon was an English, Business Education and Social Studies teacher and was assigned to this subject because he "*could touch-type and had some ICT in-service*". Mr Rose was a mathematics teacher and held a Science degree with majors in Mathematics, Chemistry and Computer Science, as well as a postgraduate teaching certificate; he had taught at Red Oaks prior to moving to Pink Hill. The Year 4 teachers were female, and there were two male and one female Year 8 teachers, which is reflective of the gender balance of teachers in Brisbane schools. While three of these teachers had pre-service ICT training and described the development of their interest in ICT prior to commencing their teacher training, four teachers had limited or no pre-service ICT training. Most of these teachers had had in-service ICT training, with one trained as an ICT coordinator.

Teacher training

Teachers are expected to be competent and to deliver a quality curriculum, but many teachers are under-prepared to deliver the ICT curriculum because of their level of ICT exposure and pre-service and in-service training (Goldman, 2003). Teachers who have not had significant exposure to ICT require ongoing support and pre-service and in-service training in hardware and software to update their ICT skills and build their confidence. While confident teachers are able to seek out their own training and expand their knowledge through exploration and use, less confident teachers may lack background skills to get started, or may be unaware of training opportunities or uncomfortable about seeking their own training. According to Barker and Aspray (2006, p. 43) the problem is that "policy has not enabled teachers the time, training, or reward structure to incorporate this newfound access into effective learning strategies". This was confirmed in this study. For instance, Mr Rose believed that the three main problems with in-service training in the government system were: the lack of government funding; that training is often provided out-of-hours; and the cost (financial and temporal).

Lack of time inhibiting ICT teaching

It appears that intrinsic interest in ICT drives teachers to give preparation for ICT activities a higher priority in their workload. Teachers have limited time to prepare lesson plans, research

new activities and prepare for the teaching of new technologies on top of their teaching, grading and reporting responsibilities. This work continues outside of contact hours and teachers often have to work many hours on top of their class contact time; it is a widely held fallacy that teachers receive twelve weeks holiday per year. Much of this time is spent on curriculum development and planning, administration and training. ICT lessons can also take more time to create, and they need to be well planned and to contain contingencies in case the technology fails. As in this study, Barker and Aspray (2006) reiterate the need to provide teachers with the time to be able to implement ICT effectively in the classroom. For example, Mrs Pink said, *"I can only bring kids into the computer area of the room when I have an aide. I cannot spare time to help or supervise when I am alone"*.

Resistance to change

Teachers who did not grow up with ICT frequently assume that the teaching methods used when they were students will work as well for their current students, "*but that assumption is no longer valid*" (Prensky, 2001a, p. 3). Other teachers resist change, or do not like being told how to do things. In Mrs Emerald's experience, teacher attitudes towards ICT could be improved with good, purposeful training, but it would take time for these changes to filter through the system. She cautioned that it might be impossible to change some old-school teachers who resisted change, before they retired or left the system. For example, Mrs Jade acknowledged that she used her past experiences to teach, and that she did not like change or to go beyond firmly established boundaries. This was reflected in her teaching as she reused lessons and workbooks. Furthermore, Mrs Emerald found that teachers who lacked the skills or confidence to implement ICT avoided using it and therefore their ICT skills remained static. According to King and Bond (2001), most teachers see computers as tools. This was confirmed in this study. For instance, Mrs Jade and Mr Maroon did not see ICT as a pleasurable task and believed that the computer was a tool and not a toy; accordingly, their teaching of ICT was also functional in nature.

Influence of teacher's attitude and interest in ICT

According to Barker and Aspray, (2006), teachers' ICT knowledge influences their students' ICT use, attitudes and computing-related behaviours into the future. Furthermore, the teachers who are interested in ICT recognise the value and power of what ICT can bring to their classroom. As such, the most noticeable feature of Year 4 ICT and Year 8 Mathematics classrooms was the positive environment. In Year 8, Mr Rose engendered interest and confidence with his philosophy of having fun and learning from mistakes. Conversely, in the Red Oaks Year 8 classroom, the underlying atmosphere was of distrust, and Mr Maroon discouraged enthusiasm and alienated students in his class. This had a negative effect on student engagement and behaviour. The teachers acknowledged and usually encouraged collaborative

© 2007 Kaylene Clayton

learning and a mutual learning environment. For instance, Mrs Jade said to the students "*we will be helping each other out because I have to relearn this program each year for this term*". When shown trust, the students responded by using technology responsibly.

Teacher influence on subject choice

Student perceptions of teachers assigned to teach a subject, including the teacher's personal abilities and preferences, can have a positive or negative influence on the student's choice to enrol in that subject. For example, the students said that if they liked a subject, but did not like the teacher, they might enrol in the subject. However, if the subject and teacher were not well liked, it is unlikely that they would choose that subject. The students also felt that the teacher could cause a student to dislike a previously liked subject. While the students did not know which teacher would teach a particular subject until the first day of class, the students could and did make informed guesses.

7.4.2 School ICT Access

School access to computers

Reinen and Plomp (1997) allude to students having unequal or poor levels of access to ICT at school, but this was not found to be the case in this study. All of the students in this study had access to computer laboratories equipped with data projectors and printers, while the Year 4 students also had computers in the classroom, with some also using SmartBoards or digital cameras (see Section 7.4.5). While several Year 4 teachers manipulated the laboratory timetable to allow longer access periods, this sometimes came at the cost of less frequent access. The teachers also felt that small pods of computers in the classroom might be more useful for a number of reasons. These included supervision of students, lost time and disruptions caused by moving between rooms, and the disruptions caused by computer failures. In this study, the ICT resources and applications provided to the coeducational school Year 8 students were not a priority. For example, Mrs Jade said, "*Year 8 is not when we are serious about the powerful stuff. I am the starting point of their journey … I am happy with it and I think most of the students are too*". The Year 8 Computer Studies classes were held in computer laboratories, and the Pink Hill class used a wireless network for their programmable calculators and had access to 16 laptop computers. However, the safe transport and secure storage of the laptops were problematical for the teacher. While the teachers believed that their access to ICT resources was adequate, they admitted that if there were more resources, they would be used.

© 2007 Kaylene Clayton

Access to the Internet, network and email

The students and teachers in this study had access to the school network, Internet and email. However, the Internet access speed frustrated both teachers and students at Red Oaks, and this meant that websites were unable to be accessed, or the content was not viewable. All of the Year 4 students were introduced to email this year, but the Pink Hill students were the most comfortable and confident with using email. The Year 4 students were also able to navigate the network and save their work to specific folders within their account. The Year 8 students at the private schools knew their passwords. had no problems accessing the network and resources, and were confident users of email. However, many of the Red Oaks Year 8 students in this study were unaware that they even had a school email account, and some had difficulties accessing the school network and the Internet because of password problems and non-payment of the school levy. Far more restrictions were also placed on intranet resources at Red Oaks because of lack of storage space on the school network.

7.4.3 Home ICT Access

Early access to ICT at home

In the past ten years, there has been rapid growth in the availability of computers (Barker and Aspray, 2006), and today's youth use ICT on a daily basis (Hartmann, 2003). In this study, the Year 4 students said that their first ICT experiences occurred between ages 3 to 6, while the Year 8 students said that their first experiences happened between ages 3 to 8. These first experiences often involved playing games. Furthermore, according to Hartmann (2003), students often use ICT differently at home. This home access to ICT, in association with individual attributes, appeared to be increasing the level of skill that the students had acquired outside of school. For example, Mrs Pink felt, and the students agreed, that at school her students were only enhancing the ICT skills that they had learnt at home. Furthermore, some Year 4 students felt that they would be more interested in ICT if they had computer access at home.

Level of home ICT access

According to the Australian Bureau of Statistics (ABS), home computer ownership and Internet access has rapidly increased since 1998. The ABS (2006) indicates that 70% of Australian homes have a computer, with 60% having Internet access, and 92% of Australian children aged 5 to 14 years have used a computer and 65% have used the Internet. According to the ABS (2006), the main reasons cited for not having Internet access at home were lack of interest in the Internet or no need for Internet access, and the expense of access. Similarly, while most of the students in this study had at least shared home access to computers, not all of the computers

were connected to the Internet, with the affordability of computers and Internet connections cited as the problem. The students also visited family, or the community library, to access computers and the Internet. This is important for students who do not have home access to computers or the Internet. Furthermore, while Downes (2002) believes lack of ICT experience may also be an inhibitor for home computer ownership, this did not seem to be a problem in this study.

Influence of ICT access on experiences

"The availability of computers in the home, school, and other places influences children's experiences with computing, and shapes their perceptions of how they get used and who uses them" (Barker and Aspray, 2006, p. 25). Competition between family members for ICT access was a negative experience for the students. While some of the students in this study had individual access to computers, many students had to share the home computer with family members. These students shared computers with their mother or siblings, but none shared access with their father. Downes (2002, p. 186) found that, in Australian homes, computers were "generally located in common spaces such as family rooms, lounge rooms and studies", and this was consistent with the findings from this study. However, more Red Oaks students reported that their computers were located in a bedroom. This is possibly due to houses in lower socioeconomic suburbs being smaller and not having space in the shared area for the computer.

Use of the Internet at home

The Year 4 students mainly used the Internet at home for online applications and websites such as *Google Earth* and *eBay*, games, school assignments and communication using email, *MSN Messenger* and *Skype.* The Year 8 students used the Internet at home for online banking, games, surfing the Internet and communicating with their friends. In this study, the students were early adopters of *MSN Messenger*, with a number of students having used it since early primary school. They recognised that the Internet enabled low cost, or free communication. However, according to Falkenberg Lund and Spanner Witzke (2006), girls are often unaware that mobile phones, chat programs and the Internet are more than just artefacts and applications.

Other forms of home ICT access

Outside of school, the students used other forms of ICT including mobile phones. Many of these phones were passed down to the students by their parents and family following the purchase of new models. The students were generally very aware of the costs of using mobile phones and moderated their use accordingly. A number of students did not just use their mobile phones to make calls or send text messages; they used the multimedia capabilities of the newer mobile phones. Other types of ICT used at home included PDA and gaming consoles such as Xbox,

© 2007 Kaylene Clayton

PlayStation or Wii. Furthermore, Mr Rose believed that the students faced peer pressure to have the latest technology "toy," which caused financial stress for their parents.

7.4.4 School Type

Differences between school types in this study

In this study, there were differences between private, government, coeducational and single-sex schools because of their underlying philosophies, values and priorities, and the financial support provided by parents and the government. These influences can affect the quality of education, resources and curriculum priorities. There was a noticeable difference in socioeconomic status of the schools and the attending students. For instance, the private school students wore full uniform and were well groomed, whereas the standard of dress and grooming was considerably lower at the government school. There were also differences in student behaviour and engagement at the three school types. Compared to the government school students, the private school students seemed calmer and were always well mannered and respectful of others, and there were far fewer behavioural issues at these schools. In particular, disruptive behaviour was a problem in the Year 8 Red Oaks Computer Studies class and caused significant teaching time to be lost. This appeared to be linked to problems with ICT resources, teacher interest in ICT and the curriculum, but Mr Maroon attributed the problems to the poor diet of the students.

Differences in ICT resources between school types

According to Meece (1997), there are differences between primary and secondary schools, with primary school classrooms tending to be less impersonal, formal, evaluative and competitive than secondary school classrooms. Furthermore, in this study, there was a vast difference between the ICT resources at the Red Oaks primary and secondary schools. For example, at the primary school, the SmartBoard was reliable and the students used it on a daily basis, while at the secondary school, the computers were unreliable and in poor condition and they were not used every day. The private schools had better access to reliable ICT resources and technical support, and Mr Rose believed that the quality of teaching was better than at the government schools (he had previously taught at Red Oaks). Compared to Red Oaks, there was little difference between the ICT resources at the private coeducational and female single-sex schools. However, the individual nature of each class, class members and teacher meant that there would always be some differences in the way that the curriculum material was delivered using ICT and received.

© 2007 Kaylene Clayton

Gender and school types

While the gender makeup of schools and classrooms can take a number of different forms, the female single-sex school setting is now receiving particular attention (Watson et al., 2002). Furthermore, the gender splitting of classes can be beneficial for both genders, with the boys working more cooperatively and quietly and the girls not being exposed to detrimental attitudes (Countryman et al., 2002; Gürer and Camp, 2002). These behaviours were also confirmed in this study, For example, the boys tended to be noisier and more disruptive in class, while the girls were calmer, more collaborative and more productive. Furthermore, the Pink Hill girls seemed to be at a higher educational level compared to their coeducational school peers. This was also confirmed by the results of the Queensland literacy and numeracy tests (see Table 7-1). Furthermore, according to Mr Rose, the gender splitting classes allowed the teacher to tailor specific materials and tasks to groups of girls and boys. Accordingly, this provides evidence that the gender splitting of schools and classes may be beneficial to both genders.

7.4.5 ICT Related Resources

Provision of ICT resources

Differing school priorities and vision drives the quality, quantity and type of available ICT resources. Each school has a predetermined budget, and it is up to the individual school and department to decide how that money is allocated. Consequently, the schools have differing types and quantities of ICT resources, and the reliability and access to these resources can be problematic. Furthermore, ICT resources are expensive and schools often struggle to find adequate funding resources to provide these resources. Not only are the hardware and ICT infrastructure expensive, the cost of software licences can also be prohibitive. Adequate support and maintenance of the resources is also an issue. In this study, the ICT resources at the private schools were newer and better maintained than the resources at the government schools. Furthermore, while the private schools continued to expand their resources, the Red Oaks secondary school struggled to maintain its existing ICT resources. Also, while the Red Oaks primary school was visionary with the implementation of SmartBoard classrooms, this came at a cost to other areas.

Since the data collection, Education Queensland and the Red Oaks primary school have announced initiatives to improve ICT integration in the classroom. Education Queensland is rolling out laptops for every government school teacher and, in October 2007[24], Red Oaks primary school announced a one-to-one laptop class starting with Year 5 students in 2008[25].

[24] http://education.qld.gov.au/smartclassrooms/strategy/si_computers.html
[25] Reference suppressed to protect the identity of the school

Furthermore, following the 2007 federal election, the Australian government has promised to revise the ICT (and related areas) curriculum and provide funding for schools to acquire or update ICT infrastructure and for individual computers for students in Years 9 to 12[26]. However, it is important to remember that the amount of technology available in a school is not always an indicator of the quality of education as, according to Goode, Estrella and Margolis (2006, p 98), "schools can be simultaneously technology rich and curriculum poor".

ICT and classroom/laboratory layout

The layout of the computer laboratories and classroom were less than optimal for the teacher and student needs. The primary school teachers felt that small pods of computers would be more useful for a number of reasons, including supervision of students, lost time and disruptions caused by moving between rooms and computer failures in the laboratory. The secondary school teachers also said that the layout of computer laboratories was not conducive to effective study when the students were working in groups or were using other items such as books. For instance, students tried to work with books propped up with the keyboard and there was no room for additional books. Laptop computers that are moved between classrooms may be able to solve the problem by allowing general classrooms areas to be used.

Problems with ICT resources

The Red Oaks computers were ageing and the technical problems were compounded by vandalism and lack of respect for the computers. The computers at the private schools tended to be set up in a standard operating environment, were newer and in a far better state of repair. While the computers at every school had technical problems, which temporarily prevented access to resources, the differentiating feature was the timeframe for rectification. For instance, at one stage in the Year 8 laboratory, approximately 25% of the computers were unusable. There were also problems with the Internet bandwidth at Red Oaks, and some of the Year 4 classroom computers did not have Internet connectivity. Furthermore, the lack of network storage at Red Oaks led to restrictions being placed on the intranet resources that the students could access. These problems added to the frustration of the Year 8 Red Oaks students and were an issue because not all Red Oaks students had home ICT access. According to Cleary, Pierce and Trauth (2006), the amount and quality of school ICT resources and Internet access that are available are important if the school student does not have home access.

Technical support issues

Technical support is important to maintain student and teacher confidence in the resources. Schools face the problem of having the technical expertise and budgets to keep their ICT

[26] http://www.alp.org.au/media/1107/msloo140.php

performing at an optimal level, and in many cases a teacher doubles as a technician (Soloway and Norris, 1999). While the private schools had access to onsite technical support teams, Red Oaks had only one support person at each school (one full-time, one part-time). Consequently, some Red Oaks teachers who had the appropriate skills assisted the technician with small tasks if the request was urgent and the technician was busy. According to Krause, Bochner and Duchesne (2003), teaching preparation also requires strategies to deal with technical failures and other problems. Mrs Jade confirmed that teachers with low levels of confidence and skill found it difficult to cope with technology failure or if the planned lesson could not be done or had to be modified on the fly. Soloway and Norris (1999) believe that some schools also have to deal with an assortment of platforms and architectures, legacy machines and well-meant donations. This was confirmed at the Red Oaks primary school, which maintained a variety of legacy computers.

7.4.6 Curriculum and Teaching

Exposure to ICT in the classroom

According to Barker and Aspray (2006), the degree to which students are exposed to computer applications, programming and games varies between schools. In this study, ICT was integrated and implemented in a variety of ways at the schools. However, at times the Year 4 teachers had to justify access to some ICT resources (e.g. email accounts and SmartBoards), which complemented the delivery of the curriculum. Furthermore, the school administration placed restrictions on the ICT hardware and applications (e.g. chat and webcams) that could be used because of safety concerns. The teachers sourced their own ICT curriculum resources and had access to some ICT curriculum resources through educational authorities, but their usability and convenience meant that even the more experienced teachers did not use them. It is very possible that this also discouraged less skilled or confident teachers who may have felt that it was too difficult and too much trouble to use the curriculum resources.

The ICT curriculum as computer literacy

According to Goode, Estrella and Margolis (2006, p. 91), "even at schools that are 'heavily wired,' computer science is too often interpreted as 'computer literacy' and only low-level user skills are taught". Barker and Aspray (2006) also believe that students have been introduced to the use of computers through keyboarding, word processing and the use of basic applications, and the limited nature of these tasks may be a real turnoff to the students. Furthermore, other researchers (e.g. Downes, 2004; Newmarch et al., 2000) agree that students obtain a skewed view of the ICT field because of this curriculum focus. This was confirmed in this study. Computer literacy appeared to be the main focus of the Year 8 Computer Studies classes in this

study. The *Microsoft Office Suite*, especially *Word*, *PowerPoint* and *Excel*, were commonly used by the students, and learning keyboarding skills was a universal factor in the Computer Studies curriculum. However, while similar core ICT skills were being taught, differences in student ability meant some students had to repeat skills that they were competent in.

Computer games to assist ICT teaching

There was a mixed reaction from teachers about the usefulness of computer games in the classroom. The Year 4 teachers felt that games were useful for reinforcing a concept or as a reward for the students, but the Year 8 teachers did not agree. Mrs Jade believed that games were not useful in the classroom. Mr Rose originally believed that using games in the curriculum was not useful, but he now thinks that games could assist with building thinking and problem-solving skills. The students appreciated playing games as a reward and as a welcome break from normal class routine, but did not want them used in everyday activities.

Inhibitors to using ICT in the curriculum and teaching

Some inhibitors to using ICT in the curriculum are the time required to create and deliver curriculum material and the lack of appropriate and timely training in hardware and software (see also Section 7.4.1). Krause, Bochner and Duchesne (2003, p. 326) identified that the "lack of access or inequitable access to technology is a significant issue that influences the quality of student learning and learning outcomes". As seen in Sections 5.4.5, 6.4.5 and 7.4.5, the availability and reliability of ICT resources impacted ICT classroom experiences and inhibited the delivery of the curriculum to some degree at the schools. Furthermore, as demonstrated in this study, teachers who are passionate about the areas that they are teaching are more likely to source new ideas and put more time into the preparation of lessons than teachers who are obligated to teach that subject. Teachers who have an interest in the ICT area need to be recruited and recognised and rewarded for their efforts.

Using ICT to engage students

While using ICT to deliver the curriculum can require more effort from the teachers and students, it can also increase student productivity and engagement while decreasing behaviour problems in the classroom. For example, the Red Oaks Year 4 teachers felt that the SmartBoard had made a huge difference in the students' engagement, behaviour and learning experience as it allowed the class to share ICT learning experiences. Also, while teachers need to focus on good teaching, they should also evaluate whether it is intellectually challenging, interesting and useful for the student (Mitchell et al., 2000). Mr Rose felt that confident teachers led to engaged students. He used ICT as a method of engaging the students, as well as making his classes innovative and interesting for the students. However, the Computer Studies subject generally

© 2007 Kaylene Clayton

appeared to be treated as a form of electronic babysitting where the students were supervised, but the content was not of high importance.

Student dissatisfaction with the ICT curriculum and teaching

Student dissatisfaction with the secondary school ICT curriculum has been a long-standing and ongoing problem (e.g. Carey, 2001; Multimedia Victoria, 2001; Pau et al., 2005; Teague, 1998). In Year 4, the students believed that learning was fun, that they liked learning useful information and being challenged and stimulated. However by Year 8, many of the tasks in the Computer Studies classes were believed to be tedious and were completed without enthusiasm. Many students spoke of their disenchantment with and boredom in the Computer Studies classes because of the emphasis on keyboarding. In contrast, the Pink Hill Year 8 girls were exposed to new technologies, tools and techniques and responded enthusiastically to learning them.

Student reaction to the ICT curriculum and teaching

There were discrepancies between how the teachers felt that ICT should be taught and the way that the students felt was useful to them. Hinds and Croft (2006) also found that most students were open to more creative ways of solving problems rather than the classical methods and found that teaching ICT in a step-by-step manner hindered their interest. This was confirmed in this study, and the students agreed that they would rather teach themselves how to use computer applications at their own pace by tinkering than having structured lessons to step them through the applications. Mr Rose felt that student expectations were changing and that they were picking up ICT skills faster because of their exposure to ICT at home and in their everyday lives. The students responded to the Computer Studies teaching and curriculum with boredom, frustration and disengagement. Engagement increased when they were given a task that had meaning or involved learning new or challenging skills. However, the students feared information overload and felt that they would not cope with the amount of learning required to work in the ICT field.

Curriculum and teaching influencing course selection

For the first time in their education, students in Year 9 onwards can choose elective ICT subjects from a number of school-defined subject groups. The selection of ICT courses can be influenced by parents, teachers and guidance counsellors steering the girls away from these courses (Barker and Aspray, 2006) as well as individual abilities, the students' ICT experiences and interpretations of these experiences (Young, 2002). Moreover, many of the names given to secondary school ICT subjects and their associated image do not reflect the true nature of the subject (Courtney et al., 2006). These influences were confirmed in this study. For instance, none of the students were encouraged to enrol in ICT subjects, they felt ICT information

sessions were biased and they frequently chose subjects based only on a brief subject description. Furthermore, they had a poor understanding of what the specialist ICT subjects involved, and they made decisions about the difficulty of a subject according to the abilities of other students who enrolled in it and their previous ICT experiences. While some students felt that the elective subjects prepared them for future study, others felt that Year 11 and 12 was when this happens. However, by Year 11, the students are competing in the tertiary entrance system and it is often too late for them to explore alternative subjects and career pathways.

7.5 Individual Attributes

7.5.1 Individual Aptitudes, Personality and Attitudes

Individual Aptitudes

While there were varying levels of ICT ability displayed by the students, the students and teachers generally felt that there were no significant gender differences in ICT ability. In this study, the students were usually able to quickly replicate the skills being taught or demonstrated. At the Year 4 level, girls were confident users of ICT and tended to complete their work faster and with more skill than their male peers. However, one Year 4 girl believed boys' ICT aptitude increased in later years. In the Year 8 classes, a number of boys declared that they were skilled and knowledgeable about computer building and repair. However, no girls acknowledged similar skills. Some Year 8 students also mocked teachers who did not meet their expectations of ICT aptitude. The students' perception of the skills and characteristics required for success in an ICT career and ICT use influenced the interest and perceived ICT ability of females (Chan et al., 2000). In this study, there was evidence of how perception of aptitude drives choice of a subject with the belief that 'smart people' enrol in ICT subjects. The Year 8 Pink Hill girls did not feel that they fit the image and as such were unlikely to enrol.

Student likes

In general, the students in this study said that they liked to learn and were excited by learning new and useful skills. In particular, the students liked the changing and evolving nature of technology. Correspondingly, exposure to new technologies also inspired the students' interest, but this was often short-lived until they became accustomed to it. For example, the Red Oaks Year 4 students were fascinated by the digital voice recorder used to record the interviews, but interest quickly waned once they tried it for themselves. Principally, the students appreciated the value of using ICT in their schoolwork as there were tools such as spell check, it was faster than working by hand and it assisted with the presentation of their work.

© 2007 Kaylene Clayton

Student dislikes

In this study, the students unanimously agreed that they were frustrated by hardware and software failures and slow computers and network/Internet access rates. These frustrations led to disengagement of the students in their ICT tasks and disruptive behaviour. Furthermore, boys, and occasionally girls, were observed demonstrating aggressive behaviour towards the computer when they were stymied by computer problems. A common theme during this study was that this disengagement led to the students being uninterested in specialist ICT subjects and occupations in the future. Furthermore, the Year 8 students did not like being intricately stepped through using applications and preferred to intuit the process and work at their own pace.

Personality

Over the years, psychologists have collated and categorised numerous personality traits in order to identify five replicable broad dimensions of personality expressed in a descriptive model of personality. These dimensions are: openness to experience; conscientiousness; extraversion; agreeableness; and neuroticism. According to John and Srivastava (1999, p. 122), "one of the apparent strengths of the Big Five taxonomy is that it can capture, at a broad level of abstraction, the commonalities amongst the existing systems of personality traits, thus providing an integrative model for research". While personality reflected in the Big Five taxonomy is frequently measured in a percentile form, this was not the aim of the study. These five dimensions of the Big-Five taxonomy are simply used to help organise the personality factors found during exploration in this research. The following paragraphs discuss the observed personality traits in the middle-school ICT classrooms. In general, while both genders were confident users of ICT, the boys were more inclined to explore the computers than the girls and the girls were more engaged in their tasks than the boys.

Openness to experience

Openness to experience includes positive traits, such as intelligence, curiosity, inventiveness, and artistic creativity, and negative traits, such as shallow and narrow interests (John and Srivastava, 1999). According to Denner and Bean (2006, p. 730), "aspects of girls' self-identity (such as confidence) and social identity (whether others consider them to be good at computers) affect problem solving and their willingness to try new things". Openness to experience was demonstrated in this study as the students frequently collaborated and problem-solved with their peers. However, the boys were often seen tinkering and exploring the computer in class, while the girls were more reserved in their explorations. Furthermore, the students indicated that they were not interested in creating with ICT, apart from games or websites. Most of the Year 4 students displayed confidence and were usually keen to attempt new tasks and learn new ICT skills, with and without the support of their teacher. However, Year 8 girls indicated that they

© 2007 Kaylene Clayton

chose subjects that they felt were easy, despite saying that they were not adverse to difficult or challenging subjects.

Conscientiousness

According to John and Srivastava (1999), conscientiousness includes positive traits, such as organised, responsible, conscientious and practical, and negative traits, such as careless and frivolous. In this study, the girls tended to be more precise and conscientious when completing their ICT tasks, while the boys rushed to complete their work and then corrected mistakes. In contrast, the girls usually ensured that their work was complete first and then decorated it. Furthermore, the students generally responded to the teacher's trust, when given, by respecting the ICT resources and using them responsibly. Some of the Year 8 students had already commenced preparations for their future careers, while others had not begun to investigate what was available. For instance, a Greenwood Year 8 boy displayed a conscientious attitude as he had considered the subject selection process and organised his subject choices based on his future career preferences. However, Mrs Jade disagreed that her Year 8 students displayed a conscientious attitude, and felt that they showed carelessness and poor precision when completing tasks.

Extraversion

Extraversion includes positive traits such as, but not exclusive of, assertive, outgoing, noisy, dominant and enthusiastic, and negative traits, such as shy and silent (John and Srivastava, 1999). The Year 4 students were generally enthusiastic about ICT. For instance, the Red Oaks boys were overheard saying, *"I love computers", and* there was a sense of excitement when the SmartBoard was in use. However, in the Red Oaks Year 8 Computer Studies class, chronic absenteeism was a problem. Furthermore, a Red Oaks Year 8 boy voluntarily left to attend the behaviour management room as a means of avoiding the Computer Studies class. The boys were also more likely to be disruptive to the other students, especially in Year 8. According to Barker and Aspray (2006, p. 31), "girls' gender identity may influence assertiveness with computer use at school." In this study, the girls were assertive when using ICT. For instance, a Year 4 girl assertively stopped a boy from interrupting her game by elbowing him and saying, *"don't touch mine!"* The girls at the coeducational school tended to be bossier than the boys, but this bossiness tended to be directed at the boys to ensure the completion of group work. The Year 4 boys were also more inclined to show off than the girls or the Year 8 students.

Agreeableness

Trust, cooperation, praise and helpfulness are the positive traits of agreeableness, while the negative traits include being quarrelsome and unkind (John and Srivastava, 1999). In this study,

the students frequently demonstrated the positive traits of agreeableness through their inclination to help others and solve ICT problems. They were also willing to collaborate with others and share their knowledge. Furthermore, they generally had a strong sense of justice and negotiated fairly about ICT access. For instance, when a Year 4 Red Oaks girl tried to have more than her fair share of time on the SmartBoard, her peers were upset and quickly let the teacher know that the girl was "*cheating*". Furthermore, a Year 8 Red Oaks boy gave up a working computer for a girl without being asked or the teacher intervening, and shared a computer with another boy. In particular, girls praised and admired each others' work and were compassionate to other girls. For instance, when a Year 8 Pink Hill girl said she felt left out because nobody contacted her on her mobile phone, another girl immediately offered to send her a message to make her feel better. Furthermore, the students responded to the trust given to them by teachers by responsibly and respectfully using the ICT resources.

Neuroticism

Neuroticism includes negative traits such as, but not exclusive of, anxious, nervous, fearful and worrying, and positive traits, such as calm and contented (John and Srivastava, 1999). According to Ambrose, Lazarus and Nair (1998), there are four main areas which are pivotal for self-confidence: performance and accomplishments, observing and learning from others, freedom from anxiety concerning work and conduct in a particular field, and persuasion and support from others. In this study, the students at times demonstrated disappointment, frustration and aggression towards the computers when there was a technical problem. For instance, to demonstrate their frustration caused by the problem, some of the boys shouted, hit the keyboard or banged the mouse on the desk. Although there were times that the girls were also frustrated, it was rare to see them be aggressive, or display their frustration in this manner. Furthermore, the female single-sex school students appeared calmer than their coeducational school peers. Some of the Year 4 girls were anxious about "breaking" the computer, while some of the Year 8 girls were anxious about being ahead of or behind the level of their peers.

7.5.2 Interpretations of Experiences

Positive interpretations of experiences in ICT classrooms

Classroom ICT experiences were interpreted both positively and negatively by the students. The students believed that computer classes could sometimes be fun and more interesting than traditional teaching, and at other times it was something that had to be endured. Generally, they discovered that ICT skills could enable their work to be completed faster, easier and neater. The students in this study found accessing new forms of technology to be stimulating, with the Internet being a key element of their experiences. In particular, the Year 8 girls reacted

positively to successfully completing new or difficult tasks and were eager to repeat their successes. For example, when the Year 8 Pink Hill girls ran the program that they had created on their calculator, a girl was heard to exclaim, "*that's awesome!*" Furthermore, the teachers' attitude towards ICT was generally reflected in their students' experiences and attitude; positive teachers encouraged positive students, and negative teacher ICT attitudes led to less engaged and uninterested students. For instance, Mr Rose was very enthusiastic and positive about ICT, and enjoyed using it, and this positive attitude filtered through into the classroom.

Negative interpretations of experiences in ICT classrooms

The students also have negative interpretations of their ICT experiences. In most of these experiences, technical issues were a prime contributor to the negativity towards ICT. The students continually referred to problems including viruses, hardware and software failures, and the cost of hardware and software. They also stated that people would not want to work in ICT because of these problems. The Year 8 Red Oaks teacher reinforced this negativity by telling the students "*don't get frustrated if you are having technical problems. It happens all of the time with computers*". The ICT teaching and curriculum also contributed to negative interpretations of ICT experiences. For instance, the students felt that the activities in the Computer Studies classes were boring and repetitive, and a number of students were frustrated because they were forced to learn skills they already knew. The Year 8 students also responded negatively to ICT subject marketing and felt that the subject descriptions did not accurately reflect the content. Given these experiences, it is not surprising that only a very small percentage of students planned to enrol in Year 9 ICT subjects.

Association of ICT experiences with ICT work

The students seemed to form their impressions about the content of specialist ICT subjects and the role of ICT professionals on their own personal ICT experiences. According to Hinds and Croft (2006), parents' perceptions of ICT careers are generally negative and include: there are few job opportunities and a high staff turnover rate; it follows a boom/bust cycle; it is a hard and competitive field to enter; and it is a solitary occupation. Correspondingly, the students in this study repeated their parents' interpretations of ICT. For instance, a Pink Hill Year 8 student said, "*Mum thinks computer lessons are a total bludge*". Furthermore, they repeated and applied negative gender and ICT activity stereotypes (e.g. male, unhealthy, geek) to the people they observed working in the ICT field. These appeared to be repeated interpretations of media images, or opinions of family and peers. During typing drills in the Red Oaks Computer Studies class, the teacher reinforced a negative association between ICT work and typing when he told the students "*we are practising work*".

© 2007 Kaylene Clayton

7.5.3 Goals and General Self-Schemata

ICT and achievement of short-term goals

According to Eccles, Barber, and Jozefowicz (1999, p. 174), "socialization shapes 'individuals' self-perceptions, identity formation, goals and values". In this study, the students associated ICT use in the classroom with achieving their short-term goals. They saw it as a means to complete their work and reduce their effort. Some of the students were anxious about damaging the computer through unintentional misuse, and they worked towards learning ICT skills to reduce this risk. In this study, some of the Year 8 students' short-term goals involved the preparation for Year 9 subject selection. According to Meece (1997), students may have difficulty in understanding the relevance and importance of schoolwork in achieving their future goals. On the contrary, some of the students understood how Year 9 and 10 subject choices fed into senior subjects and the linking of subject choices in Years 11 and 12 to careers. However, one student felt that subject choice was not important in Years 9 and 10, as there would be time to learn things that were important to their careers in Years 11 and 12.

ICT and achievement of long-term goals

In this study, the students were also beginning to plan how they were going to achieve their long-term goals, such as the types of senior subjects they should choose to prepare them for their tertiary education and careers. Contrary to Meece's (1997) findings, the students saw the benefit of learning ICT skills at school for when they are studying or working. They also felt that ICT would help them to achieve their long-term goals as they understood that ICT was involved in most jobs. According to Eccles, Barber, and Jozefowicz (1999), if peers reinforce traditional gender role behaviours and values, there will be gender differences in the types of activities undertaken and acquired values, competencies, patterns of expectations and long-term goals. In this study, many of the girls expressed the desire to work in predominantly pink-collar, or humanitarian occupations, such as nursing, childcare or hairdressing, while the boys spoke about male-dominated fields, such as a being butcher.

Representations of self-concept

In this study, the students demonstrated attributes of actual-self when they described themselves as having the ability to develop web pages and being able to repair or build computers. One boy also felt that, while he possessed the attributes required to work in the ICT field, he did not want to. Furthermore, some of the Pink Hill girls also felt that they could not do the Year 9 ICT subject, as "*all the smart people do that subject*". The students' ideal- and ought-self was represented through their preferred careers. In almost all cases, the negative ICT stereotypes repeated by the students did not fit into the image of their ideal-self. Consequently, student

involvement in ICT occupations was unlikely. The students also matched the observations of their parents' occupational characteristics to their ideal-self. Furthermore, their views of their ideal-self related to the beliefs about their abilities, such as being talented in sports. Generally, the students felt obliged to listen to their parents' opinions of appropriate careers. They also expected to be guided by their parents' experience and believed their advice would be beneficial. Mr Rose also believed that children feared being thought of as failures because they did not achieve the same level of standing as their parents.

7.5.4 Subjective Task Value

The utility value of learning ICT skills

Even in the early primary school years, people "appear to have distinct beliefs about what they are *good* at and what they *value* in different achievement domains" (Wigfield and Eccles, 2000, p. 75). The students were observed customising their work in order to give their work a purpose, or context, and make it more interesting. In general, the students felt that learning to touch-type, developing information searching skills and learning to use computers would help to prepare them in future study or careers. They also felt that learning ICT skills would allow them to help others, increase their independence, be more efficient, have fun and make money. Furthermore, while keyboarding was unpopular, the students recognised the value of keyboarding skills for social and educational reasons. The teachers also reinforced the value of the ICT skills. For example, Mr Rose said, "*these are the things that you will need to know how to do for the rest of your lives*". The teachers were motivated by personal interest in ICT, a thirst for knowledge and the desire to engage students by making the teaching interesting and fun.

Cost of ICT tasks

Cost is the perceived negative aspect of being involved in a task (Pintrich and Schunk, 2002). The cost of participating in an activity is a trade-off between the time and energy required for that and other activities, and is influenced by fear of failure, the social consequences of success and anticipated anxiety (Eccles, 1994). Students and teachers recognised the disadvantages of working with ICT and spoke about the cost of using or working with ICT in a financial and temporal manner. Furthermore, both students and teachers referred to the expense of computers, purchasing delays because of funding and the cost of training. The students also recognised that learning ICT skills could be time consuming, and specialist ICT subjects required considerable effort, and consequently time, to achieve success. The students also considered the cost of working in ICT including the cost to image, health and employability. For example, most students recounted many negative ICT occupational stereotypes and felt that working in the IT field would cost them their fitness because of the belief that it was an unhealthy, sedentary

© 2007 Kaylene Clayton

occupation. Another inhibitor for completing ICT qualifications was the perception that it would be difficult to secure ICT employment.

7.6 Socioeconomic Status

Socioeconomic background of the student

According to Pallas (2000), parental education is a measure of socioeconomic status, and well-educated parents are more likely to provide their children with better educational resources and information. There were distinct differences between the socioeconomic backgrounds of the students (see Sections 4.5.1 and 5.6). For instance, Red Oaks was located in a disadvantaged, blue-collar suburb with a higher than average rate of unemployment and number of single-parent families. Furthermore, only 5.7% of the Red Oaks suburb population worked in professional occupations. Although Greenwoods and Pink Hill were within a reasonably close distance to Red Oaks, they were located in middle to upper-middle class suburbs with a lower than average unemployment rate and predominantly white-collar workforce.

Cost of attending the schools

The parents of the private school students paid between $5300 and $9000 per annum for tuition, or were in receipt of a scholarship, and the cost of their more complex uniforms and required equipment would add a significant amount to this tuition cost. The parents of the Red Oaks students paid only a small levy (the cost depended on the subjects undertaken) to cover textbook hire and some consumables and classroom supplies. Although the levy was relatively small, the non-payment of it caused problems with some of the students being unable to log onto the network, as they had not been issued with an identification card. Furthermore, the Year 4 private school teachers did not seem to have any issue with students missing school supplies such as pencils or books. However, the Red Oaks teachers kept a stock of spare items and it was quite common for students to be missing items. The Red Oaks uniform was simple and cost significantly less than the private school uniforms.

Differences in attitude and behaviour

According to Volman and van Eck (2001, p. 625), "young people's attitudes appear to be linked to those of their parents and to the socioeconomic backgrounds of their families". The differences in the behaviour of the students, along with their diet, reflected their socioeconomic status. While the private school students took pride in their presentation, some Red Oaks students in this study were unkempt and scruffily dressed. The private school students in this study were always well mannered and generally respectful of property, and there were fewer behaviour problems at the private schools, possibly due to the influence of parents, the

selectivity of the school and a better diet. Furthermore, the female single-sex school students seldom required censure in the classroom. Mr Maroon blamed some of the behaviour problems in the Red Oaks classroom on their poor diet. The students often skipped breakfast and their diet largely consisted of fast foods.

Socioeconomic issues in school environment and ICT resources

There were some differences noticed in the school facilities and environment in relation to the socioeconomic status of the school location and the tuition charged by the school. The private school classrooms and computer laboratories generally had a pleasant environment, and the facilities were in good condition and well maintained, while at the government coeducational school, apart from the SmartBoards, their facilities were basic, ageing, run-down and at times unpleasant. For example, the general facilities at the Red Oaks secondary school were in poor condition, with graffiti on the buildings and inadequately maintained and malodorous girls' toilets. Furthermore, the small, window-fitted air-conditioning units in the Year 8 computer laboratory sprayed black water over the computers and students sitting below it and caused an unpleasant odour when they were turned on.

Socioeconomic issues in school environment and ICT classroom

According to Krause, Bochner and Duchesne (2003, p. 326), the "learner's socioeconomic status and the financial resources of the schools they attend play a significant role in determining access to quality learning resources". This was confirmed in this study. The computers at the private schools were generally reliable and reasonably modern. The private schools also had dedicated teams of ICT support staff to address problems within a short time frame. However, the laboratory and classroom computers and technical support at the government school were deficient. While the Red Oaks primary school made a significant investment to provide SmartBoards in each double classroom, they had sacrificed other areas of the school budget, such as replacement of individual computers and some maintenance. The Year 8 Red Oaks computers were particularly in a bad state with at one stage approximately 25% of the computers in the room being out of order. While there was no evidence of malicious damage to the computers at the private schools and at the Year 4 level, the computer equipment at the Red Oaks secondary school showed signs of malicious damage and significant wear and tear. The Greenwood computer laboratory was one of the older, low-priority laboratories and while it was in relatively good condition, it did need some minor maintenance/repairs which were attended to during the term. Pink Hill was by far the best maintained and resourced of the three schools.

© 2007 Kaylene Clayton

7.7 Study and Career Choice

7.7.1 Orientation to Size and Power

According to Gottfredson (2005) , between the ages of three and five children categorise people by basic attributes, associate occupations as adult roles, and stop wanting to fulfil fantasy roles. Some of the Year 4 students saw themselves in fantasy or idealistic careers in the future and most of these occupations involved fame and wealth such as being a princess, rock star or actress. Other idealistic occupations were sporting in nature and included V8 Supercar driver, football player or equestrian. These idealistic careers appeared to be based, in part, on their life experiences. In the Year 8 classes, there was still some trivial evidence of fantasy careers amongst the students, but they were infrequent and more related to real-life roles, such as being an elite sportsperson or a musician.

7.7.2 Orientation to Sex Roles

According to Gottfredson (2002), between the ages of six and eight children rule out occupations that are not perceived to be appropriate to their sex type and focus on visual attributes such as activities and clothing. There was evidence of students having reached stage two of the circumscription process in this study. For instance, a Year 4 Red Oaks girl declared that she wanted to be a V8 Supercar driver, but was verbally attacked by a boy who told her that "*girls don't drive*". Furthermore, many of the girls wanted to work in stereotypically female job roles. Some of these roles included operating a beauty salon, modelling, teaching, fashion design, nursing and childcare. With the exception of teaching, none of the boys expressed the desire to work in these predominantly pink-collar or humanitarian occupations. Instead, they were interested in being in the army, a police officer or a butcher. Some girls also expressed the desire to follow similar career pathways as their mother, or female family members, especially if these occupations had a reasonable status.

7.7.3 Orientation to Social Valuation

When children reach stage three (ages nine to thirteen) of the circumscription process, they become aware of differences in the social standing of occupations and the personal attributes needed for that occupation, and they eliminate occupations that are perceived to not match their social status or require too much effort or ability (Gottfredson, 2006). There was evidence that most of the students were at least beginning to evaluate the wealth and status of their preferred occupation and the amount of effort that would be required. For instance, many of the preferred

© 2007 Kaylene Clayton

occupations of the private school students were in professional or respected areas, and they aspired to work in an occupation that would make them wealthy and/or famous. University was seen as one of the ways for the students to increase the prestige of their occupation. However, they rejected following in their parents' occupations if they believed that it was a low-status job. While remuneration was important to students, a number of the students said their parents advised them to choose their career based on enjoyment. The students also believed that making some sacrifices for your career was acceptable, as long as you enjoyed the occupation. Only one Year 4 girl and one Year 8 boy identified that ICT occupations were highly remunerated, while one Year 8 boy felt that working in ICT made a person important. Many other students discounted ICT careers, as they believed that the introductory ICT subjects were too difficult.

7.7.4 Orientation to the Internal, Unique Self

Some of the Year 8 students were entering stage four of the circumscription process, which involves the conscious elimination of careers from a narrowed group of options, to leave occupations students think will be fulfilling and compatible with their self-image (Gottfredson, 2005). In this study, the students were observed reflecting upon their likes and dislikes, and strengths and weaknesses, in order to make their subject choices for Year 9. For instance, a Year 8 boy found that he enjoyed learning about ICT, so he decided to enrol in Year 9 and 10 ICT subjects as a prelude to the senior secondary and tertiary ICT subjects. However, many Year 8 students chose not to take Year 9 ICT subjects as they did not like the content or felt that they lacked the ability to cope with the work. Furthermore, the association of ICT workers with being nerdy was not compatible with the students' self-image.

© 2007 Kaylene Clayton

7.8 Model of Girls' ICT Study and Career Choices

Through a search of related literature and the findings from this study, the Model of Girls' ICT Study and Career Choices (see Figure 7-2) was developed showing factors that influence the ICT study and career choices of middle-school students at the three Brisbane schools.

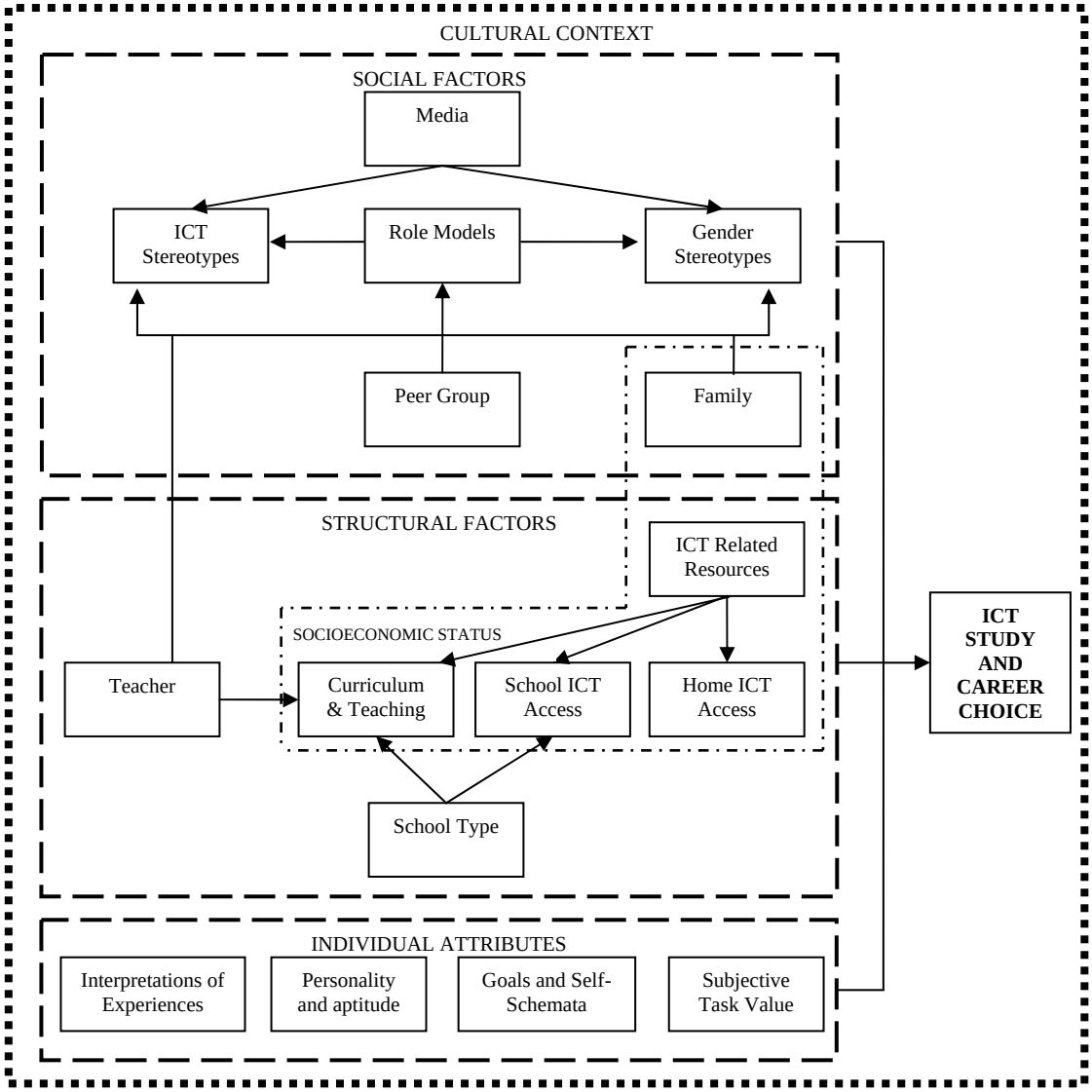

Figure 7-2 Model of Girls' ICT Study and Career Choices

Like Adya and Kaiser's Model of Girls' Career Choices (2005), the model is exploratory in nature and groups the factors that influence middle-school girls' study and career choices into three main areas: Social Factors, Structural Factors and Individual Attributes. All of these factors and the study and career choices take place in an environment affected by the culture in which the students live and have been socialised in. Socioeconomic factors further shape the way that some of the social and structural factors, including home and school ICT access,

curriculum and teaching, ICT related resources, and family, impact middle-school girls' study and career choices.

The influences of these factors on girls' ICT study and career choices can work in isolation or in combination, and the effects can be cumulative. Furthermore, these influences should not be regarded as being equal in origin or effect, as it depends on the context and the individual's interpretation of the event, situation or result. These factors are also not absolute and could be turned around if the reversing influence is greater than the effect of the factors or cumulative effect.

While the Model of Girls' ICT Study and Career Choices (see Figure 7-2) has evolved from the initial conceptual model (see Figure 7-1) into clearer categories, the model has only been grouped and reorganised and there were no new major influences identified. As such, the literature to support the inclusion of these factors (see Section 3-5) remains relevant to the development and discussion of the Model of Girls' ICT Study and Career Choices.

The key findings from the study, presented under the major subheadings of the Model of Girls' ICT Study and Career Choices (Figure 7-2), are as follows:

Social Factors

- Observations of parents' use of and their perceived capability with ICT impacted on the ICT perceptions of students.
- There was a strong association between fun activities and computer use by fathers, and mothers were believed to have less ICT ability than fathers.
- Most of the students absorbed the career values and advice offered by their parents, but this advice can be biased by the parents' perceptions and preconceived ideas.
- The students responded to teacher, peer and family enthusiasm for ICT by increased interest in ICT.
- The students collaborated, shared ICT knowledge and helped each other to solve ICT problems, but classroom layout and teacher imposed restrictions impacted on this.
- Peers with high levels of ICT skill and ability were referred to in stereotypical terms used in a positive manner to demonstrate admiration.
- The Year 4 girls felt that they currently had the same ICT ability as the boys, but felt that as boys got older their ICT skill development accelerated.
- Generally, while girls worked industriously on tasks and were not disposed to make mistakes and test limits, boys tended to be disengaged and disruptive and tinkered with the computer.

© 2007 Kaylene Clayton

- The students repeated common ICT and gender stereotypes, which appeared to be a product of the media and extreme examples of their (and their families') experiences.
- The students did not initially associate women with working in the ICT field, but when prompted they described them in positive terms, unlike the stereotypical male images.

Within the Social Factors element, Role Models and Mentors were separated out, as it was felt that Media and Peer Group were strong enough influences to deserve specific attention. This study demonstrated that the media can reinforce and reproduce stereotypical views of ICT and gender roles through movies, television and the Internet, amongst others. However, as peers, media, teachers and family all acted as influences on the girls as (positive and negative) role models, the sub-factor of Role Models required specific attention. Furthermore, Role Models can also positively or negatively influence these Gender and ICT Stereotypes. From the initial conceptual model, Stereotypes were split into ICT Stereotypes and Gender Stereotypes, as they have separate influences and there were distinct differences in how the girls viewed the ICT occupation and gender roles. Furthermore, Home ICT Access is more appropriately placed in the Structural Factors element, and as such has been removed from the Social Factors element. Within Family, parents, siblings and extended family were part of the girl's socialisation, and the girls observed and interpreted the ICT attitudes and beliefs of their family in terms of their own experiences. Furthermore, the socioeconomic status of the family influenced expectations of the girl's educational achievements, her occupational goals, the school type the girl attended, and the type and quality of ICT resources available to her.

Structural Factors

- Differences in the underlying philosophies, values and priorities of the schools and teachers, and the financial support provided by parents and the government, affect the quality of teaching, ICT resources and curriculum priorities.
- The teachers' background, personal beliefs and intrinsic interest in ICT can influence the implementation of ICT in their classroom and the ICT attitudes of their students.
- The individual nature of each class, class members and teacher means that there will always be differences in the way that the curriculum material is delivered and received.
- Time constraints and competing priorities impact on a teacher's ability to tinker and learn and implement new ICT skills and technologies, while the lack of classroom support limits the time teachers can spend with students during ICT activities.
- Teachers without significant exposure to ICT require pre-service and in-service training to update their skills and increase their ICT confidence, but this is limited by their willingness to seek and undertake the training.

© 2007 Kaylene Clayton

- A paradigm shift is required to change some teachers' teaching and attitudes, but this will take time and it may be impossible to change resistant teachers in the short term.
- The students were frequently introduced to computers as toddlers and their first experiences usually involved playing games.
- While some students had limited access to computers and the Internet at home, all of the students had access to computers inside the classroom and computer laboratories.
- Computer laboratories in the early middle-school years are not as effective as in-class computers due to difficulties in student supervision and support and disruptions caused by moving between rooms.
- Computer laboratories with computers closely spaced along benches around the room's perimeter or projecting from the wall do not support group work or the use of other resources, such as books.
- The students at the more affluent schools generally had access to more reliable and modern ICT resources and more effective technical support
- The unreliability of ICT resources at the government coeducational school impacted on curriculum delivery and caused frustration and disengagement of the students, which led to disruptive and destructive behaviour in the classroom.
- The innovative delivery of ICT in the curriculum can increase student engagement.
- Due to early access to computers at home, the students have already acquired many ICT skills and were believed to be only enhancing these skills at school.
- The girls from the female single-sex school tended to be calmer, more productive and collaborative, and less competitive than students at the coeducational schools.
- At the coeducational schools, the all-boy groups tended to be noisier and more disruptive to other students than the mixed-sex or all-girl groups.
- The naming of the Year 8 Computer Studies subject led to mistaken beliefs about its content, and the Year 8 students based their decision to enrol in the Year 9 ICT subject on a brief subject description, perceptions of the teacher and previous ICT experiences.
- The students perceived that many of the Computer Studies subject tasks were tedious and they completed them without enthusiasm.

The original Structural Factors elements of School Environment, ICT Access, Curriculum, Career Guidance and Teacher remain, but the structure has been changed to School Type, School ICT Access, Home ICT Access, ICT Related Resources, Curriculum and Teaching, and Teachers. Firstly, the distinct differences between the three different school types as demonstrated in this study indicated the need for School Type to be extracted from the School Environment sub-factor. ICT Access was divided into Home ICT Access and School ICT

© 2007 Kaylene Clayton

Access because, while there were similarities in the technologies and resources used at home and school, there were also individual differences between households and schools. Furthermore, while all of the students had access to computers and the Internet at school, not every student had computer or Internet access at home. ICT Related Resources was separated out from School Environment, as the importance of ICT resources and associated problems and technical difficulties was highlighted due to the significant influence that they had on the enthusiasm and attitudes of the students. Curriculum was renamed to Curriculum and Teaching to emphasise that, not only does the content of the lessons influence the student, but the way that the curriculum is delivered can encourage or dampen the student's enthusiasm and interest in ICT. Furthermore, the background of the teachers and their interest in ICT can influence the implementation of ICT in their classroom, while their personal beliefs can be transferred to the students. The ICT resources, quality of teaching and types of skills taught between schools can differ between schools because of differences in the values and priorities of the schools and the financial support provided by parents and the government.

Individual Attributes

- Generally, the students were able to quickly replicate the new ICT skills being learnt or demonstrated, but were not interested in creating or improving ICT.
- The students tended to judge their ICT aptitude by comparing themselves to their peers and their family.
- The students liked to access new forms of technology, learn new skills and were keen to repeat their successes when completing new or difficult tasks.
- Frustrations with computer problems led to loss of interest in the task, disengagement of the student and future interest in working in the ICT field.
- The students had a strong sense of justice and fairness when using the computers, but at times demonstrated competitiveness and assertiveness.
- The students used observations of their family, peer and teacher use of ICT, personal ICT experiences and media representations of ICT professionals to form their impressions about the role and image of ICT workers.
- The students understood the need for ICT skills in their future study or careers to help others, increase their independence and effectiveness and make money.
- While the Year 8 students were interested in using ICT, they expressed an 'I can, but I don't want to' attitude towards ICT or being involved in the ICT field.
- Many of the Year 8 students based their subject choices on prerequisites for their career or enjoyment of an area; most were not interested in studying Year 9 ICT subjects, and some only chose it when other subjects were deemed unsuitable.

© 2007 Kaylene Clayton

- Inhibitors for working in the ICT field included their perception that they lacked the required cognitive skills, would be unable find an ICT job and ICT stereotypes.

The Individual Attributes element has undergone minor changes since the initial conceptual model. The identified sub-factors, namely, personalities, attitudes and aptitudes; goals and general schemata; subjective task value; and interpretations of experience, were identified as described in Section 3.5 and used for the exploration of the individual attributes of the students. The original sub-factors of Self-Efficacy and Confidence; Personality and Attitude; and Study and Career Goals were combined and reorganised to form Personality and Aptitude; and Goals and Self-Schemata, while Subjective Task Value and Interpretations of Experiences remained unchanged. Self-Efficacy and Confidence was recombined with Study and Career Goals to form Goals and Self-Schemata. This reflects the Child's Goals and General Self-Schemata component of Eccles, Wigfield, and colleagues' Expectancy-value Model of Achievement-related Choices (2000). Personality, Attitude and Aptitude were identified as a significant element in Trauth's Theory of Individual Differences (2002) and Adya and Kaiser's Model of Girls' Career Choices (2005). In particular, personality was referred to in broad terms in their research and provided little guidance to which traits are significant, especially in the middle-school years. As such, the Big Five taxonomy of personality traits (John and Srivastava, 1999) was used to assist with the identification and organisation of the observed personality traits of the students in this study.

7.9 Conclusion

This chapter systematically discussed the collective results from the Year 4 and Year 8 middle-school classes in three school types. The results from the analyses of the interviews and participant observations from the Year 4 and Year 8 levels at all schools involved in the research were presented under subheadings from the Model of Girls' ICT Study and Career Choices (Figure 7-2) as summaries of the analysed data. This new model evolved from the initial conceptual model (Figure 3-3), created from a synthesis of the key aspects in the literature detailed in Chapters Two and Three and justified in Section 3.5, as a result of the clarifications provided from the analysis of the data.

The main findings were that study and career choices take place in an environment specific to the Australian cultural context and are influenced by social and structural factors and individual attributes. Family and peer groups can act as positive and negative role models, and influence gender and ICT stereotypes. The media was also found to influence and reinforce the negative perceptions of gender role and ICT stereotypes.

© 2007 Kaylene Clayton

Teacher attitude, curriculum content and teaching practice, and quality and reliability of ICT resources had a strong influence on the student's motivation to choose ICT study and career paths. Teachers who acted as positive ICT role models and were enthusiastic about implementing ICT in their classroom practice and teaching generated far more positive student interpretations of their ICT experiences. Furthermore, poor quality and unreliable ICT resources had a strong negative impact on the student's desire to engage in ICT study or career paths. ICT resources can vastly differ between schools, which appeared to be related to the socioeconomic status of the school's population and location and the school's vision.

Socioeconomic factors further shape the way that some of the social and structural factors, including personal and school access, curriculum and teaching, ICT related resources, and family, impact middle-school students' study and career choices. Individual attributes, such as personality, aptitudes and attitudes; goals and general schemata; subjective task value; and interpretations of experience, influenced the middle-school girls' motivation to follow ICT study and career choices.

© 2007 Kaylene Clayton

Chapter 8 Conclusions and Implications

8.1 Introduction

This thesis has explored the ICT experiences of Year 4 and Year 8 students attending three schools (two coeducational and one female single-sex), in metropolitan Brisbane, and contributes to the scholarly literature in this domain. Research over the past two decades has investigated the low and declining female participation in the ICT educational and vocational pipeline (e.g. Adya and Kaiser, 2005; Cohoon and Aspray, 2006; Frenkle, 1990; Gürer and Camp, 2002; Margolis and Fisher, 2002; Trauth et al., 2000). However, there has been a lack of literature investigating this problem in terms of middle-school students, especially in the Australian context. Middle-schooling is an important stage in the career choice development of a student. By the time students reach the senior stage of education, many have progressively rejected occupations that are perceived to be incompatible with their self-concept and abilities, and are making compromises because of the availability, or perceived availability of their preferred occupation (Gottfredson, 2006). ICT educational and vocational paths are frequently rejected, and as a result, ICT faculties in Australian universities are in crisis, and a shortage of adequately trained ICT professionals is looming.

The purpose of this chapter is to review the findings of the case study, as described in Chapters Five, Six and Seven, in terms of the research problem, and the research aims outlined in Chapter One, and methodology and approach described in Chapter Four. Chapter Five described the findings about the Year 4 ICT classroom experiences, while Chapter Six provided the Year 8 ICT classroom experiences findings arrived at by using the sensitising concepts from the literature described in Chapters Two and Three. Chapter Seven discussed these findings and their influence on ICT study and career choices, from which a Model of Girls' ICT Study and Career Choices was developed. In this chapter, the answers to the research questions are recapped, and recommendations related to the findings are presented. Following this, the limitations of the study and contributions to knowledge are then considered, as well as areas where future research would further enhance the body of knowledge in this field.

8.2 Fulfilment of Research Objectives

This case study of Year 4 and Year 8 students at a private coeducational school, a government coeducational school and a female single-sex school in metropolitan Brisbane investigated the

impact of girls' ICT experiences on their ICT study and career intentions. The overarching research question for this study was:

> **What is the nature of middle-school ICT experiences in metropolitan Brisbane, and what influence do these experiences have on girls' ICT study and career choices?**

In summary, through an investigation of these experiences, a number of factors, grouped as Social Factors; Structural Factors; and Individual Attributes, were identified. All of these factors and the students' study and career choices take place in an environment affected by the culture in which they live and have been socialised in (see Weisinger and Trauth, 2002). The Social Factors (i.e. ICT and gender stereotypes, peer group, role models, family and media) were drawn from and confirmed through research conducted by, for example, Barker and Aspray (2006) and Gürer and Camp (2002). The Structural factors (i.e. home and school ICT access, teacher, teaching and curriculum, school type and ICT related resources) were also drawn from and confirmed through research conducted by, for example, Multimedia Victoria (2001), Barker and Aspray (2006), and Gürer and Camp (2002). Socioeconomic factors further shape the way that some of the social and structural factors, including access to ICT, curriculum and teaching, ICT related resources, and family, impact middle-school students' ICT study and career choices (for example, Volman and van Eck, 2001). To better illustrate the identified factors, a Model of Girls' ICT Study and Career Choices (Figure 7-2) was developed. Further elaboration of this model and links to literature can be found in Section 7.8.

The Model of Girls' ICT Study and Career Choices is similar to the work of Adya and Kaiser (2005), but it is differentiated by the identification and description of different sub-factors and their relationships to other factors, an elaboration on individual attributes and the inclusion of socioeconomic factors. The inclusion of the sub-factors in the Individual Attributes section (i.e. interpretations of experience, personality and aptitude, goals and self-schemata and subjective task value) was guided by the work of Eccles et al. (2000) and Gottfredson (2002). Additionally, while the factors of Adya and Kaiser's (2005) model were formed through a review of literature, the factors and sub-factors of the Model of Girls' ICT Study and Career Choices were confirmed through the case study results as well as through literature.

The research pointed to how both negative and positive ICT experiences and beliefs of their family, teachers and peers were often reflected in the students' attitude to ICT. Their experiences in the ICT classroom, including the curriculum, the teaching of the curriculum and the ICT resources, influenced their interest in future involvement in the ICT field. Personal

© 2007 Kaylene Clayton

attributes such as goals, personality and experiences also contributed to their interest in ICT subjects and careers in the future. It is interest in ICT that leads to future involvement in ICT education and career pathways. As such, several of the students had considered continuing education or a career path in the ICT field. However, almost all the Year 4 and Year 8 students in this study rejected this idea.

To guide the research investigation, four sub-questions were developed (a to d). While the answers to these questions were provided in Chapters Five, Six and Seven, they are recapped in the following subsections.

a) What is the nature of ICT experiences at the Year 4 level?
b) What is the nature of ICT experiences at the Year 8 level?
c) Are the ICT experiences the same for boys and girls, and are there gender differences in the ICT classroom?
d) What influence do these experiences have on girls' ICT study and career choices?

8.2.1 The nature of ICT experiences at the Year 4 level

The results from the investigation of sub-question a) were outlined in Chapter Five. To investigate this question, interview and observation data was collected from Year 4 students and their teachers at the three school types and analysed using a thematic framework described in Section 4.5.5.

The analysis of the Year 4 data confirmed the key themes in the Social Factors section of the thematic framework. Parents and teachers role-modelled behaviour, including ICT use and attitudes, and reinforced gender and ICT stereotypes to the Year 4 students. This was confirmed by Barker and Aspray (2006) and Eccles (1994), who found that parents, older siblings and teachers can explicitly and implicitly share beliefs about interests, social norms and gendered behaviour. Furthermore, the Year 4 students reciprocated and acted as positive ICT role models to their parents, teachers and peers. As confirmed by Eccles (1994), the Year 4 students expressed a desire to follow similar occupational pathways as their parents or family members, especially occupations with a reasonable status.

Not all of the gender stereotypes described in literature were confirmed at the Year 4 level in this study. For instance, some research (e.g. Gürer and Camp, 2002) has suggested that boys tend to dominate computer use in the classroom, but in this study, the Year 4 students worked cooperatively with their peers and shared ICT resources fairly. Furthermore, it has been suggested (e.g. Gürer and Camp, 2002) that boys are more technically savvy than girls because

of their exposure to ICT. However, the Year 4 girls were enthusiastic and confident with ICT and in some cases more technically savvy than the boys. They were also observed defending their ICT abilities against boys. However, most Year 4 students only considered female ICT workers when prompted, but their image of female ICT workers was more positive and less stereotyped than the male image. The students in their home and school environments were also exposed to various forms of media, including the Internet, television, movies, music, literature and computer games, where gender and ICT stereotypes are common (Barker and Aspray, 2006). Accordingly, many ICT stereotypes such as ICT workers wearing glasses and being male, 'nerds' or 'geeks' (e.g. Queensland Government, 2006) were commonly repeated by the students.

The exploration at the Year 4 level of structural factors, such as teacher, school and personal access, school type, technology resources and curriculum, confirmed key factors in the thematic framework. The teachers demonstrated how their personal interest in ICT could influence the implementation of ICT in their classroom. As with the students, individual attributes such as subjective task value, personality, goals and self-schemata and interpretations of experience motivate teachers to learn new ICT skills, improve ICT infrastructure and prepare innovative ICT activities. The Year 4 teachers were enthusiastic about teaching with ICT, and this enthusiasm was generally mirrored by the students in their classrooms. However, there were a number of inhibitors to successfully using ICT in the classroom. These included the amount of available time for the teacher to spend on preparation of ICT activities and the lack of quality ICT resources and technical support. This was also confirmed in Zakopoulos' (2005) study of teaching in an ICT-rich primary school environment in the UK.

The type and quality of ICT access and support influenced how the curriculum was delivered and limited the type of activities the students participated in. While the government school students used SmartBoards in their everyday activities, this initiative was let down by poor individual ICT resources and technical support. The Year 4 private school students had more access to higher quality individual ICT resources and technical support. This was linked to the socioeconomic status of the school location, the tuition fees paid by their parents, and the students who attended (see Section 5.1.1). While previous research (see Reinen and Plomp, 1997) has alluded to girls having poor access to ICT, this was not confirmed in the study. All of the Year 4 students had regular and equal ICT access at school and generally at home. ICT was integrated into their schoolwork and they frequently used the *Microsoft Office* suite to complete their work, played computer games in the classroom and at home and were learning to use email. Communication between Year 4 students and family was facilitated through the Internet and *MSN Messenger*; this application has been used by some of the students for a number of

© 2007 Kaylene Clayton

years. However, the amount and quality of Internet access available to the Year 4 students varied more widely than their access to computers.

When investigating the individual attributes, including aptitudes and personality, goals and self-schemata, interpretations of experience, and subjective task value, at the Year 4 level, several themes were confirmed. According to Denner and Bean (2006), self identity and social identity affect problem solving and the willingness to attempt new things. In this study, while aptitude differed between individuals, most of the Year 4 students displayed a confident attitude, and were usually keen to attempt new tasks and learn new ICT skills. Furthermore, when the Year 4 students had difficulties with an ICT task, they had no hesitation to collaborate and problem-solve with their peers. Additionally, Barker and Aspray (2006, p. 31) state that "girls' gender identity may influence assertiveness with computer use at school". In this study, the Year 4 girls were quite assertive when using ICT and would not let the boys interrupt their work. However, with the competitiveness and assertiveness displayed by the Year 4 students, there was also a strong sense of justice and fairness towards other students.

According to Meece (1997), students may have difficulty in understanding the relevance and importance of schoolwork in achieving their future goals. However, the Year 4 students in this study could see the relevance and importance of ICT in the classroom. They saw ICT in the classroom as a means of performing tasks more quickly and making the learning process easier, helping others and decreasing their reliance on other people as well as being useful in their future studies and careers. Nonetheless, a common theme throughout the interviews and observations was that frustrations with the computers led to disengagement of the student, and possibly apathy towards working in ICT in the future. While the Year 4 students generally enjoyed using computers and referred to them as being fun and helpful, and saw the value in learning ICT skills, they unanimously agreed that they disliked and were frustrated by computer failures, slow computers and access rates. When these negative experiences occurred, they demonstrated disappointment, frustration and some boys acted aggressively towards the computer.

Attitudes towards ICT are formed early in life, and experiences are highly influential in determining these attitudes as children mature (Miller et al., 2000). In this study, the Year 4 students frequently referred to ICT problems, including slow computers and Internet access, viruses, computer failure, and the cost of hardware and software, and believed that people would not want to work with computers because of these problems. Moreover, children are keen observers and notice their parents' role and behaviours (Margolis and Fisher, 2002). Peer networks can also influence an individual's academic motivation through the observation of

interactions and access to activities (Pintrich and Schunk, 2002). In this study, the Year 4 students used observations of the way that their family, peers and teachers used ICT, media representations of ICT professionals and their personal ICT experiences to form their impressions about the role of ICT professionals. Furthermore, they also appeared to measure their level of ICT skill and ability against their parents' and family members' abilities and skills.

8.2.2 The nature of ICT experiences at the Year 8 level

The results from the investigation of sub-question b) were outlined in Chapter Six. To investigate this question, interview and observation data was collected from Year 8 students and their teachers at the three school types and analysed using a thematic framework described in Section 4.5.5. Many of the Year 8 findings paralleled the Year 4 findings, but there were some distinct differences with regard to the Year 8 teacher and student attitudes towards ICT.

The analysis of the Year 8 data confirmed the key themes (family, role models, peers, media and gender and ICT stereotypes) in the Social Factors section of the thematic framework. As with the Year 4 students, parents and teachers role-modelled behaviour, including ICT use and attitudes, and reinforced gender and ICT stereotypes to the Year 8 students. However, the positive and negative role-modelling of the Year 8 teachers were reflected in the attitudes of their students. For instance, the female single-sex school teacher was positive and confident with ICT and his students responded with enthusiasm and interest. Conversely, the coeducational school teachers were not particularly interested in the Computer Studies topics, and this was reflected in their students' negative attitude and behaviour.

The Year 8 students in this study generally worked cooperatively with their peers and shared the ICT resources fairly; this reflects the findings from the *Women in IT, Tasmania* report (2002). However, the Year 8 boys tended to work more independently and could be contemptuous of their peers' work when unchecked, while girls were more inclined to collaborate on their work, share ideas and solve problems. The Year 8 boys also tended to be more disruptive and off-task in the classroom and were observed exploring the ICT resources, while girls generally focused on completing their tasks. Margolis and Fisher (2002) also confirm that girls generally talk about watching others explore the computer while boys are more involved in hands-on exploration. In the Year 8 classroom, collaboration and the sharing of ICT knowledge were facilitated if the students were allowed to move around the room and sit in friendship groups. The Year 8 students tended to sit in same-sex or friendship groups, unless directed otherwise by the teacher.

© 2007 Kaylene Clayton

Similarly to the Year 4 level, not all of the gender stereotypes described in literature were confirmed at the Year 8 level. As with the Year 4 students, the Year 8 boys did not dominate the ICT resources, but worked cooperatively and fairly with all students in the class. The Year 8 students were also exposed, in their home and school environments, to various forms of media, where gender and ICT stereotypes are common (Barker and Aspray, 2006). The most apparent way that the media had an impact on the Year 8 students was through computer games and the Internet. It is probable that the ICT and gender stereotypes being repeated by the students originated in part from the media. For instance, the Year 8 students believed that people who worked with computers were male, intelligent, and unattractive, wore glasses and had biros in their pockets. These are common ICT images portrayed in the media. Like the Year 4 students, the Year 8 students did not associate ICT workers with being female until prompted. The Year 8 students also seized upon extreme examples of people known to them who work with ICT, and used these examples to form their descriptions of ICT workers. Perceptions of the work involved in ICT occupations also seemed to be based on their parents' or family member's job roles and their ICT experiences at school.

The exploration of structural factors at the Year 8 level, such as teacher, school and personal access, school type, technology resources and curriculum, confirmed key factors in the thematic framework. The teachers demonstrated how their personal interest, or lack thereof, in ICT could influence the implementation of ICT in their classroom. Zakopoulos (2005) also confirms that teachers' perceptions and attitudes towards teaching and learning about ICT can significantly influence their students' learning attitudes. Additionally, and as seen in this study, some teachers resist change and do not want to change teaching techniques and lesson plans which have worked in their classrooms in previous years. As with the Year 4 level, there were a number of inhibitors to successfully using ICT in the Year 8 classroom. Technical problems, which prevented access to ICT resources, occurred at every school, but the differentiating feature was the timeframe for rectification. Technical problems at the government school were compounded by vandalism and lack of respect for the computers, possibly due to the frustrations and issues that the students had with the computers. As with the Year 4 level, the socioeconomic status of the school location and the tuition fees paid by their parents, reflected the quality of ICT resources and support (see Section 6.1.1). Furthermore, private school students appeared to be given more trust by the teacher and they in turn appeared to have more respect for the ICT resources. Zakopoulos (2005) verifies that the lack of quality ICT resources and technical support can have considerable implications for teaching and student learning.

The Computer Studies classes appeared to consist mainly of typing drills and using *PowerPoint*, *Excel* and *Word*, with many activities involving transcription and reformatting of information in

Word or *Excel*. The students found these activities to be tedious and mundane and completed them without enthusiasm. Downs (2004) and Newmarch, Taylor-Steele and Cumpston (2000) confirm that students are obtaining a skewed view of the ICT field because of the ICT curriculum focus on mastering software packages and the perception that ICT is simply word processing. When choosing their elective subjects, the students tended to rely on: short subject descriptions; information nights; personal beliefs about the nature of the subject; previous experiences; and stereotypical ideas. The students did not appear to have a good understanding of what Year 9 ICT subjects involved, and sometimes chose them by default as the best of the available choices. While previous research (see Adya and Kaiser, 2005; Reinen and Plomp, 1997) has alluded to girls having poor access to ICT, this was not confirmed in the study. Most of the interviewed Year 8 students had (at least) shared access to home computers, but some of these computers were not connected to the Internet. Like the Year 4 students, communication between the Year 8 students and family was facilitated through the Internet and *MSN Messenger*. The Year 8 students also used their home computer for Internet banking and to surf the Internet, play online and computer games, download music and communicate with their friends.

When investigating the individual attributes, including aptitudes and personality, goals and self-schemata, interpretations of experience and subjective task value, at the Year 8 level, several themes were confirmed. According to Denner and Bean (2006), self identity and social identity affect problem solving and the willingness to attempt new things. The Year 8 students displayed varying levels of ICT ability; some were skilled and confident and others were less certain. Furthermore, the teachers felt that their current students were not necessarily more advanced than their previous peers; it depended on the individual, their home environment and the amount of ICT exposure they had. However, the Year 8 students at the female single-sex school embraced the introduction of the wireless network and were enthusiastic about learning programming basics to program their calculators.

The student's perceptions of the skills and characteristics required for success in an ICT career and ICT use influence the interest and perceived ability of females in ICT (Chan et al., 2000). In this study, there was evidence of how perception of aptitude drives choice of a subject, with students believing that 'smart people' enrolled in ICT subjects; these Year 8 students felt that they did not fit the image and as such were unlikely to enrol. Furthermore, the Year 8 students did not have a good understanding of what their Year 9 elective subjects involved, and they relied on brief subject descriptions, their perceptions about the teacher and the nature of the subject based on personal experience and stereotypical ideas. According to Meece (1997), students may have difficulty in understanding the relevance and importance of schoolwork in

© 2007 Kaylene Clayton

achieving their future goals. In this study, however, students demonstrated an understanding of how their elective ICT subjects in Year 9 enabled them to learn skills that would be useful in their future careers. Furthermore, while the Year 8 students were interested in using ICT, the students also expressed an 'I can, but I don't want to' attitude towards ICT or being involved in the ICT field.

Attitudes towards ICT are formed early in life, and experiences are highly influential in determining these attitudes as children mature (Miller et al., 2000). In this study, the Year 8 students believed that ICT classes could sometimes be fun, but at other times they were something that had to be endured. They unanimously disliked being bored in ICT classes, computer failures, and being stepped through ICT tasks. The students also responded negatively to the subject marketing for ICT and felt that the ICT course descriptions did not accurately reflect the content, and that the work was less enjoyable and more difficult than in the description. The Year 8 students demonstrated both positive and negative representations of self-concept, including perceptions of ability and a perceived lack of intelligence: the positive traits included collaboration and the sharing of ICT knowledge with their peers and teachers; the negative traits, displayed particularly at the government school, included anger, aggression and disruptive behaviour.

8.2.3 Gender differences in ICT experiences and middle-school ICT classrooms

Sub-question c) was examined with Year 4 and Year 8 outcomes described in Chapters Five and Six respectively and collectively as middle-school students in Chapter Seven. Gender differences relating to ICT access, engagement in ICT activities, interest and ability with ICT, ICT stereotypes and the way that ICT work was undertaken by students were explored. According to Margolis and Fisher (2002), there are gender differences in the type and level of ICT access, and encouragement of hands-on exploration of the computer for students. In this study, there were no gender differences in terms of access to ICT resources at home and school. The students did not report unequal ICT access at home or at school, but they often encountered competition, from their siblings and parents, for ICT resources at home. The teachers were also careful to ensure equal access to computers and other technologies. This overturns previous research stating that boys have more access to ICT resources in the classroom than girls (e.g. Reinen and Plomp, 1997).

There were noteworthy gender differences in the levels of engagement in ICT work. In the classroom, the boys tended to show-off and were less focused on their work, easily distracted

and disruptive to the other students, while girls tended to focus on their work and were frustrated by the boys' disruptive behaviour. The government coeducational school Year 8 boys were particularly disruptive in class, and a fair amount of teacher time was spent disciplining these boys. These differences in behaviour were explained by a Year 4 teacher, who believed that girls were educationally more mature than boys. Furthermore, she felt that students became unfocused and disruptive when they were not able, or did not know how to do the work. However, Deci, Vallerand, Pelletier and Ryan (1991) believe that students must value achievement, learning and accomplishment, even with activities they find uninteresting, if they are to be actively engaged in education.

In the classroom, there also appeared to be gender differences in how boys and girls worked together and completed their work using ICT. Wentzel and Wigfield (1998) assert that engagement with or alienation from classroom activities can result from instructional characteristics, classroom climate and interpersonal relationships. As an example of the influence of interpersonal relationships influencing engagement, when working in mixed pairs, the Year 4 girls tended to undertake the ICT task, while the boys talked to boys in other groups. However, when in male pairs, the boys were keen to actively work on the task, whereas the female pairs shared the task and collaborated about the design and layout of the work. There were also differences in the way that Year 8 students worked together on ICT tasks. The Year 8 students tended to sit and work in same-sex or friendship groups unless directed otherwise by the teacher, and this influenced the collaboration between students. Furthermore, when allowed the freedom to complete their work as they chose to, Year 8 boys were more likely to work independently, while girls were more inclined to collaborate and solve problems in groups. Collaboration is important for girls, according to Inkpen, Booth, Klawe, and Upitis (1995), who found that small groups of girls were able to solve more puzzles than girls who worked alone, while the opposite occurred with boys. This affects girls' confidence.

Boys are expected to be more technically savvy than girls because of their exposure to ICT (Gürer and Camp, 2002). However, in the Year 4 classes, the girls were enthusiastic and confident with ICT, and in some cases more technically savvy than the boys. Furthermore, the Year 4 girls felt that they tried harder to achieve than the boys and they were also observed defending their ICT skills against comments from the boys. One Year 4 girl also felt that, as they got older, boys' ICT skills increased more than girls'. At the Year 8 level, the girls responded to the enthusiasm of the teacher and again demonstrated ICT aptitude when the opportunity presented. However, the Year 8 students did not seem to be as enthusiastic as the Year 4 students. This confirms Craig's (2006) assertion that, as girls progress up through the years, their level of enthusiasm and engagement wanes. However, it is difficult to generalise

© 2007 Kaylene Clayton

from this finding as the teachers stressed that the students' levels of ICT interest and ability vary from class to class and year to year. Furthermore, while a Year 8 teacher believed that girls' attitudes were becoming '*can do*', some of the Year 8 girls tried to make themselves appear less knowledgeable in front of their friends, possibly to fit in with their peers (see Margolis and Fisher, 1997).

While the teachers in this study did not believe that there were any gender differences in their students' abilities, there were differences in the way that the students used ICT. For instance, the Year 4 and Year 8 girls generally did not engage in independent exploration of the computer, and focused on diligently completing their work and making it aesthetically pleasing. However, the boys were less inhibited when exploring the computer, did not seem to be afraid to make mistakes or test limits, and were often not focused on completing the task. This finding was confirmed by Margolis and Fisher (2002), who state that boys are more involved in hands-on exploration, and this leads to increasing interest and gives them an advantage in ICT classes. Additionally, in this study, the boys treated the computer more as a toy, something to tinker and play with, while the girls treated it more as a means of completing their work. For instance, while girls often played computer games to solve the puzzles and achieve the learning outcome, the boys manipulated the game in order to quickly complete it and then move on to more enjoyable tasks. This finding confirms previous research which posits that women see the computer as a tool, while men see it as a toy (Harrelson, 1999).

Mass media images of ICT carry implicit and significant messages about gender roles: computer programmers and developers are often depicted as men, while the users are frequently female (Barker and Aspray, 2006). While most of the Year 4 and Year 8 students had not had significant exposure to ICT work or contact with ICT professionals, the students repeated common ICT and gender stereotypes; these appeared to originate from the media. For instance, when asked about their impression of ICT workers, the students rarely spoke about ICT workers as being female, but, when prompted, their image of female ICT workers was more positive than the male image. Teachers were also heard to express a number of common gender stereotypes, including that girls are "*more loving*" and affectionate and interested in friendship than the boys. There also appeared to be subtle differences in the way that some teachers acted towards male and female students. For instance, some Year 8 teachers appeared to expect the worst from the boys and seemed to be more helpful towards the girls. According to Barker and Aspray (2006), these teacher beliefs and attitudes, when combined with their attitudes towards ICT, can subtly influence girls not to study ICT.

© 2007 Kaylene Clayton

8.2.4 Influence of ICT experiences on girls' ICT study and career choices

Sub-question d) was examined in Chapter Seven. The examined influence of ICT experiences culminated in the creation of the Model of Girls' ICT Study and Career Choices (Figure 7-2). While the Year 4 and Year 8 female single-sex school students were engaged with and enthusiastic about using ICT, very few of the students in this study expressed an interest in studying or working in the ICT field. Influences from a number of different ICT experiences worked in isolation and concurrently to influence their ICT study and career choices. As illustrated in Figure 7-2, these influences are classified in three main groupings as social factors, structural factors and individual attributes.

Family are an important influence on study and career choices during childhood and into adolescence (Barker and Aspray, 2006), and family expectations contribute towards girls' decisions to enter ICT study or career pathways (Lang and McKay, 2006). During this study, the Year 4 and Year 8 girls told how their parents offered suggestions about the occupations that they felt were, or were not, appropriate or suitable. These occupations included interpreter, teacher and hairdresser. The Year 8 girls from the female single-sex school also felt that their parents would intervene if they did not agree with their career choice. Other girls also spoke about wanting to follow in their parents' careers, such as medicine, law, childcare or flight attendant. None of the students spoke about their parents or family encouraging them to pursue ICT study and career pathways, and some actively decried ICT subjects.

Peers exert a powerful influence on a child's beliefs and behavioural choices (Barker and Aspray, 2006; Henslin, 1999), and this in turn plays a role in student course selection decisions (Margolis and Fisher, 2002). In this study, the girls worked cooperatively on ICT tasks, supported each other and were heard praising each others' work. Furthermore, the Year 4 girls were confident with ICT and were observed actively defending their ICT abilities against the boys. The Year 8 female single-sex girls were enthusiastic and engaged during their ICT classes, but were seen trying to make themselves appear less knowledgeable in front of their friends, possibly to fit in with their peers (see Margolis and Fisher, 1997). The Year 8 teacher at the female single-sex school also felt that the students were under a lot of peer pressure to have the latest devices and technology.

The media appeared to have a strong influence the students' perceptions of ICT occupations and people who work in the ICT field. While most of the students did not have extensive exposure to ICT work or contact with ICT professionals, the students were heard to repeat common negative ICT stereotypes and gender stereotypes. For instance, when asked about the

© 2007 Kaylene Clayton

appearance of an ICT professional, common beliefs included that ICT professionals were male, wore glasses and the students commonly referred to them as nerds and geeks. These are common images of ICT workers portrayed by the media, and confirm Goode, Estrella and Margolis' (2006) research that found students who do not have actual exposure to people studying or working in the ICT field rely on images in popular culture. Furthermore, the students rarely referred to ICT workers as being female, but when prompted, their image of female ICT workers was more positive than the male image. This was more than likely due to the limited portrayal of female ICT professionals in the media and the lack of exposure to female ICT professionals. It also meant that the girls had fewer female ICT professionals to model their behaviour on. Successful female ICT role models are needed to inspire girls to be involved in ICT pathways (Gürer and Camp, 2002). Additionally, few students, and even fewer girls, understood the true nature of ICT work, and they often based their beliefs on their previous ICT experiences and observations of their family.

According to Barker and Aspray (2006, p. 25), "school policies and teachers can have a significant influence on children". This study demonstrated how the ICT interest and enthusiasm of the teacher influenced the implementation of ICT in the classroom and the enthusiasm of the students. The Year 4 teachers and the Year 8 mathematics teacher were interested in ICT and worked hard to prepare interesting activities for their students. The Year 8 Computer Studies teachers were from the business faculty. One of the Computer Studies teachers openly admitted that she had no interest in ICT, while the other said that, although he had been assigned to this subject, his "*main problem is that I am not a trained Computer Studies teacher; I am just conversant in Word*". This teacher interest, or lack of, was transferred to their students. Conversely, this study demonstrated that, by encouraging peer support and allowing exploration, the teachers increased the girls' confidence in and enthusiasm for ICT.

This study also confirmed that the students are being taught by teachers with a disparate range of ICT skills (Barker and Aspray, 2006), partially due to the level of exposure and training they had received in their pre-service and in-service education, and their access to software and hardware (Goldman, 2003). While two of the teachers had significant pre-service ICT training, four teachers had limited or no pre-service ICT training, but most of these teachers have had in-service ICT training. The Year 4 teacher's comment that it would be difficult, or even impossible, to change the attitude of some teachers, was confirmed by the Year 8 Computer Studies teacher's comment that she had no interest in ICT or undertaking ICT training. Lack of time for the teacher was another common issue. For instance, a number of teachers spoke about the amount of time required to prepare for ICT classes, and much of the Year 8 government coeducational school teacher's time was taken in disciplining the disengaged students. Barker

and Aspray (2006) reiterate the need for these teachers to undertake training in ICT areas, as well as the need to provide teachers with the time to implement ICT effectively in the classroom.

This research confirmed Goode, Estrella and Margolis' (2006) findings that ICT subjects are synonymous with computer literacy, and low-level skills are being taught in these classes. For instance, computer literacy appeared to be the main focus of the Year 8 Computer Studies classes in this study. However, while the Year 4 teachers used ICT to deliver their curriculum, the private coeducational school teacher was emphatic in her belief that *"IT is not typing, and it is not typing passwords"*. Barker and Aspray (2006) also believe that children have been introduced to the use of computers through keyboarding, word processing and using basic applications, and the limited nature of these activities may cause students to lose interest. This was also confirmed in this study, as the *Microsoft Office Suite* was commonly used by the students, and learning keyboarding skills was a universal factor in the Computer Studies curriculum. The consequence of the focus on software package mastery is the perception that ICT is simply word processing (Downes, 2004; Newmarch et al., 2000). While the girls in this study recognised how learning to use software packages and typing was useful, students commented that they would rather learn more about the computer during the Computer Studies classes. Furthermore, the female single-sex school students learnt principles of programming in their mathematics class, not in their Computer Studies class. The students are indeed getting a skewed view of ICT study through their ICT experiences.

According to Cleary (2006), computer and Internet access often leads to interest in ICT. In this study, ICT was integrated and implemented in a variety of ways in the schools, and this included the use of SmartBoards, digital cameras, computer laboratories, wireless networks for programmable calculators and laptop computers. All of the students in this study had access to computers at school and most had at least shared access at home. However, the quality of the computers and technical support at the government coeducational schools was significantly less than at the private schools. This lack of reliability and usability of the ICT resources led to a lack of interest in the ICT field. For instance, the students commonly cited computer problems and difficulties as the reason for people not wanting to work in the ICT field. The private school students also appeared to have higher levels of computer and Internet access at home, and good quality, reliable computers at school. The quality and availability of ICT resources, including computers and Internet access, were linked to the socioeconomic status of the school's location and the students' family. This study also confirmed Scott's (1996) finding that girls from coeducational schools had more negative attitudes towards ICT than those attending single-sex schools. Furthermore, the girls at the single-sex school also had higher real career aspirations

© 2007 Kaylene Clayton

than their peers at coeducational schools, as confirmed by Watson, Quatman and Elder's (2002) research.

According to Fisher, Margolis, and Miller (1997, p. 107), "there seems to be less tinkering, less unguided exploration and less obsession" in relation to girls and ICT. This was also observed in this study. The boys were not afraid to make mistakes and tended to be less inhibited when exploring the computer, attempting new work and testing the limits of the computer. It is this tinkering that increases interest and prepares them for future ICT studies (Goode et al., 2006). However, the girls' demonstrated compliance with classroom expectations and being careful with resources may hinder this tinkering. For instance, one girl commented that boys pretend to know what they are doing, but can cause more problems by tinkering.

Denner and Bean (2006, p. 730) state that their research "suggests that aspects of girls' self-identity (such as confidence) and social identity (whether others consider them to be good at computers) affect problem solving and their willingness to try new things". The girls spoke about enjoying the changing and evolving nature of ICT, and demonstrated their enthusiasm, imagination and curiosity in their peer groups. However, the girls also associated the stereotype that "ICT workers are intelligent" with ICT subjects. They believed that "smart" students enrolled in the Year 9 ICT subjects, but that they themselves were unlikely to enrol in these subjects because they felt that they did not fit this image. Moreover, some of the Year 8 girls tried to make themselves appear less knowledgeable in front of their friends, possibly to fit in with their peers (see Margolis and Fisher, 1997).

The Year 8 Computer Studies classes seemed to be used as a form of electronic babysitting; the students were supervised while at school, but content and delivery seemed to be given little importance. The students responded with demonstrations of boredom, frustration and disengagement. Chronic absenteeism was also a problem in the government school Computer Studies class, which related to students' beliefs about the subject's importance and their disengagement. However, student engagement increased when they were given a task which had meaning or involved learning new skills. Studies have also shown that females tend to be more interested in the use of ICT, and the relations between ICT and other fields (Margolis et al., 1998; Young, 2002). Accordingly, a number of girls identified how ICT would be useful in their future careers. However, while the girls were interested in using ICT, they also expressed an 'I can, but I don't want to' attitude towards ICT or being involved in the ICT field.

© 2007 Kaylene Clayton

8.3 Contribution to Knowledge

In his 1995 paper, Walsham (1995) describes the problem of generalisability of the results of case study research. He outlines four non-mutually exclusive types of generalisation from interpretive case studies, namely, development of concepts, generation of theory, drawing of specific implications and contribution of rich insight. While the outcomes of this research are specific to the contexts of the participating schools and cannot be widely generalised, the research has generated theory that may be used to guide future research into ICT career decisions.

The intention of the research was to provide a holistic view of the research problem through a fresh examination of the social and structural factors and the clarification of the individual attributes that influence girls' ICT study and career choices. The culmination of this research is the production of the Girls' ICT Study and Career Choices conceptual model (Figure 7-2). It was created through a synthesis of relevant literature about the topic and in related fields, as described in Chapters Two and Three. The key themes from this literature were used to guide the analysis of the data collected during the case study to further clarify and confirm aspects of the model.

It is believed that this model will assist researchers and policy makers to better understand the factors influencing girls' ICT study and career choices, and inform educational practitioners when developing programs aimed at increasing girls' involvement in ICT educational and vocational pathways. The recommendations for the ways that educational authorities, schools and teachers can have a positive influence on girls' interest in the ICT field, stemming from this research, are provided in Section 8.4. Furthermore, it is thought that most of the factors and their relationships identified in this model also apply to boys. This is significant, due to the decline of both male and female interest in ICT study and career options (Thorp, 2003).

This research also sought to add weight to existing opinion, as well as contributing rich insights into the ICT experiences of middle-school students in metropolitan Brisbane schools, while addressing the dearth of Australian literature about students' ICT experiences in the middle-school years. While early research investigating girls' declining interest in the ICT field concentrated on social and/or structural influences, more recent research indicated that individual attributes are a key influence on a young person's interest in ICT (e.g. Adya and Kaiser, 2006; Trauth et al., 2004). However, more work was required to clarify what the individual attributes were, and what they involved. To address this, this research provided clarification of the individual attributes influencing girls' ICT study and career choices.

© 2007 Kaylene Clayton

This research is unique. To date, there is no known research into the early middle-school ICT experiences of Brisbane students and the influence of these experiences on their interest in the ICT field. Furthermore, due to the rapid advances and integration of ICT into everyday life, the applicability of results from related research to current students needed to be reassessed. For instance, previously research alluded to unequal access to ICT resources between genders (e.g. Gürer and Camp, 2002); this was not found in this study.

8.4 Recommendations for the teaching of ICT in schools

Interest in an area is a key factor in choosing to enter and continue in the educational and career pathways associated with that field. This research has shown that interest in ICT wanes in the late middle-school years. Thus, it is highly probable that most of the students in this study will not pursue a career in the ICT field. In this research, there were many reasons identified to account for this waning interest, including individual attributes and the influence of teachers, role models, media, peers and family. Socioeconomic and cultural influences, such as the professional and financial status of the parent and their occupational expectations for their child and access to ICT resources at home also played a role in ICT interest. Furthermore, the ICT curriculum content and teaching and the school environment, including the amount and quality of ICT resources and the level of technical support and classroom assistance provided, were shown to have an impact on the student's interest in ICT. In light of these findings, a number of recommendations are suggested. These recommendations are organised around recommendations for education authorities, recommendations for schools and recommendations for teachers.

8.4.1 Recommendations for Education Authorities

- Provide a state-wide ICT curriculum that outlines the expected level of achievement for students in each year level to standardise basic, intermediate and advanced skill levels across schools and regions.
- Alter the late middle-school curriculum to act as an introduction to the senior-school ICT curriculum.
- Implement and maintain a centralised, common-access communication portal holding information about ICT training opportunities for teachers at all schools.
- Provide dedicated funding allocations to allow sufficient levels of ICT infrastructure, resources and technical support to be provided at each school.

© 2007 Kaylene Clayton

- Provide funding to employ, at a minimum, a shared ICT coordinator at smaller schools and a dedicated ICT coordinator at medium to large schools to support the teaching staff.
- Simplify the process of obtaining and accessing education authority-provided ICT teaching resources, and provide clear instructions and training in their use.

8.4.2 Recommendations for Schools

- Replace dedicated computer laboratories for middle-school ICT lessons with mobile banks of laptop computers that can be moved between classes on an as-needed basis.
- Provide adequate teacher-aide support to enable teachers to spend dedicated time with individual students on ICT activities.
- Consider integrating interactive whiteboards into every classroom and provide teacher training in their use to encourage interactive and innovative lessons.
- Ensure an adequate ICT budget to provide the required levels of ICT resources and maintenance, and incorporate the development and management of the ICT budget and purchasing decisions into the position description of the ICT coordinator.
- Encourage a culture of seeking and undertaking ICT training and enrichment activities in the teaching staff.
- Recruit teachers who are interested in ICT and provide a recognition and rewards system for teachers who excel in ICT teaching or support activities.
- Implement a mentoring program to support teaching staff who have low levels of ICT skills or are under-confident in teaching ICT.
- Implement online communication strategies as common practice (for example, email and intranet instant messaging) between teachers, parents, students and administration.
- Provide more opportunities for students to access classroom computers and ICT resources after hours.

8.4.3 Recommendations for Teachers

- Seek ICT training opportunities through the ICT coordinator and educational authorities.
- Invite and encourage parents and other volunteers to support the teaching of ICT in the classroom.
- Pool ICT resource time to allow a longer block of time for interacting with and individually assisting students.
- Peer mentor less confident or less skilled teachers in the school.

© 2007 Kaylene Clayton

- Actively seek the guidance and support of the ICT coordinator when implementing innovative or new ICT activities.
- Encourage and enable the mutual sharing of ICT knowledge and skills between students and teachers in the classroom and with teachers at neighbouring schools.
- Be flexible in the delivery of the ICT curriculum and be prepared to allow extension activities beyond the basic key skills delivered through the curriculum.
- Keep ICT tasks gender neutral to encourage participation by both boys and girls.
- Allow students to move around the room and collaborate when working on ICT activities.
- Provide opportunities for girls to work in female only groups and encourage support mechanisms.
- Identify innovative and challenging activities for the students from professional and online sources and adapt them for use in the classroom.
- Include teaching activities that provide an understanding of computers rather than the use of the *Microsoft Office Suite* applications and basic formatting skills.

8.5 Study Limitations

This study has progressed research on the social and structural factors and individual attributes influencing middle-school students' interest in ICT study and career pathways. However, the context of the study also acted to limit the study. Firstly, the study size reflected the limited resources and access available to the researcher. While there are a large number of schools of various compositions in Brisbane and the surrounding localities, only one example of each school type (government coeducational, private coeducational and female single-sex) was utilised in this study. Although attempts were made to include a similar male single-sex school, significant problems were encountered in engaging a school willing to participate in the study. Consent issues also placed a constraint on which schools from each school type participated in the study.

Secondly, it may have been advantageous to include representation from each middle-school year level and each school type. Furthermore, because of the low level of Year 8 student interest and participation in the interview process, broadening the scope of Year 8 involvement to multiple Year 8 classes at each school to increase the interview pool size may have been useful. Again, consent issues and difficulties in the logistics of arranging access meant that this was not feasible. Furthermore, it was outside of the scope of this research to include representation from the other year levels between Prep and Year 12, their teachers, and the principals and support staff at the schools.

© 2007 Kaylene Clayton

Thirdly, as demonstrated in the findings and discussion sections and confirmed in the literature, parents, siblings and family are amongst the important influences in the lives of children (for example see Barker and Aspray, 2006). It would have been useful to contact the participating students' families and further reflect upon the influence of their social environment. However, this would have created enormous privacy and consent issues and again was not considered feasible within the scope of this study.

Finally, the longitudinal monitoring of the evolution of the participating students' study and career choices would be informative. However, time constraints imposed by the nature of the research project did not allow for this. Furthermore, tracking students over the years may have been difficult or even impossible due to the high mobility of students in some of the schools, and the privacy and consent issues this would raise.

8.6 Future Research

A number of future areas for research have emerged during and as a result of the research. Firstly, while the outcomes of this research are specific to the contexts of the participating schools and cannot be widely generalised, the research has generated theory that may be used to guide future research into ICT career decisions. As such, a state-wide study using the Model of Girls' ICT Study and Career Choices could confirm, refine or broaden the applicability of the findings to other contexts. The research could also be extended to interstate and international schools, if the model holds in a state-wide context. Furthermore, the policy implications (for example, budget, training and asset management) of a better understanding of the impacts of ICT experiences on ICT study and career choices should also be investigated.

Based on the major components of the Model of Girls' ICT Study and Career Choices, studies that focus on particular aspects of the model could also be carried out. Firstly, further research into the social factors identified in the Model of Girls' ICT Study and Career Choices could be conducted. For instance, further investigation of the influence parents, siblings and other family had on the students' ICT experiences would be useful. This would involve interviews of the student's family and home visits to answer the question: "What is the relationship between the level of ICT knowledge and skill of family members on a middle-school student's interest in ICT?" Furthermore, a review of the changing nature of ICT and gender stereotypes could be carried out involving junior-school, middle-school and senior-school students. The results at these three levels could be compared to determine the nature and extent of the changes. In addition, an exploration of student subcultures could be conducted relating to their influence on student ICT study and career choices.

© 2007 Kaylene Clayton

Studies could also focus on the structural factor of the model. For instance, following Education Queensland's rollout of laptops[27] for every government school teacher, it would be useful to determine whether they have had any positive influence on the teaching of ICT in the classroom. The question "What are the ICT experiences and beliefs in Queensland schools following the rollout of laptops for every teacher?" could be used for this research. Furthermore, a study could investigate how government funding and the allocation of school budgets to purchase, maintain and support ICT resources in schools could be improved, in order to effectively facilitate high quality and reliable ICT resources.

Studies concentrating on the individual attributes of students could also enhance this research. Four areas of interest have been identified as being significant, and these should be further explored to better understand the impact, complexities and cross-influences of these areas. For instance, the linkage between personality, goals, self-concept and interest in ICT and the next step of ICT career choice could be strengthened. A question such as "What are the individual differences between students whose interest in ICT develops into ICT career interests, and students who continue to be only interested in the use of ICT?" could be used for this.

Other opportunities include a longitudinal study of one class of Brisbane students. This study would involve monitoring the influence of the students' ICT experiences throughout their education on their subject choices and final post-secondary school study and career destinations. However, it is important to bear in mind that that it is now common for people to have a number of different careers throughout their working lives. It is entirely possible that students who do not choose to enter into ICT study or careers directly from school may follow an ICT pathway later in life because of changes in circumstance and interest. A study could investigate late ICT career entrants to determine the triggers for entering tertiary level ICT education or changing to ICT career paths.

8.7 Final Comments

While there has been much research into dwindling female interest in ICT study and career paths, the area of middle-school ICT experiences on ICT study and career choices has been underexplored, especially in the Australian context. This theory building research has identified that a number of factors influence the decision of middle-school students to pursue an ICT career path and provides a foundation for future research. Data was collected through participant observation of Year 4 and Year 8 students whilst engaged in ICT activities, semi-structured interviews with the Year 4 and Year 8 teachers, and group interviews with the Year 4 and Year

[27] http://education.qld.gov.au/smartclassrooms/strategy/si_computers.html

8 students. Although almost all of the Year 4 and Year 8 students appeared to have rejected a future in the ICT field, a number of the students had considered continuing education or a career path in the ICT field. It was found that a combination of social factors, such as family experiences and beliefs, structural factors such as adequate access to ICT resources, and individual factors such as interests and goals, influence decisions to pursue a future in the ICT field.

From these findings a Model of Girls' ICT Study and Career Choices (see Figure 7-2) was developed. It is believed that this model will assist researchers and policy makers to understand the factors influencing girls' ICT study and career choices, as well as inform educational practitioners and interested others when developing programs aimed at increasing girls' involvement in ICT educational and vocational pathways. Furthermore, it is thought that most of the factors and their relationships identified in this model also apply to boys; this is significant, due to the decline of male interest in ICT study and career options.

We must be the change we wish to see.

M.K. Gandhi

References

Abercrombie, N., Hill, S., and Turner, B. S. (2000). *The Penguin Dictionary of Sociology* (4th ed.). London: Penguin Books.

ABS. (2006). *Household use of information technology, Australia 2005-2006* (No. 8146.0). Canberra: Australian Bureau of Statistics.

ABS. (2007). *Household use of information technology, Australia 2006-2007* (No. 8146.0). Canberra: Australian Bureau of Statistics.

Adams, J. C., Baichoo, S., and Bauer, V. (2006). Women embrace computing in Mauritius. In E. M. Trauth (Ed.). *Encyclopedia of Gender and Information Technology* (Vol. 2). Hershey: Idea Group Reference, 1258-1266.

Adams, J. C., Bauer, V., and Baichoo, S. (2003). An expanding pipeline: Gender in Mauritius. *ACM SIGCSE Bulletin, 35*(1), 59-63.

Adya, M., and Kaiser, K. M. (2005). Early determinants of women in the IT workforce: a model of girls' career choices. *Information Technology and People, 18*(3), 230 - 259.

Adya, M., and Kaiser, K. M. (2006). Factors Influencing Girls' Choice of Information Technology Careers. In E. M. Trauth (Ed.). *Encyclopedia of Gender and Information Technology* (Vol. 1). Hershey: Idea Group Reference, 282-288.

Ahuja, M. K. (2002). Women in the information technology profession: a literature review, synthesis and research agenda. *European Journal of Information Systems, 11*(1), 20-34.

Altheide, D. L., and Johnson, J. M. (1994). Criteria for assessing interpretive validity in qualitative research. In N. K. Denzin and Y. S. Lincoln (Eds.). *Handbook of Qualitative Research*. Thousand Oaks, California: Sage Publications.

Ambrose, S., Lazarus, B., and Nair, I. (1998). No Universal Constants: Journeys of Women in Engineering and Computer Science. *Journal of Engineering Education, 87*(4), 363 - 368.

Anderson, N., Timms, C., and Courtney, L. (2006). *"If you want to advance in the ICT industry, you have to work harder than your male peers" Women in ICT industry survey: Preliminary findings.* Paper presented at the Australian Women in IT Conference, Adelaide, Australia.

Anfara Jr., V. A., and Mertz, N. T. (Eds.). (2006). *Theoretical Frameworks in Qualitative Research [Introduction]*. Thousand Oaks, California: Sage Publications.

Attewell, P., and Battle, J. (1999). Home Computers and School Performance. *The Information Society, 15*(1), 1-10.

Babbie, E. (2000). *The practice of social research* (9th ed.). Melbourne: Wadsworth Publishing Company.

Bandura, A. (1997). *Self-efficacy: The Exercise of Control*. New York: W.H. Freeman and Company.

Barker, L. J., and Aspray, W. (2006). The state of research on girls and IT. In J. M. Cohoon and W. Aspray (Eds.). *Women and Information Technology: Research on underrepresentation*. Cambridge, Massachusetts: The MIT Press.

Beise, C., Myers, M., VanBrackle, L., and Chevli-Saroq, N. (2003). An examination of age, race, and sex as predictors of success in the first programming course. *Journal of Informatics Education Research, 5*(1), 51-64.

Belcher, D., Lee, A. M., Solmon, M. A., and Harrison Jr, L. (2003). The Influence of Gender-Related Beliefs and Conceptions of Ability on Women Learning the Hockey Wrist Shot. *Research Quarterly for Exercise and Sport, 74*(2), 183 – 192.

Benbasat, I., Goldstein, D. K., and Mead, M. (1987). The Case Research Strategy in Studies of Information Systems. *MIS Quarterly, 11*(3), 369-387.

Berger, P., and Luckmann, T. (1991). *The Social Construction of Reality: A Treatise in the Sociology of Knowledge*. Ringwood, Victoria: Penguin Books.

Beyer, S. (2006). Comparing Gender Differences in Computer Science and Management Information Systems Majors. In E. M. Trauth (Ed.). *Encyclopedia of Gender and Information Technology* (Vol. 1). Hershey: Idea Group Reference, 109-115.

Block, J. H. (1973). Conceptions of Sex Role: Some Cross-Cultural and Longitudinal Perspectives. *American Psychologist, 28*(6), 512-526.

Bowers, C. A. (1988). *The cultural dimensions of educational computing: understanding the non-neutrality of technology*. New York: Teachers College Press.

Braun, V., and Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*, 77-101.

Byrne, E. M. (1993). *Women and science: the snark syndrome*. London: The Falmer Press.

Byrne, P., and Lyons, G. (2001). *The effect of student attributes on success in programming.* Paper presented at the Sixth Annual Conference on Innovation and Technology in Computer Science Education, Canterbury, UK.

Camp, T. (1997). The Incredible Shrinking Pipeline. *Communications of the ACM, 40*(10), 103-110.

Carey, P. (2001). *Girls and Technology in the Secondary School*. Perth: Catholic Education Office of Western Australia.

Chan, V., Stafford, K., Klawe, M., and Chen, G. (2000). *Gender differences in Vancouver secondary students' interests related to information technology careers.* Paper presented at the Seventh International Conference on Women, Work and Computerization, Vancouver, British Columbia.

Christensen, R., Knezek, G., and Overall, T. (2005). Transition points for the gender gap in computer enjoyment. *Journal of Research on Technology in Education, 38*(1), 23-38.

Chua, W. F. (1986). Radical developments in accounting thought. *The Accounting Review, 61*(4), 601-632.

Clayton, D., and Lynch, T. (2002). Ten years of strategies to increase participation of women in computing programs The Central Queensland University Experience: 1999-2001. *ACM SIGCSE Bulletin, 34*(2), 89-93.

Cleary, P. F. (2006). Childhood interest in computers and adult career choices in IT. In E. M. Trauth (Ed.). *Encyclopedia of Gender and Information Technology* (Vol. 1). Hershey: Idea Group Reference, 96-102.

Cleary, P. F., Pierce, G., and Trauth, E. M. (2006). Closing the Digital Divide: understanding racial, ethnic, social class, gender and geographic disparities in Internet use in school age children in the United States. *Universal Access in the Information Society, 4*(4), 354 - 373.

Coffey, A. (2006). Participant observation. In V. Jupp (Ed.). *The Sage Dictionary of Social Research Methods*. London: Sage Publications.

Cohoon, J. M., and Aspray, W. (Eds.). (2006). *Women and Information Technology: Research on Underrepresentation*. Cambridge Massachusetts: The MIT Press.

Countryman, J., Feldman, A., Kekelis, L., and Spertus, E. (2002). Developing a hardware and programming curriculum for middle school girls. *ACM SIGCSE Bulletin, 34*(2), 44 - 47.

Courtney, L., Timms, C., and Anderson, N. (2006). *"I would rather spend time with a person than with a machine": Qualitative findings from the Girls and ICT survey.* Paper presented at the Quality and Impact of Qualitative Research 3rd Annual QualIT Conference, Brisbane.

Covington, M. V. (1992). *Making the grade : a self-worth perspective on motivation and school reform*. Cambridge: Cambridge University Press.

Craig, A. (2006). *Young Girls ICT Into Computing Too*. Australia: AWISE.

Creswell, J. W. (1998). *Qualitative inquiry and research design : choosing among five traditions*. Thousand Oaks, California: Sage Publications.

Cuny, J., and Aspray, W. (2000). *Recruitment and Retention of Women Graduate Students in Computer Science and Engineering: Report of a Workshop June 20-21, 2000*. Washington, DC.: Computing Research Association.

Darke, P., Shanks, G., and Broadbent, M. (1998). Successfully completing case study research: combining rigour, relevance and pragmatism. *Information Systems Journal, 8*(4), 273-289.

Davies, P. (2006). Interviews. In V. Jupp (Ed.). *The Sage Dictionary of Social Research Methods*. London: Sage Publications.

Davis, J. (Creator) (2005). Criminal Minds [Television series]. [With J. Mantegna, P. Brewster, M. G. Gubler, S. Moore, A. J. Cook, K. Vangsness and T. Gibson]. United States: CBS.

Davis, J. (Creator) (2006). Criminal Minds [Television series]. [With J. Mantegna, P. Brewster, M. G. Gubler, S. Moore, A. J. Cook, K. Vangsness and T. Gibson]. United States: CBS.

Davis, J. (Creator) (2007). Criminal Minds [Television series]. [With J. Mantegna, P. Brewster, M. G. Gubler, S. Moore, A. J. Cook, K. Vangsness and T. Gibson]. United States: CBS.

de Laine, M. (1997). *Ethnography: Theory and applications in health research*. Sydney: Maclennan + Petty.

Deci, E. L., Vallerand, R. J., Pelletier, L. G., and Ryan, R. M. (1991). Motivation and Education: The Self-Determination Perspective. *Educational Psychologist 26*(3&4), 325-346.

Denner, J., and Bean, S. (2006). Girls, games and intrepid exploration on the computer. In E. M. Trauth (Ed.). *Encyclopedia of Gender and Information Technology* (Vol. 1). Hershey: Idea Group Reference, 727-732.

Denning, P. J. (2001). The Profession of IT: Who are we? *Communications of the ACM, 44*(2), 15-19.

Dennis, A. R., Kinney, S. T., and Caisy, H. Y.-T. (1999). Gender differences in the effects of media richness. *Small Group Research, 30*(4), 405-437.

Denzin, N. K. (1978). *The research act : a theoretical introduction to sociological methods* (2nd ed.). New York: McGraw-Hill.

Denzin, N. K., and Lincoln, Y. S. (1998). Introduction: Entering the field of qualitative research. In N. K. Denzin and Y. S. Lincoln (Eds.). *The landscape of qualitative research : theories and issues*. Thousand Oaks, California: Sage Publications, 1-34.

Denzin, N. K., and Lincoln, Y. S. (2005). Introduction. In N. K. Denzin and Y. S. Lincoln (Eds.). *The Sage Handbook of Qualitative Research* (3rd ed.). Thousand Oaks: Sage Publications.

deRaadt, M. (2004). *Searching for tomorrow's programmers.* Paper presented at the Issues in informing science and information technology, Rockhampton, Australia.

Dey, I. (1993). *Qualitative data analysis : a user-friendly guide for social scientists*. London: Routledge.

Dorman, S. M. (1998). Technology and the gender gap. *Journal of School Health, 68*(4), 165-166.

Downes, S. (2004). *Into the New Millennium: Why do Students Decide to Study IT?* Paper presented at the Informing Science and Information Technology Education Joint Conference, Rockhampton, Australia.

Downes, T. (2002). Children's and Families' Use of Computers in Australian Homes. *Contemporary Issues in Early Childhood, 3*(2), 182-196.

Dryler, H. (1998). Parental role models, gender and educational choice. *British Journal of Sociology, 49*(3), 375-398.

Durndell, A., and Miller, J. (2006). Gender, IT and educational choice in East and West Europe. In E. M. Trauth (Ed.). *Encyclopedia of Gender and Information Technology* (Vol. 1). Hershey: Idea Group Reference, 693-698.

Eccles, J., and Harold, R. (1992). Gender differences in educational and occupational patterns among the gifted. In N. Colangelo, S. G. Assouline and D. L. Ambroson. (Eds.). *Talent Development: Proceedings from the 1991 Henry B. and Jocelyn Wallace National Research Symposium or Talent Development*. New York: Trillium Press, 2-30.

Eccles, J., Wigfield, A., Harold, R. D., and Blumenfeld, P. (1993). Age and gender differences in children's self- and task perceptions during elementary school. *Child Development, 64*(3), 830-847.

Eccles, J. S. (1994). Understanding women's educational and occupational choices: Applying the Eccles et al. Model of Achievement-Related Choices. *Psychology of Women Quarterly, 18*(4), 585-609.

Eccles, J. S., Barber, B., and Jozefowicz, D. (1999). Linking gender to educational, occupational and recreational choices: Applying the Eccles et al. model of achievement related choices. In W. B. Swan Jr., J. H. Langlois and L. A. Gilbert (Eds.). *Sexism and stereotypes in modern society: The gender science of Janet Taylor Spence*. Washington DC.: Americal Psychological Association.

Eccles, J. S., Wigfield, A., and Schiefele, U. (1998). Motivation to succeed. In N. Eisenberg (Ed.). *Handbook of child psychology: Social, emotional, and personality development* (5th ed.). New York Wiley.

Eidelman, L., and Hazzan, O. (2006). The Shrinking Pipeline in Israeli High Schools. In E. M. Trauth (Ed.). *Encyclopedia of Gender and Information Technology* (Vol. 1). Hershey: Idea Group Reference, 1092-1098.

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *Academy of Management Review, 14*(4), 532-550.

Evans, D., and Gruba, P. (2002). *How to write a better thesis* (2nd ed.). Carlton, Victoria: Melbourne University Press.

Evans, K. (1995). Barriers to Participation of Women in Technological Education and the Role of Distance Education. Retrieved July 21, 2003, from http://www.col.org/barriers.htm

Ewen, R. B. (1998). *Personality, a topical approach : theories, research, major controversies, and emerging findings*. Mahwah, N.J: L. Erlbaum Associates.

Eysenck, H. J. (1998). *Intelligence: a new look*. New Brunswick, NJ: Transaction Publishers.

Falkenberg Lund, K., and Spanner Witzke, A. S. (2006). *Innovative reinforcement of computer science to girls.* Paper presented at the Australian Women in IT Conference, Adelaide.

Fine, G. A., and Sandstrom, K. L. (1988). *Knowing children : participant observation with minors* Newbury Park, California: Sage Publications.

Fisher, A., Margolis, J., and Miller, F. (1997). Undergraduate Women in Computer Science: Experience, Motivation and Culture. *ACM SIGCSE Bulletin, 29*(1), 106 - 110.

Foreshew, J. (2005, 4 September). Graduate demand lifts. *Australian IT*, pp. [electronic version] Retrieved from http://australianit.news.com.au/articles/0,7204,16469266%16469265E16415306%16469265E%16469265Enbv%16469265E,16469200.html.

Frauenheim, E. (2004, August 11). Students saying no to computer science. *CNET News.com*.

Frenkle, K. A. (1990). Women & Computing. *Communications of The ACM, 33*(11), 34-46.

Frieze, C. (2005). *Diversifying the Images of Computer Science: Undergraduate Women Take on the Challenge!* Paper presented at the SIGCSE technical symposium on Computer science education, St. Louis, Missouri.

Gansmo, H. J. (2006). Girls and Computing. In E. M. Trauth (Ed.). *Encyclopedia of Gender and Information Technology* (Vol. 1). Hershey: Idea Group Reference, 721-726.

Genrich, R., Roberts, D., Cater-Steel, A., and Low, E. K. (2004). *Connecting with the Y generation: an analysis of factors associated with the academic performance of foundation IS students.* Paper presented at the Issues in Informing Science and Information Technology, Rockhampton, Australia.

Gharibyan, H., and Gunsaulus, S. (2006). Gender gap in computer science does not exist in one former soviet republic: results of a study. *ACM SIGCSE Bulletin, 38*(3), 222-226.

Goldman, D. (2003). *Reality Bytes: A reflection of the perception versus the reality of teaching with ICT.* Paper presented at the IFIP Working Groups 3.1 and 3.3 Working conference: ICT and the Teacher of the Future, Melbourne Australia.

Golombok, S., and Fivush, R. (1994). *Gender Development*. Cambridge: Cambridge University Press.

Goode, J., Estrella, R., and Margolis, J. (2006). Lost in translation: gender and high school computer science. In J. M. Cohoon and W. Aspray (Eds.). *Women and Information Technology: Research on underrepresentation*. Cambridge, Massachusetts: The MIT Press.

Gorski, P. C. (2002). How computers STILL cheat girls. *The Education Digest, 68*(3), 23-27.
Gottfredson, L. S. (1981). Circumscription and compromise: A developmental theory of occupational aspirations. *Journal of Counseling Psychology, 28*(6), 545-579.
Gottfredson, L. S. (1996). Gottfredson's Theory of Circumscription and Compromise. In D. Brown and L. Brooks (Eds.). *Career Choice and Development* (3rd ed.). San Francisco: Jossey-Bass, 179-232.
Gottfredson, L. S. (2002). Gottfredson's Theory of Circumscription, Compromise and Self-Creation. In D. Brown (Ed.). *Career Choice and Development*. San Fransisco: Jossey-Bass, 85 - 148.
Gottfredson, L. S. (2005). Applying Gottfredson's theory of circumscription and compromise in career guidance and counseling. In S. D. Brown and R. W. Lent (Eds.). *Career development and counseling: Putting theory and research to work* New York: Wiley, 71-100.
Gottfredson, L. S. (2006). Circumscription and compromise. In J. H. Greenhaus (Ed.). *Encyclopedia of Career Development*. Thousand Oaks, CA: Sage.
Guba, E. G., and Lincoln, Y. S. (2005). Paradigmatic controversies, contradictions, and emerging confluences. In N. K. Denzin and Y. S. Lincoln (Eds.). *The SAGE Handbook of Qualitative Research* (3rd ed.). Thousand Oaks: Sage Publications.
Gürer, D., and Camp, T. (2002). *Investigating the Incredible Shrinking Pipeline for Women in Computer Science Final Report* (No. 9812016): The Association of Computing's Committee on Women in Computing.
Hamelink, C. J. (1997). *New Information and Communication Technologies, Social Development and Cultural Change* Geneva, Switzerland: United Nations Research Institute for Social Development.
Hapnes, T., and Rasmussen, B. (2000). Young girls on the Internet. In E. Balka and R. Smith (Eds.). *Women, work, and computerization: Charting a course to the future*. London: Kluwer Academic Publishers, 233-240.
Harrelson, S. (1999). Women and computer science. Retrieved March 31, 2003, from http://www.resnet.wm.edu/~slharr/WomenCsci.html
Harris, R., and Wilkinson, M. A. (2004). Situating gender: students' perceptions of information work. *Information Technology & People., 17*(1), 71-86.
Hartmann, M. (2003). *The Web Generation: the (De)Construction of Users, Morals and Consumption* (EMTEL Network Key Deliverable). Brussels: SMIT - VUB, Free University of Brussels.
Helwig, A. A. (1981). A Test of Gottfredson's Theory Using a Ten-Year Longitudinal Study. *Journal of Career Development, 28*(2), 77-95.
Henslin, J. M. (1999). *Sociology : a down-to-earth approach* (4th ed.). Boston, MA: Allyn and Bacon.
Higgins, E. T. (1987). Self-Discrepancy: A Theory Relating Self and Affect. *Psychological Review, 94*(3), 319-340.
Hill, N. E., Ramirez, C., and Dumka, L. E. (2003). Early Adolescents' Career Aspirations: A Qualitative Study of Perceived Barriers and Family Support among Low-Income, Ethnically Diverse Adolescents. *Journal of Family Issues, 24*(7), 934-959.
Hinds, A., and Croft, V. (2006). *National ICT Skills Summit Research*: TNS Social Research.
Hofstede, G. (1983). The Cultural Relativity of Organizational Practices and Theories. *Journal of International Business Studies 14*(2), 75-89.
Holland, J. L. (1973). *Making Vocational Choices: A Theory of Careers*. Englewood Cliffs, NJ: Prentice Hall.
Hollander, J. A. (2004). The social contexts of focus groups. *Journal of Contemporary Ethnography, 33*(5), 602-637.
Howcroft, D., and Trauth, E. M. (2004). The choice of critical information systems research. In B. Kaplan, D. P. Truex, D. Wastell, A. T. Wood-Harper and J. DeGross (Eds.). *Information Systems Research: Relevant Theory and Informed Practice (IFIP 8.2 Proceedings)*. Boston: Springer, 195-211.

Huberman, A. M., and Miles, M. B. (1994). Data management and analysis methods. In N. K. Denzin and Y. S. Lincoln (Eds.). *Handbook of Qualitative Research*. Thousand Oaks, California: Sage Publications.

Huff, C. (2002). Gender, software design and occupational equity. *ACM SIGCSE Bulletin, 34*(2), 112-115.

Hyde, J. S., and Rosenberg, B. G. (1976). *Half the human experience : the psychology of women*. Lexington, MA: D. C. Heath.

Iivari, J. (1991). A paradigmatic analysis of contemporary schools of IS development. *European Journal of Information Systems, 1*(4), 249-272.

Iivari, J., and Hirschheim, R. (1992). *A Paradigmatic Analysis of Four Emerging Information Systems Development Approaches.* Paper presented at the Third Australian Conference on Information Systems, Wollongong, Australia.

Iivari, J., Hirschheim, R. A., and Klein, H. K. (1998). A Paradigmatic Analysis Contrasting Information Systems Development Approaches and Methodologies. *Information Systems Research, 9*(2), 164-193.

Inkpen, K., Booth, K. S., Klawe, M., and Upitis, R. (1995). *Playing Together Beats Playing Apart, Especially for Girls.* Paper presented at the Proceedings of the Conference on Computer-Supported Collaborative Learning (CSCL)'95, Indiana, IL.

Irwin, J. (2005). Notes on the status of the concept subculture [1970]. In K. Gelder and S. Thornton (Eds.). *The Subcultures Reader* (2nd ed.). London: Routledge.

Jackson, C. (2002). Can Single-sex Classes in Co-educational Schools Enhance the Learning Experiences of Girls and/or Boys? An Exploration of Pupils' Perceptions. *British Educational Research Journal, 28*(1), 37-48.

Jepson, A., and Peri, T. (2002a). Priming the pipeline. *ACM SIGCSE Bulletin, 34*(2), 36-39.

Jepson, A., and Peri, T. (2002b). Priming the pipeline. *Inroads - The SIGCSE Bulletin, 34*(2), 36-39.

Jewell, H., and Maltby, J. R. (2001). *Female Involvement in Information Technology Degrees: Perception, Expectation and Enrolment.* Paper presented at the Twelfth Australasian Conference on Information Systems, Coffs Harbour, NSW.

Jick, T. D. (1979). Mixing Qualitative and Quantitative Methods: Triangulation in Action. *Administrative Science Quarterly, 24*(4), 602-611.

John, O. P., and Srivastava, S. (1999). The Big-Five Trait Taxonomy: History, Measurement and Theoretical Perspectives. In O. P. John and L. A. Pervin (Eds.). *Handbook of Personality: Theory and Research* (2nd ed.). New York: Guilford Press.

Joshi, K. D., and Kuhn, K. (2001). *Gender differences in IS career choice: examine the role of attitudes and social norms in selecting IS profession.* Paper presented at the ACM SIGCPR Conference, New York, NY.

Kiesler, S., Sproull, L., and Eccles, J. (1985). Pool halls, chips and war games: women in the culture of computing. *Psychology of Women Quarterly, 9*(4), 451-463.

Kimmel, M. S. (2004). *The Gendered Society* (2nd edition ed.). Oxford: Oxford University Press.

King, J., and Bond, T. (2001). *Parents' and Students' Satisfaction with the Use of Information Technology in Government Schools in Queensland, Australia.* Paper presented at the World Conference on Computers in Education, Copenhagen, Denmark.

Kling, R. (1999). What is Social Informatics and Why Does it Matter? *D-Lib Magazine, 5*(1).

Kling, R. (2001). Social Informatics. In M. Drake (Ed.). *Encyclopedia of Library and Information Science* (2nd edition ed.). online: Marcel Dekker, Inc., 2656 - 2661.

Krause, K.-L., Bochner, S., and Duchesne, S. (2003). *Educational Psychology for learning and teaching*. South Melbourne: Thomson Learning.

Krueger, R. A., and Casey, M. A. (2000). *Focus groups: a practical guide for applied research* (3rd ed.). Thousand Oaks, CA: Sage Publications Inc.

Lagesen, V. A. (2006). The Woman Problem in Computer Science. In E. M. Trauth (Ed.). *Encyclopedia of Gender and Information Technology* (Vol. 1). Hershey: Idea Group Reference, 1216-1222.

Lai, K.-W., and Pratt, K. (2004). Information and communication technology (ICT) in secondary schools: the role of the computer coordinator. *British Journal of Educational Technology, 35*(4), 461-475.

Lamb, R., and Sawyer, S. (2005). On extending social informatics from a rich legacy of networks and conceptual resources. *Information Technology & People, 18*(1), 9-20.

Lamb, S. (1997). *School achievement and initial education and labour market outcomes* (Longitudinal Surveys of Australian Youth No. 4): Australian Council for Educational Research.

Lang, C., and McKay, J. (2006). Australian IT enrollment trends and model of contributing factors. In E. M. Trauth (Ed.). *Encyclopedia of Gender and Information Technology* (Vol. 1). Hershey: Idea Group Reference, 50-56.

Langridge, J. (2003). The Backyard Blitz Syndrome: the emerging student culture in Australian Higher Education. *Transformations online journal of region, culture and society*(7).

Lapan, R. T., and Jingelski, J. (1992). Circumscribing Vocational Aspirations in Junior High School. *Journal of Counseling Psychology, 39*(1), 81-90.

Lee, J. D. (2002). More than Ability: Gender and Personal Relationships Influence Science and Technology Involvement. *Sociology of Education, 75*(4), 349-373.

Li, W., Lee, A., and Solmon, M. (2007). The role of perceptions of task difficulty in relation to self-perceptions of ability, intrinsic value, attainment value, and performance. *European Physical Education Review, 3*(3), 301 - 318.

Lim, C. P. (2002). A theoretical framework for the study of ICT in schools: a proposal. *British Journal of Educational Technology, 33*(4), 411-421.

Linehan, G. (Director). (2006). *The IT Crowd* [Television series]. [With C. O'Dowd, R. Ayoade and K. Parkinson]. United Kingdom: British Ash Atalla

Linehan, G. (Director). (2007). *The IT Crowd* [Television series]. [With C. O'Dowd, R. Ayoade and K. Parkinson]. United Kingdom: British Ash Atalla

Little, J. C., Granger, M., Adams, E. S., Holvikivi, J., Lippert, S. K., Walker, H. M., et al. (2000). *Integrating Cultural Issues into the Computer and Information Technology Curriculum.* Paper presented at the The 5th Annual Conference on Innovation and Technology in Computer Science Education, Helsinki, Finland.

Logan, K. A. (2004). *A case for single-sex classrooms in computing.* Paper presented at the International Symposium GIST (Gender Perspectives Increasing Diversity for Information Society Technology), Bremen Germany.

Lupart, J. L., and Cannon, E. M. (2000). *Gender differences in junior high school students towards future plans and career choices.* Paper presented at the Eighth Canadian Conference for the Advancement of Women in Engineering, Science, and Technology (CCWEST), St Johns Newfoundland.

Margolis, J., and Fisher, A. (1997). Geek Mythology and attracting undergraduate women to computer science. *Joint National Conference of the Women in Engineering Program, Advocates Network, and the National Association of Minority Engineering Program Administrators* Retrieved February 10, 2003, from http://www.cs.cmu.edu/~gendergap/wepan97.html

Margolis, J., and Fisher, A. (2002). *Unlocking the Clubhouse: Women in Computing*. Cambridge, Massachusetts: The MIT Press.

Margolis, J., Fisher, A., and Miller, F. (1998). Failure Is Not an Option: International Women in Computer Science (Work in progress). *Working Paper of Women in Computer Sciences: Closing the Gender Gap in Higher Education* Retrieved February 10, 2003, 2003, from http://www.cs.cmu.edu/~gendergap/intwomen.html

Marshall, G. (1994). *Oxford Dictionary of Sociology*. Oxford: Oxford University Press.

Martin, T. (Director). (2003). *Bad Eggs* [Motion Picture]. [With M. Molloy, B. Franklin and J. Lucy]. Australia: Village Roadshow Pictures.

Matthew, K., Callaway, R., Letendre, C., Kimbell-Lopez, K., and Sephens, E. (2002). Adoption of Information Communication Technology by Teacher Educators: one-on-one coaching. *Journal of Information Technology for Teacher Education, 11*(1).

Maxwell, J. A. (2005). *Qualitative Research Design: An interactive approach* (2nd ed.). Thousand Oaks, California: Sage Publications.

McMurray, A. J., Pace, W. R., and Scott, D. (2004). *Research: A commonsense approach*. Southbank, Victoria: Thomson Social Science Press.

McNair, S., Kirova-Petrova, A., and Bhargava, A. (2001). Computers and Young Children in the Classroom: Strategies for Minimizing Gender Bias. *Early Childhood Education Journal, 29*(1), 51-55.

Meece, J. L. (1997). *Child and adolescent development for educators*. New York: The McGraw-Hill Companies.

Mertens, D. M. (1997). *Research Methods in Education and Psychology: Integrating Diversity with Quantitative and Qualitative Approaches*. Thousand Oaks: Sage Publications.

Meszaros, P. S., Laughlin, A., Creamer, E. G., Burger, C. J., and Lee, S. (2006). Parental support for female IT career interest and choice. In E. M. Trauth (Ed.). *Encyclopedia of Gender and Information Technology* (Vol. 2). Hershey: Idea Group Reference, 963-969.

Miles, M. B., and Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Thousand Oaks, California: Sage Publications.

Miller, L., and Budd, J. (1999). The development of occupational sex-role stereotypes, occupational preferences and academic subject preferences in children at ages 8, 12 and 16. *Educational Psychology, 19*(1), 17-35.

Miller, L., Wood, T. A., Halligan, J., Keller, L., Hutchinson-Pike, C., Kornbrot, D., et al. (2000). Saying "welcome" is not enough: women, information systems and equity in work. *Career Development International, 5*(7), 379-389.

Milliken, M. E. (1998). *Understanding Human Behavior: a Guide for Health Care Providers* (6th ed.). Albany: Delmar.

Millward, L. J., Houston, D., Barrett, M., and Larkin, C. (2006). *"Who am I in relation to work and the job that I do?": Gender stereotypes and occupational choice in 14-16's.* Paper presented at the Developmental Psychology British Psychological Society Conference, Royal Holloway, University of London.

Mingers, J. (2004). Re-establishing the Real: Critical Realism and Information Systems. In J. Mingers and L. P. Wilcox (Eds.). *Social Theory and Philosophy for Information Systems Research*. Chichester: John Wiley & Sons Ltd., 372-406.

Mitchell, M., Sheard, J., and Markham, S. (2000). *Student Motivation and Positive Impressions of Computing Subjects.* Paper presented at the Australasian Computing Education Conference, Melbourne, Australia.

Moore, B. (1997). *The Australian Concise Oxford Dictionary* (3rd ed.). Melbourne: Oxford University Press.

Moorman, P., and Johnson, E. (2003). *Still a stranger here: Attitudes among secondary school students towards computer science.* Paper presented at the Annual Joint Conference Integrating Technology into Computer Science Education, Thessaloniki, Greece.

Multimedia Victoria. (2001). Reality bytes. Retrieved March 31, 2003, from http://www.mmv.vic.gov.au/cvnewsletter

Myers, D. G. (2002). Social Psychology (Glossary). 7th Edition. Retrieved 2 April 2005, from http://highered.mcgraw-hill.com/sites/0072413875/student_view0/glossary.html

Myers, M. D. (1997). Qualitative Research in Information Systems. *MIS Quarterly, 21*(2), 241-242.

Myers, M. D., and Newman, M. (2007). The qualitative interview in IS research: Examining the craft. *Information and Organization, 17*(1), 2-26.

Myers, M. E., and Beise, C. M. (2001). *Nerd Work: Attractors and Barriers Perceived by Students Entering the IT Field.* Paper presented at the ACM SIGCPR Conference, New York, NY.

Newmarch, E., Taylor-Steele, S., and Cumpston, A. (2000). Women in IT – What Are the Barriers? *Network of Women in Further Education Conference Showcase of Strategies for Women in Education on Information Technology Conference Paper* Retrieved April 7, 2003, from www.detya.gov.au/iae/analysis/womeninit.htm

Nielsen, S., von Hellens, L. A., and Wong, S. (2001). *The Male IT Domain: You've Got To Be In It To WinIT!* Paper presented at the Twelfth Australasian Conference on Information Systems, Coffs Harbour, NSW.

O'Keefe, B. (2005, January 12). Women lead IT course exodus. *Australian IT*.

O'Leary, Z. (2004). *The Essential Guide to Doing Research* London: Sage Publications.

Oates, B. J. (2006). *Researching Information Systems and Computing*. London: Sage Publications Ltd.

Oblinger, D., and Oblinger, J. (Eds.). (2005). *Educating the Net Generation*. [eBook] http://www.educause.edu/educatingthenetgen: EDUCAUSE.

Oettingen, G., and Gollwitzer, P. M. (2001). Goal Setting and Goal Striving. In A. Tesser and N. Schwarz (Eds.). *Intraindividual Processes*. Oxford, UK: Blackwell Publishers, 329-347.

Ogan, C., Robinson, J. C., Ahuja, M., and Herring, S. C. (2006). Gender differences among students in computer science and applied information technology. In J. M. Cohoon and W. Aspray (Eds.). *Women and Information Technology: Research on underrepresentation*. Cambridge, Massachusetts: The MIT Press.

Oliver, P. (2006). Purposive sampling. In V. Jupp (Ed.). *The Sage Dictionary of Social Research Methods*. London: Sage Publications.

Orlikowski, W. J., and Baroudi, J. J. (1991). Studying Information Technology in Organizations: Research Approaches and Assumptions. *Information Systems Research, 2*(1), 1-28.

Paa, H. K., and McWhirter, E. H. (2000). Perceived influences on high school students' current career expectations. *The Career Development Quarterly, 49*(1), 29-44.

Pajares, F. (1997). Current directions in self-efficacy research. In M. L. Maehr and P. R. Pintrich (Eds.). *Advances in motivation and achievement* (Vol. 10). Greenwich, CT: JAI Press Inc.

Pallas, A. M. (2000). The Effects of Schooling on Individual Lives. In M. T. Hallinan (Ed.). *Handbook of the Sociology of Education.* New York: Kluwer Academic/Plenum Publishers, 499 - 528.

Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd edition ed.). Thousand Oaks, California: Sage publications.

Pau, R., Argles, D., White, S., and Lovegrove, G. (2005). *Computer Geek Versus Computer Chic: IT education and IT careers.* Paper presented at the Sixth International Women into Computing Conference, Greenwich, UK. .

Peiris, D. R., Gregor, P., and V, I. (2000). *Women And Computing.* Paper presented at the Women, Work, and Computerization Conference, Vancouver, Canada.

Pintrich, P. R., and Schunk, D. H. (2002). *Motivation in education: Theory, research and applications* (2nd ed.). Upper Saddle River, New Jersey: Merill Prentice Hall.

Pizzolato, J. E. (2007). Impossible Selves: Investigating Students' Persistence Decisions When Their Career-Possible Selves Border on Impossible. *Journal of Career Development, 33*(3), 201-223.

Polesel, J., Helme, S., and Teese, R. (2005). *The Next Step Report 2005 on the destinations of Year 12 completers in Queensland*. Brisbane: Department of Education and the Arts, Queensland.

Polesel, J., and Teese, R. (2006). *The Next Step Report 2006 on the destinations of Year 12 completers in Queensland*. Brisbane: Department of Education and the Arts, Queensland.

Poole, M., and Low, B. (1985). Career and marriage: Orientations of adolescent girls. *Australian Journal of Education, 29*(1), 36–46.

Prensky, M. (2001a). Digital Natives, Digital Immigrants. *On the Horizon, 9*(5).

Prensky, M. (2001b). Digital Natives, Digital Immigrants, Part II: Do they really think differently? *On the Horizon, 9*(6).

Pryor, R. G. L., and Taylor, N. B. (1986). What would I do if I couldn't do what I wanted to do? investigating career compromise strategies *Australian Psychologist, 21*(3).

Purkey, W. W. (1988). *An Overview of Self-Concept Theory for Counselors. Highlights: An ERICS/CAPS Digest* (No. ED304630). Ann Arbor MI.: University of Michigan ERIC Clearinghouse on Counseling and Personnel Services

QSA. (2003). Technology: Years 1 to 10 Syllabus. Retrieved 28 June 2007, from www.qsa.qld.edu.au/downloads/syllabus/kla_tech_syll.pdf

Queensland Government. (2006). Issues Paper:National ICT skills summit. Retrieved 19 June 2006, from http://www.iib.qld.gov.au/skillschallenge/downloads/Issues_Paper.pdf

Queensland Government. (2007). *Commission for Children and Young People and Child Guardian Act 2000* (No. 5B). **Brisbane**: Office of the Queensland Parliamentary Counsel.

Quimby, J. L., and DeSantis, A. M. (2006). The influence of role models on women's career choices. *The Career Development Quarterly, 54*(4), 297-306.

Reinen, I. J., and Plomp, T. (1997). Information Technology and gender equality:A contradiction in terminis? *Computers and Education, 28*(2), 65-78.

Roberts, G. R. (2005). Technology and learning: expectations of the net generation. In D. Oblinger and J. Oblinger (Eds.). *Educating the net generation*. [eBook] http://www.educause.edu/educatingthenetgen: EDUCAUSE.

Sawyer, S., and Rosenbaum, H. (2000). Social Informatics in the Information Sciences: Current Activities and Emerging Directions. *Informing Science, 3*(2), 89-95.

Schein, E. H. (1984). Coming to a new awareness of organizational culture. *Sloan Management Review, 25*(2), 3-16.

Schneiderman, B. (2000). Universal Usability. *Communications of the ACM, 43*(5), 84-91.

Scott, V. A. (1996). Why are girls under represented? Ten years on. *Australian Educational Computing, 11*(1), 17-21.

Sena, D. (Director). (2001). *Swordfish* [Motion Picture]. [With H. Jackman, J. Travolta, H. Berry and D. Cheadle]. United States: Warner Brothers.

Sheahan, P. (2005). *Generation Y: Thriving and surviving with generation Y at work*. Pahran, Victoria: Hardie Grant Books.

Sheard, J., Lowe, G., and Markham, S. (2001). *Educating Students in IT Course Options: An Impact Evaluation.* Paper presented at the International Conference on Computers in Education, Seoul, Korea.

Shoib, G., Nandhakumar, J., and Jones, M. (2006). *Using social theory in information systems research.* Paper presented at the International Conference on Qualitative Research in IT & IT in Qualitative Research, Brisbane, Australia.

Skaalik, E. M. (1997). Issues in research on seslf-concept. In M. L. Maehr and P. R. Pintrich (Eds.). *Advances in motivation and achievement* (Vol. 10). Greenwich, CT: JAI Press Inc, 51-97.

Smith, L., Sinclair, K. E., and Chapman, E. S. (2002). Students' Goals, Self-Efficacy, Self-Handicapping, and Negative Affective Responses: An Australian Senior School Student Study. *Contemporary Educational Psychology*(27), 471–485.

Soloway, E., and Norris, C. (1999). Back to the future. *netWorker, 3*(4), 28-29.

Spencer, S. (2003). *Can you do Addition? Questioning the Domain of IT.* Paper presented at the Australian Women in IT Conference, Hobart Tasmania.

Stake, R. E. (2005). Qualitative case studies. In N. K. Denzin and Y. S. Lincoln (Eds.). *The Sage Handbook of Qualitative Research* (3rd ed.). Thousand Oaks, California: Sage Publications.

Standley, J., and Stroombergen, L. (2001). *21st Century Women and Understanding the Future Research Report*: University of Nottingham Research Report.

Steele, C. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist, 52*(6), 613-629.

Stewart, D. W., Shamdasani, P. N., and Rook, D. W. (2007). *Focus Groups: Theory and practice* (2nd ed.). Thousand Oaks, CA: Sage Publications Inc.

Tapia, A. H., and Kvasny, L. (2004). *Recruitment is never enough: Retention of women and minorities in the IT workplace.* Paper presented at the ACM SIGCPR/MIS Conference, Tuscon, Arizona.

Teague, J. (1997). *A structured review of reasons for the underrepresentation of women in computing.* Paper presented at the Second Australasian conference on Computer science education, Melbourne.

Teague, J. (1998). *Personality type, career preference and implications for computer science recruitment and teaching.* Paper presented at the Third Australasian Conference on Computer Science Education, Brisbane, Australia.

Teague, J. (2002). Women in Computing: What brings them to it, what keeps them in it? *ACM SIGCSE Bulletin, 34*(2), 147-158.

Thorp, D. (2003, 26 August). University numbers drop. *The Australian,* p. 27.

Trauth, E. M. (2002). Odd girl out: an individual differences perspective on women in the IT profession. *Information Technology & People., 15*(2), 98-118.

Trauth, E. M. (2006a). An Agenda for Research on Gender Diversity in the Global Information Economy. In E. M. Trauth (Ed.). *Encyclopedia of Gender and Information Technology* (Vol. 1). Hershey: Idea Group Reference, xxix-xxxiii.

Trauth, E. M. (2006b). Theorizing gender and information technology research. In E. M. Trauth (Ed.). *Encyclopedia of Gender and Information Technology* (Vol. 2). Hershey: Idea Group Reference, 1154-1159.

Trauth, E. M., Nielsen, S., and von Hellens, L. A. (2003). Explaining the IT Gender Gap: Australian Stories for the New Millennium. *Journal of Research and Practice in Information Technology, 35*(1), 7-20.

Trauth, E. M., Nielsen, S. H., and von Hellens, L. A. (2000). *Explaining the IT Gender Gap: Australian Stories.* Paper presented at the Eleventh Australasian Conference on Information Systems, Brisbane, Australia.

Trauth, E. M., Quesenberry, J. L., and Morgan, A. J. (2004). *Understanding the under representation of women in IT: Toward a theory of individual differences.* Paper presented at the ACM SIGCPR/MIS Conference, Tucson, Arizona.

Trusty, J., Robinson, C. R., Plata, M., and Ng, K.-M. (2000). Effects of gender, socioeconomic status, and early academic performance on postsecondary educational choice. *Journal of Counseling and Development, 78*(4), 463-472.

Van Der Vyver, G., Crabb, D., and Lane, M. S. (2004). *Factors influencing the decision to choose information technology preparatory studies in secondary schools: an exploratory study in regional/rural Australia.* Paper presented at the Issues in Informing Science and Information Technology, Rockhampton, Australia.

Vandiver, B. J., and Bowman, S. L. (1996). A schematic reconceptualization and application of Gottfredson's model. In M. L. Savickas and W. B. Walsh (Eds.). *Handbook of Career Counseling: Theory and practice*. Palo Alto, CA: Davies-Black Publishing.

Vaughn, S., Shay Schumm, J., and Sinagub, J. (1996). *Focus group interviews in education and psychology*. Thousand Oaks CA: Sage Publications.

Venkatesh, V., and Morris, M. G. (2000). Why don't men ever stop to ask for directions? Gender, social influence, and their role in technology acceptance and usage behavior. *MIS Quarterly, 24*(1), 115-139.

Volman, M., and van Eck, E. (2001). Gender equity and information technology in education: The second decade. *Review of Educational Research, 71*(4), 613-634.

von Hellens, L., and Nielsen, S. (2006). Facing and changing reality in the Australian IT industry. In E. M. Trauth (Ed.). *Encyclopedia of Gender and Information Technology* (Vol. 1). Hershey: Idea Group Reference, xxxiv-xxxvi.

von Hellens, L. A., and Nielsen, S. (2001). Australian Women in IT. *Communications of the ACM, 44*(7), 46-52.

von Hellens, L. A., Nielsen, S. H., and Beekhuyzen, J. (2004). An exploration of dualisms in female perceptions of IT work. *Journal of Information Technology Education, 3*.

von Hellens, L. A., Nielsen, S. H., Beekhuyzen, J., and Trauth, E. M. (2003). *Women Talking About IT Work:Duality or Dualisms.* Paper presented at the ACM SIGCPR/MIS Conference, Philadelphia, Pennsylvania.

Walliman, N. (2006). *Social Research Methods*. London: Sage Publications.

Walsham, G. (1995). Interpretive case studies in IS research: nature and method. *European Journal of Information Systems, 4*, 74-81.
Walsham, G. (2006). Doing interpretive research. *European Journal of Information Systems, 15*(2), 320-330.
Watson, C. M., Quatman, T., and Edler, E. (2002). Career Aspirations of Adolescent Girls: Effects of Achievement Level, Grade, and Single-Sex School Environment. *Sex Roles, 46*(9/10), 323-335.
Webb, C. (1999). Analysing qualitative data: computerized and other approaches. *Journal of Advanced Nursing, 29*(2), 323-330.
Weber, R. (2004). Editor's comments: The Rhetoric of Positivism Versus Interpretivism: A Personal View. *MIS Quarterly, 28*(1), iii-xii.
Weisinger, J. Y., and Trauth, E. M. (2002). Situating culture in the global information sector. *Information Technology and People, 15*(4), 306-320.
Wentzel, K. R., and Wigfield, A. (1998). Academic and Social Motivational Influences on Students' Academic Performance. *Educational Psychology Review, 10*(2), 155-175.
Whitehouse, C., Lovegrove, G., and S. Williams. (1997). *IT Equity through the Web and Internet.* Paper presented at the 6th International IFIP Conference on Women, Work and Computerization, Bonn, Germany.
Wigfield, A., and Eccles, J. S. (2000). Expectancy–Value Theory of Achievement Motivation. *Contemporary Educational Psychology, 25*, 68–81.
Wigfield, A., Eccles, J. S., and Rodrigues, D. (1998). The Development of Children's Motivation in School Contexts. *Review of Research in Education, 23*, 73-118.
Wigfield, A., Tonks, S., and Eccles, J. S. (2004). Expectancy value theory in cross-cultural perspective. In M. McInerney and S. Van Etten (Eds.). *Big Theories Revisited*. Greenwich, CT: Information Age Publishing, 165–198.
Wolcott, H. F. (1995). *The art of fieldwork* Walnut Creek: AltaMira Press.
Woodfield, R. (2002). Woman and information systems development: not just a pretty (inter)face? *Information Technology & People, 15*(2), 119-138.
Yin, R. K. (1994). *Case Study Research: Design and Methods*. Thousand Oaks: Sage Publications.
Yin, R. K. (2003). *Case Study Research: Design and Methods* (2nd ed.). Thousand Oaks: Sage Publications.
Young, J. (2002). Women In IT Tasmania: Increasing the participation of women in information, communication technology careers. *Prepared for Intelligent Island,Tasmania* Retrieved March 22, 2003, from http://www.intelligentadvantage.net.au/documents/292.pdf
Young, J. (2003). The extent to which information technology careers fulfil the career ideals of girls. *Australian Journal of Information Systems, 10*(2), 115-125.
Zakopoulos, V. (2005). An Evaluation of the Quality of ICT Teaching within an ICT-Rich Environment: The Case of Two Primary Schools. *Education and Information Technologies, 10*(4), 323–340.
Zarrett, N., Malanchuk, O., Davis-Kean, P. E., and Eccles, J. (2006). Examining the gender gap in IT by race: Young adults' decisions to peruse an IT career. In J. M. Cohoon and W. Aspray (Eds.). *Women and Information Technology: Research on underrepresentation*. Cambridge, Massachusetts: The MIT Press.

Appendix A Interview Questions

Student Interview Question Pool

Computers and their availability

1. Do you have a computer for YOUR OWN use? Can you tell me who bought it for you? What room is the computer in? What is the computer mainly used for? Is it connected to the Internet?
2. Do you have a computer that your FAMILY uses? Can you tell me who bought it? What room is the computer in? Who uses it most? How is it shared between members of your family? What do your FAMILY mainly use the computer for? What do YOU use the computer for? Is the computer connected to the Internet?
3. For the students who DON'T HAVE a computer at home – do you think that you would be more interested in computers if you had one at home?

Socialisers

1. Are your PARENTS good with computers? What about other people in your FAMILY?
2. Does your MUM use computers? Does she like using them? Does she use them a lot? Is this at home or at work or in both places?
3. Does your DAD use computers? Does he like using them? Does he use them a lot? Is this at home or at work or in both places?
4. Do your PARENTS and TEACHERS encourage you to do well with computers? What about your FRIENDS?
5. How important is it to you to fit in with your FRIENDS and what they like to do?

School subjects

1. How do you PREFER TO DO SCHOOL WORK? Would you prefer to do it on or with a computer or would you like to do it without one?
2. What do you THINK ABOUT CLASSES where you learn about computers?
3. Do you think that you learn anything NEW in your computer lessons? Do you feel that you learn anything USEFUL in your computer lessons?
4. Do you think that learning how to USE THE COMPUTER PROPERLY is important and why
5. Do you think computer classes are FUN?

Careers

1. What do YOU use a computer for? What do YOU like doing the most on a computer? Do you think that you could get a JOB in that area?
2. Why DO you think people want to WORK with computers?
3. Why DON'T you think people want to WORK with computers?
4. If you could be anything, what do YOU think you will be doing when you leave school?
5. How important are the opinions of your PARENTS when you are thinking about future jobs?
6. Do you want to do the sort of work your PARENTS or other member of your FAMILY do?
7. Do YOU think that you will WORK with computers when you are older? What do you think that you will be doing? Why?
8. Do you think that you would have to GIVE UP anything to have a job in computers? Why? How important are those things to you?
9. Tell me what you think about this STATEMENT "Learning to use a computer well is important to my future"
10. If you were to think about working with computers as a career – what AREA would you be most INTERESTED in – designing new technology, helping people to use technology better, teaching them to use the technology, creating new technology, solving problems or something else?
11. Can you tell me or give me an EXAMPLE of what a person working in computers does

12. Can you DESCRIBE to me what you think a person is like who works in computer looks like and is like?

Computer applications and their use

1. Do you PLAY GAMES on the computer? What sort of games do you play? Why do you play these ones – why do you like playing them? In an imaginary world where there is every sort of computer game you can think of, what sort of computer game would you like to play the most?
2. How many of you use MSN messenger or ICQ or some other chat program? How long have you been using it? Would you like to have made something like this for yourself?
3. How many of you have made a WEB PAGE? What do you think about being able to do this?
4. Who has used a BLOG or online diary page?
5. Who uses EMAIL? What do you think about using email?
6. Who has a MOBILE PHONE? What do you think about having things like this? Would you like to create something like this?
7. Can you remember the FIRST TIME you used a computer? When was this? What did you do? How did you feel?
8. What do you like doing the MOST on a computer?

Ability and feelings

1. Do you think GIRLS can do things with computers as good as BOYS? What about you – do you think you can do things with computers as well as boys do? Why do you think that?
2. How do you think about computers – is it more of a thing to help you get things DONE, or do you think it is more for FUN or is it a combination of both things, - why?
3. How do you FEEL when you are doing stuff on a computer at SCHOOL? Are you happy, sad, worried, confident or something else?
4. If you have used a computer outside of school such as at home or at a FRIEND'S house, how do you FEEL when you are doing stuff on a computer then?
5. Do you like to PERSONALISE your computer to the way you want it to work and look? What do you do to do that?
6. What do you think about HELPING other people when they are having PROBLEMS with their computer or doing something on a computer?
7. What do you think about finding out about NEW THINGS for your computer or how to do things differently on the computer?
8. What is the BEST THING about technology?
9. Do you think that people who are good at working on or with computers get enough RECOGNITION? Do you prefer to win AWARDS or to feel good inside yourself when you do something well?
10. Thinking about when you did new things on the computer in class. Do you think that you COULD DO IT before you tried it? How do you feel about it now?

Specific Year 8 questions

1. What do you think you do in computer subjects such as Information Technology, ITS and IPT when you are in Grades 9 -12 when you can choose your subjects? How hard do you think that these subjects are? What things are important to you when you choose your subjects?
2. Does the teacher make any difference to you as to whether you choose or like a subject? Do you make decisions about whether to take a subject or not because of who the teacher will or may be?
3. You have chosen your subjects for next year already. Did anyone choose Information Technology?
   If yes: What made you chose that subject? Do you think you will do well in it? Does this affect the reason why you did or even didn't choose this subject?
   If no: Why didn't you chose it?

4. What subjects do you think you will choose in Year 11 and 12? Are these important to what you want to do for a career? What career do you want to be involved in? Why have you chosen this career?

Teacher Interview Question Pool

1. Can you remember the first time you used computers?
2. Do you have a computer at home? Do you use it often to prepare work using ICT for your class?
3. Did you study computer subjects when undertaking your teaching qualification? If so, did you think that the ICT curriculum during your training was relevant to your needs?
4. Have you recently undergone training in computers – either informal or informal? What was it? Did it fill your needs? What could have been done better? Do you feel that you receive enough training relating to computers?
5. Do you have to teach yourself to do things with computers? How does this make you feel?
6. How comfortable are you with ICT?
7. Do you think that ICT are an important part of the curriculum?
8. What do you think is the hardest aspect about teaching ICT?
9. Do you feel that using ICT in the classroom is a burden or a bonus?
10. Has the implementation of IT made your teaching job easier or more difficult? Why?
11. What do you see as the main inhibitor to using ICT in the classroom?
12. Do you think that gender split classes would be beneficial for students? What about for teachers?
13. Do you think that girls have to work harder than boys when learning how to use a computer? Why?
14. Have you noticed anything related to ability and gender related to ICT?
15. Have you noticed anything in particular about your current students' attitudes towards ICT? Has this changed from previous years?
16. Do you think that your students are learning ICT skills faster and earlier? How does this make you feel?
17. Who decides what software/hardware you get to use? Would you like a greater say in how much you get in your ICT budget or how it is to be spent? Do you know how often the computers and software are updated? Are you notified about new updates and can you request ones yourself?
18. Do you have enough computer access in your classroom? If not, what are your ideal requirements?
19. Do you prefer to teach using ICT or not? Why?
20. How often does your teaching or content have to change because of ICT?
21. Do you think that computer games could be an important tool for teaching students other areas of the curriculum? Do you use computer games to teach? If so have you noticed whether they have had positive benefits from this? Is there a downside to computer game playing?
22. Have you used technologies such as web cams or chat programs (such as those offered by Education Queensland or others like msn) as a tool to aid your teaching?
23. What do you think about students using email at school? Is this a good thing or a bad thing?
24. What do you think about students using mobile phones? Are they good or bad?
25. Have you noticed any difference between the attitudes of older students compared to younger students in relation to ICT? Why do you think this is?
26. Do you think that there should be specialty subjects for ICT like LOTE or drama to prepare and encourage students to think about ICT as a post school option? Why is that?
27. Have you noticed any difference between boys and girls with relation to technology?
28. Do you find it difficult to find new things to inspire the students with technology?

© 2007 Kaylene Clayton

29. Do you know someone who you can see as an ICT role model? If so, is this person a family member, another teacher, student or someone else?
30. What is the best thing about technology? What is the worst thing?

SmartBoard specific questions

31. What is the main difference that you have noticed in the classroom related to the SmartBoard?
32. Do you prefer to teach with or without the SmartBoards now?
33. What is the best thing about teaching with the SmartBoards? What is the worst?

Appendix B Consent Packages

School Approach

Dear Principal name

Request to observe Year 4 and 8 students and teachers in the classroom and conduct interviews.

I am a doctoral candidate at Griffith University researching the area of attitudes and perceptions students in relation to technology. I have also been working closely with a number of high schools and Education Queensland over several years to encourage students to consider the areas of Information Technology and Science as a study or career path.

With your permission and the permission of the students, parents and teachers involved, I would like to be a participant observer of the normal Year 4 and Year 8 classroom activities (involving technology) one day per week each class in Term 4 2005. I would also like to conduct an interview with their teacher(s) outside of class time as well as focus group interviews with the students during part of their lunch break. This strategy is planned to minimise disruption to normal classroom activities.

Participation in this research would be of a voluntary and consensual basis. Students, parents and teachers who decline to participate in the research rights will be respected and no data will be collected from them. As the majority of the research involves observation of normal classroom activities, non-participation in the research will have no adverse effect on those declining to participate. Ethical approval will be obtained from Griffith University and Education Queensland. I also hold a current Working with Children “blue” card.

I would be more than willing to assist and support the teacher in any activities and tasks during this period as research responsibilities allow. I would also be willing to offer advice regarding technology or mentoring amongst other things as my experience permits.

If you have any questions regarding this please feel free to contact me.

Yours Sincerely

Kaylene Clayton

K.Clayton@griffith.edu.au

Mobile: 0402032659

Parent Consent Pack

Dear Parent:

We are asking permission to observe your son or daughter during their normal classroom activities for one day per week during Term X, 200X. All students in your son or daughter's class are being invited to participate. Students at several other schools in Brisbane are also being invited to participate. We would also like the opportunity to ask your child their opinions about technology and computers during part of a lunch break (up to 30 mins).

The purpose of my project is to gather information to help me understand what young people think about technology and computers and what we can do to make subjects and careers in this area more appealing. Each participating school will receive a copy of my research thesis report presenting the results of my project.

The information collected will be anonymous. The participants, class and school be referred to in broad terms or by fictitious names and will not be identifiable in the research report. There are no identified costs or risks to your child. The researcher also requests permission to audio record the talk. This audio recording is only to assist the researcher and will only be available to the research team. It will be destroyed once it has been transcribed.

Your child's participation is completely voluntary and they may decline to participate, if they wish. You may also decline to have your child participate, if you wish. If you do decline, your son or daughter will be discretely identified to the researcher who will not collect any information related to them. Your decision will have no effect on your child's grades or relationship with the school/teachers.

Should you have any further questions about this research please do not hesitate to contact Kaylene Clayton on 3382 1086 or K.Clayton@griffith.edu.au .

This research is being conducted by:

Names: Liisa von Hellens, Sue Nielsen, Kaylene Clayton
School: School of Information and Communication Technology
Contact Phone: 3382 1086
Contact Email: K.Clayton@griffith.edu.au

Could you please complete and sign the form over the page and return it to the school.

I appreciate your time and thank you for your help

Griffith University conducts research in accordance with the *National Statement on Ethical Conduct in Research Involving Humans*. If potential participants have any concerns or complaints about the ethical conduct of the research project they should contact the Manager, Research Ethics on 3875 5585 or research-ethics@griffith.edu.au

CONSENT FORM

Who is conducting the research

Names: Liisa von Hellens, Sue Nielsen, Kaylene Clayton
School: School of Information and Communication Technology
Contact Phone: 3382 1086
Contact Email: K.Clayton@griffith.edu.au

By signing below, I confirm that I have read and understood the information package and in particular have noted that:

- I understand that involvement in this research will involve observation of everyday activities of my child's class and my child participating in a talk about their opinions about computers and technology;
- I have had any questions answered to my satisfaction;
- I understand the risks involved;
- I understand that there will be no direct benefit to me or my child from participation in this research;
- I understand that my child's participation in this research is voluntary and will have no effect on their grade or relationship with the school/teachers;
- I understand that if I have any additional questions I can contact the research team;
- I understand that I am free to withdraw at any time, without comment or penalty;
- I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on 3875 5585 (or research-ethics@griffith.edu.au) if I have any concerns about the ethical conduct of the project; and
- I agree to participate in the project.

- I agree to allow my child's interview to be audiotaped ☐

Name:_____

Signature: _____ Date:_____

© 2007 Kaylene Clayton

Teacher Consent Pack

INFORMATION SHEET

Who is conducting the research

Names: Liisa von Hellens, Sue Nielsen, Kaylene Clayton
School: School of Information and Communication Technology
Contact Phone: 3382 1086
Contact Email: K.Clayton@griffith.edu.au

Why is the research being conducted?

Technology and computers are more and more becoming part of most jobs and everyday life. However, the number of people, especially girls, entering technology and computing careers are decreasing. Because of this, it is important that we understand why this is happening by finding out how young people feel about computers and technology and how we can make it ICTs study and careers more appealing to them.

What you will be asked to do

The researcher would like to observe classroom activity for one day per week for one term and ask you regarding your opinions about computers and technology. This talk would take place outside of scheduled class time and will take about 30 minutes.

The expected benefits of the research

This research will assist in understanding what young people think about technology and computers and what we can do to make subjects and careers in this area more appealing.

Your participation is voluntary

Your participation in this research is completely voluntary and you may decline to participate in part or as a whole, if you wish. If you volunteer to be in this study, you may withdraw at any time without comment or consequences of any kind.

Risks and confidentiality

There are no identified risks involved in this research. The researcher will be observing normal classroom activity and asking your opinions about computers and technology.

No identifying data will be collected for this research. Data collected from the observations and interviews will be referred to by a pseudonym or in broad terms. The school name, class number and actual names will not be referred to in this research.

The researcher also requests permission to audio record the interview to assist in the interview process. This audio recording will only be available to the research team and will be destroyed once it has been transcribed.

Questions / further information

Should you have any further questions about this research please do no hesitate to contact Kaylene Clayton on 3382 1086 or K.Clayton@griffith.edu.au .

Griffith University conducts research in accordance with the *National Statement on Ethical Conduct in Research Involving Humans*. If potential participants have any concerns or complaints about the ethical conduct of the research project they should contact the Manager, Research Ethics on 3875 5585 or research-ethics@griffith.edu.au .

Feedback to you

Each participating school will receive a copy of my research thesis report presenting the results of my project and will be available for viewing through the school office.

© 2007 Kaylene Clayton

CONSENT FORM

Who is conducting the research

Names: Liisa von Hellens, Sue Nielsen, Kaylene Clayton
School: School of Information and Communication Technology
Contact Phone: 3382 1086
Contact Email: K.Clayton@griffith.edu.au

By signing below, I confirm that I have read and understood the information package and in particular have noted that:

- I understand that my involvement in this research will include observation of normal classroom activity for one day per week for one term and an interview;
- I have had any questions answered to my satisfaction;
- I understand the risks involved;
- I understand that there will be no direct benefit to me from my participation in this research;
- I understand that my participation in this research is voluntary;
- I understand that if I have any additional questions I can contact the research team;
- I understand that I am free to withdraw at any time, without comment or penalty;
- I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on 3875 5585 (or research-ethics@griffith.edu.au) if I have any concerns about the ethical conduct of the project; and
- I agree to participate in the project.

- I agree to allow my interview to be audiotaped ☐

Name

Signature

Date

© 2007 Kaylene Clayton

Student Information

Hello! ☺

My name is Kaylene Clayton. I am a student at Griffith University. I am doing a project to find out what people your age know and think about computers and technology. When I finish my project it will be part of my degree, called a "PhD". My teachers, Dr Liisa von Hellens and Dr Sue Nielsen, help me with my project. We both work in the “School of Information and Communication Technology". We can be contacted by phone: 33821086 or by email: K.Clayton@griffith.edu.au

Your school principal and your teacher have given me permission to send you this letter to tell you a bit about my project. Once you have read the letter you can decide if you would like to take part. You should talk to your parents about the project too.

I would like to watch how the people in your class use computers and ask you what you think about computers and technology. I would also like to ask you and the other people from your class who are taking part about computers and technology. This talk would happen during part of a lunch break and take about 30 minutes. If you don’t want me to watch you in the classroom, just let me know. If you want to stop talking with us, you can leave any time you like. If you don’t want to answer a question, that’s fine too.

I would like to record what you say during our talks so that I can listen to what you say. When I finish writing my notes about the talk, I will delete the recording. I will not use your name when I am making my notes and writing about my project. Only my teachers and I will see what you tell me or notes that I make, so please don’t worry that your teacher might see what I have written. Watching how you use computers and what you tell me will have nothing to do with your school report or your grade.

Remember, you don’t have to take part unless you want to. If you have any questions you should talk to your teacher or a parent. If they don’t know the answer to your question, they can contact me for you.

Griffith University conducts research in accordance with the *National Statement on Ethical Conduct in Research Involving Humans*. If potential participants have any concerns or complaints about the ethical conduct of the research project they should contact the Manager, Research Ethics on 3875 5585 or research-ethics@griffith.edu.au

Appendix C Timeline of Research Activities

Year	Month	Activities
2004	May	Commence PhD
	May to December	Investigate background literature Develop research plan Develop research questions Identify and plan research approach and methodology
2005	January to February	Continue investigation of literature, methodology and approach Identify potential participant schools for the research
	March	Complete and submit ethical clearance applications Commence approaches to schools Prepare confirmation report
	April to June	Continue approaches to schools Continue investigation of literature, methodology and approach Prepare first drafts of Chapters 2, 3 and 4 Deliver confirmation seminar Prepare interview questions and establish goals for observations
	July to September	Continue approaches to schools Commence data collection Data collection (observations and student interviews) at female single-sex (Year 4 and Year 8) school Data collection (observations and student interviews) at government coeducational (Year 8) school Transcription of interviews and observation notes Commence data analysis Continue review of literature
	October to December	Continue approaches to schools Data collection (observations and student interviews) at government coeducational (Year 4) school Interview female single-sex school Year 4 teacher Interview government coeducational school Year 4 teachers Transcription of interviews and observation notes Continue data analysis Continue review of literature
2006	January to June	Transcription of interviews and observation notes Continue approaches to schools Continue review of literature Continue data analysis
	July to September	Data collection (teacher and student interviews and observations) at Greenwood (Year 4 and Year 8) Continue data analysis Continue review of literature Interview with female single-sex school Year 8 teacher Transcription of interviews and observation notes
	September to December	Transcription of interviews and observation notes Continue data analysis Continue review of literature Prepare first draft of Chapter 5
2007	January to August	Continue data analysis Continue review of literature Revise Chapters 2, 3, 4 and 5 Prepare drafts of Chapters 6, 7 and 8
	September to December	Write Chapters 1 and 9 Revise all chapters, review and finalise thesis

© 2007 Kaylene Clayton

Appendix D Pink Hill ICT Curriculum

PINK HILL SCHOOL

1-10 INFORMATION TECHNOLOGY PROGRAM

By Censored - document also edited for privacy and appendices not included

Accredited November 2006

1

Contents

	Page
1. The Place of Information Technology within the Curriculum	3
2. The Nature of Information Technology Education at	4
3. Rationale	6
4. Key Outcomes Developed by the Information Technology Learning Area	8
5. Strands of the Information Technology Learning Area	9
6. Course Organisation	10
7. Assessment	12
8. Year Level Programs	14
9. Resource List	30
10. Appendix – Sample Assessments	31

2

1. THE PLACE OF INFORMATION TECHNOLOGY WITHIN THE CURRICULUM

Pre-school	YEARS 1- 10		1-5	6 - 7	8	9 - 10	11 - 12
Communicating	ENGLISH		✓	✓	✓	✓	***CORE SUBJECT: English***
	MATHEMATICS		✓	✓	✓	✓	**SCHOOL SUBJECTS**
	SCIENCE		✓	✓	✓	✓	• Personal Development
Cultural understanding	STUDIES OF SOCIETY & THE ENVIRONMENT		✓	✓	✓	✓	• Physical Education
	LANGUAGES	Japanese		✔	✔	Elective	• Religious Education
		French		✔	✔	Elective	***ELECTIVES (5)***
Health & Physical understanding	THE ARTS	Art	✓	✓	✓	Elective	• Accounting
		Drama	✓	✓	✓	Elective	• Ancient History
		Music	✓	✓	✓	Elective	• Art
		Dance				Elective	• Biology
		Health & Physical Education	✓	✓	✓	Elective	• Business Communication & Technologies
	PERSONAL	Religious Education	✓	✓	✓	✓	• Chemistry
Thinking	DEVELOPMENT	Personal development	✓	✓	✓	✓	• Drama
Understanding environments		Computer Application Skills	✓	✓		✓	• Creative Arts*
	TECHNOLOGY	Information Technology			✓	Elective	• Economics
Sense of self & others		Food & Textile Technology				Elective	• French
	BUSINESS					Elective	• Geography
							• Health Education
							• Home Economics
							• Early Childhood Practices *
							• Information Processing & Technology
							• Japanese
							• Legal Studies
							• Mathematics A
							• Mathematics B
							• Mathematics C
							• Modern History
							• Multi-Strand Science
							• Music
							• Music Extension (Performance Year 12))
							• Physical Education
							• Physics
							• Study of Religion
							• Tourism *
							• Pre-Vocational Mathematics *
							• EVS (External Vocational Subjects) *

* = QSA Authority-Registered Subject

3

2. THE NATURE OF INFORMATION TECHNOLOGY EDUCATION

Pink Hill School has a strong and developing ICT program from pre-school through to Year 12 in the Secondary school and Information Technology (together with Food and Textile Technology) forms one of the nine Learning Areas and is a core part of the curriculum 1-10. Primary students can access computers within their classrooms or in their own computer laboratory. Students in years five, six and seven have access to specially created cluster rooms of eight PCs adjacent to their classrooms. Secondary students have the use of six computer laboratories and an electronic learning centre attached to the library. As well, key department areas have the use of clusters of PCs within their own block.

The aim of the Information Technology program at Pink Hill School is three fold. Firstly, it aims to equip students so they can function effectively and continue to learn in a technologically based world. This involves students learning ICT skills and gaining ICT knowledge, as well as learning how to transfer knowledge and practices in a changing environment.

Secondly, Information Technology aims to create learning environments for students at Pink Hill School where the use of computers and associated information and communication technologies is the key focus.

Finally Information Technology aims to develop students' problem solving abilities. Students learn problem solving strategies in Information Technology as they respond to challenges that can be solved in a variety of ways.

At Pink Hill School the Information Technology program is delivered in different ways depending on the phase of schooling. In years 1 to 7, Information Technology skills are delivered within the curriculum. Teachers have access to the IT skills checklist for their particular year group and these skills are developed as their students work in the other key learning areas. In term 4, the students are assessed on how well they have mastered the particular IT skills for their year level. Lower primary classes (Years 1 to 3) are directly assisted in classes by the Primary Technology Coordinator.

In year 8 all students study a core course called Information Technology for five fifty minute lessons per fortnight. In Years 9 and 10 students study Computer Applications which is compulsory for all students and consists of the equivalent of three fifty minute lessons per fortnight. While Computer Applications is run and staffed primarily by the Business Department, the Head of Business works closely with the Director of Information Services and Technology in the development of the students' IT skills in years 9 to 10. The Head of Business is responsible for the staffing and running of Computer Applications, while the Director of Information Services and Technology ensures that the subject is developing the IT skills identified for each year level.

4

Students in Years 9 and 10 can also choose to study the elective subject Information Technology which offers a much greater breadth and depth of course material for students wishing to gain a deeper understanding of IT. This course leads naturally into our senior elective IT subject, Information Processing and Technology (IPT). Both the subjects Information Technology and IPT are staffed by members of the IT Department and run for seven fifty minute lessons per fortnight. Teaching members of the IT Department consist of censored.All staff members have been involved with IT education for the past decade with censored being involved with teaching senior IT courses for a combined total of over twenty years. Censored are both involved with the Queensland Studies Authority censored

In the first three weeks of first term all students in year 8, and all new students in year 6 attend classes on the Pink Hill School Network to enable new students to quickly become familiar with the Pink Hill School IT environment and to attempt to compensate for the possible lack of IT skills by any of the new students. The classes are taken by the Director of Information Services and Technology and the Network Manager and teach the girls how to use many of the basic network applications. The Secondary Teacher Librarians also take three lessons for the year 8 girls on Information Literacy skills. It is hoped these lessons help our new girls to quickly become efficient and effective users of the Schools' IT resources.

5

3. RATIONALE

Why Study Information Technology?

The nature of learning in Information Technology provides opportunities for students to understand and critique technological innovations that emerge during their school life and beyond. Students learn to transfer knowledge and practices in a changing environment as well as developing dispositions associated with being active and informed citizens and knowledge workers. This helps them ***to function effectively outside*** school though the use of the skills that they develop.

Students learn ethical and responsible practices when making use of information and communication technologies. They learn about ***their rights and responsibilities as a member of a society*** that is increasingly becoming information rich. Students become aware of the impacts of power relationships between the information poor and the information rich.

Learning in this subject area involves the knowledge, practices and dispositions associated with the disciplines of computer science, informatics, communication, media studies and graphic design. Students learn with, about and through communication and information through the use of computer-mediated technologies and hence ***know and understand more about the technological world*** in which they live.

With Information Technology, students can develop the ability ***to learn independently and autonomously***. Learning in Information Technology is engaged learning. Engaged learning encompasses strategies that actively involve participants in meaningful learning in a technologically based world. Learning in Information Technology is often based around the students' ability to ***solve problems***. Students learn in Information Technology as they respond to challenges. An Information and Communication challenge is a problem that can be solved in a variety of ways. It is open-ended and its solution is only limited by constraints pertaining to available resources, expertise, experience or time.

Information Technology creates collaborative and challenging learning environments for students through the use of computers. Learning in Information Technology is not limited by the physical settings of schools, time or place. Information Technology involves individuals, schools, and professionals collaboratively participating in real life and life-like experiences. An education in Information and Communication emphasises the value of effective communication through the use and building of information products and systems and the critical evaluation of technologies. In Information Technology, students are regularly required ***to communicate ideas and information***.

Fundamental to this subject area is practical experience with digital hardware and software that can be applied to students' present and future lives. Students understand the consequences and implications of new ***technologies and their impact on society*** and on themselves.

6

Active participation in an increasingly globalised and knowledge-based society requires personal strategies of communication, comprehension, creation, transformation and critical evaluation of information in rapidly changing technological environments. Students should not only ***be able to collect, analyse and organise information***, but also ***select, use and adapt information and communication technologies***. Information and Communication is a part of the emerging knowledge economy. The management, creation, critique, dispersal and control of knowledge are important to a nation's economic competitiveness. To be effective participants in any knowledge economy individuals need to communicate as knowledge workers. Knowledge workers develop critical understandings of the social and ethical implications of the use of information and communication technologies. Knowledge workers are flexible, communicate deeply, are self-directed, work to patterns of logic, combine analysis with intuition, have high discretion, behave ethically and are skilled at collective sense-making.

At Pink Hill School the development of Information Technology skills is a highly valued outcome of the total school program. TheSchool aims to help each student reach their academic and personal potentials and a necessary part of this development is in the area of IT. Our mission statement shows that the School is 'committed to providing the full breadth of personal growth and development opportunities' and to 'enable each student to achieve her full academic potential, considering her individual needs and abilities'. The development of each girl's IT skills is a very necessary part of these aims. The School community also highly values IT skills with recent parent surveying showing that 100% of our students use IT at home. Our students largely are drawn from high socio economic environments and this also plays its part in providing us with a School community where IT literacy is highly desired. Our program of scaled development of IT skills and further elective extension in the IT area has been tailored to meet these needs.

* highlighted text refer to the attributes of an Pink Hill School graduate.

7

4. KEY OUTCOMES DEVELOPED BY THE IT LEARNING AREA

- **Learners understand that knowledge about information and communication technologies assists people to make decisions and choices**. This is based on using and accessing data to solve personal and social challenges in a rapidly changing world. They understand the nature of information and communication.
- **Learners identify information and communication challenges.** This is based on the use of reasoning, lateral thinking and intuition to investigate, ideate, produce and evaluate information and communications products.
- **Learners create technological solutions and use information and communication technologies creatively**. This is based on the need to communicate appropriately and effectively.
- **Learners use their natural curiosity and enthusiasm to identify challenges with an information and communication demand.** They investigate underlying issues, and explore a range of alternatives and keep up to date on latest information and communication technological developments.
- **Learners interpret and communicate information using appropriate language, symbol systems and representations.** This is based on the need to communicate appropriately and effectively.
- **Learners work cooperatively and consider issues of appropriateness** as they work with information and communication technologies to meet real life and life-like challenges.

8

5. STRANDS OF THE INFORMATION TECHNOLOGY LEARNING AREA

There is no Queensland Studies Authority 1-10 Information Technology Syllabus and so the learning outcomes for the Information Technology learning area at Pink Hill School are those considered relevant from the Queensland Studies Authority 1-10 Technology Syllabus

The learning outcomes for the Information Technology learning area are organized into strands. There are four strands. Each strand develops specific key concepts:

- Information Literacy
- Software Applications
- Peripherals and Operating Systems
- Ethics and Safe Practices

9

6. COURSE ORGANISATION

Core Content Strand	Core Learning Outcome		Year									
			1	2	3	4	5	6	7	8	9	10
Technology Practice	1.1	Students gather knowledge, ideas and data and consider how they will use this information to meet communication challenges.	✓	✓								
	1.2	Students generate ideas and communicate these through text, play and pictures.	✓	✓								
	1.3	Students create documents that are meaningful to them, and describe their production procedures.	✓	✓								
	1.4	Students express thoughts and opinions to evaluate their own and others' design ideas and products.	✓	✓								
	2.1	Students organise knowledge, ideas and data and use this information when meeting communication challenges.			✓	✓	✓					
	2.2	Students generate ideas, acknowledge the ideas of others and communicate their ideas using plans.			✓	✓	✓					
	2.3	Students identify, sequence and follow procedures to make documents and presentations of their own design.			✓	✓	✓					
	2.4	Students compare initial design ideas with final products and give reasons for similarities and differences.			✓	✓	✓					
	3.1	Students examine knowledge, ideas and data from a range of sources and establish the relevance of this information.						✓	✓	✓	✓	✓
	3.2	Students collaboratively generate design ideas and communicate these using presentations terms.						✓	✓		✓	✓
	3.3	Students develop and follow production procedures to make products that reflect their design ideas.						✓	✓	✓	✓	✓
	3.4	Students appraise how effectively their own and others' processes and products meet the design challenge.						✓	✓		✓	✓
	4.3	Students identify and make use of the practical expertise of others when following production procedures to make products for specific users.									✓	✓
	4.4	Students gather feedback to gauge how well their design ideas and processes meet design challenges and how effectively products meet the needs of specific users.									✓	✓
	5.3	Students meet predetermined standards as they follow production procedures to make quality products.								✓	✓	✓

10

Information	1.1	Students identify different forms of information.	✓	✓								
	1.2	Students use simple techniques for presenting information.	✓	✓								
	2.1	Students recognise different forms of information and use the information in different ways.			✓	✓	✓					
	2.2	Students use simple techniques for accessing and pr presenting information for themselves and others.			✓	✓	✓					
	3.1	Students describe advantages and disadvantages of different sources and forms of information.						✓	✓	✓	✓	✓
	3.2	Students select and use techniques for generating, modifying and presenting information for different purposes.						✓	✓	✓	✓	✓
	4.2	Students apply techniques for transforming and transmitting information for different audiences								✓	✓	✓
	5.2	Students compare and select techniques fro processing, managing and presenting information for specific users									✓	✓
	6.2	Students use specialised techniques for managing the organising the presentation of information to meet detailed specifications.									✓	✓
	B6.2	Students develop and use specialised techniques to present information in innovative ways.										✓
Systems	1.1	Students identify familiar systems and describe how these are used in everyday life.	✓	✓								
	1.2	Students sequence steps to carry out familiar tasks.	✓	✓								
	2.1	Students identify and describe the components in familiar systems.			✓	✓	✓					
	3.1	Students identify and describe inputs, processes and outputs in systems.						✓	✓	✓	✓	✓

11

7. ASSESSMENT

Information Technology as a subject in its own right does not exist within the Pink Hill School curriculum in years 1-7. Rather, ICT skills are developed within the other Pink Hill School curriculum areas. To ensure that students in these years gain the necessary ICT skills within the general curriculum, competency/mastery testing is used to gauge an individual student's progress in mastering the skills for their given year level. These are generally administered in the second half of the year.

7.1 Years 1 - 7

There is no formal assessment in years one to seven in the Information Technology program. Rather, ICT skills are incorporated into the tasks and assessments used by the other Pink Hill School curriculum areas. However, each year the students' mastery of their year level ICT skills are tested. Examples of these tests are included in the appendix.

7.2 Year 8 (Information Technology)

Students in year 8 complete three assessment tasks each semester. These tasks are made up of a variety of assessment techniques including written tests, project work and practical tests.

7.3 Years 9 and 10 (Computer Applications)

7.3.1 FORMATIVE ASSESSMENT

A combination of class work and internal testing is conducted throughout both semesters in Year 9 and semester I in Year 10. Class work accounts for the majority of the year's result. This class work, where possible, is assessed in conjunction with other subject areas.

7.3.2 SUMMATIVE ASSESSMENT

Students in Year 10 Semester II are assessed on a portfolio of class work.

12

7.3.3 Criterion Standards

EXIT CRITERIA

A	B	C	D	E
A very high achiever consistently: ▪ completes tasks within the desired timeframe and proofreads thoroughly ▪ follows the majority of written/verbal instructions ▪ demonstrates a thorough understanding of the operation of relevant software packages by presenting almost all work effectively and professionally	**A high achiever usually**: ▪ completes tasks within the desired timeframe and proofreads carefully ▪ follows most written/verbal instructions ▪ demonstrates a solid understanding of the operation of relevant software packages by presenting most work effectively	**A sound achiever generally**: ▪ completes tasks within the desired timeframe but needs to proofread more careful proofreading ▪ follows written/verbal instructions ▪ demonstrates a sound knowledge of the operation of relevant software packages by presenting some work to a satisfactory standard	A limited achiever sometimes: ▪ completes most tasks within the desired timeframe but needs to proofread more carefully ▪ follows written/verbal instructions ▪ demonstrates a basic knowledge of the operation of relevant software packages and some work is displayed to a satisfactory standard	A very limited achiever has difficulty ▪ completing tasks within the desired timeframe and undertaking any proofreading ▪ following written/verbal instructions ▪ demonstrating a basic knowledge of the operation of relevant software packages and displaying work to a satisfactory standard

13

8. YEAR LEVEL PROGRAMS

YEARS 1 and 2

LEVEL STATEMENT

Students gather information, generate ideas and communicate these through text, play and pictures. They make products and describe the production procedures used. Students express opinions about their own and others' design ideas and products. Students identify and describe different forms of information and use simple techniques to present it.

CORE LEARNING OUTCOMES

TP 1.1 Students gather knowledge, ideas and data and consider how they will use this information to meet communication challenges.
TP 1.2 Students generate ideas and communicate these through text, play and pictures.
TP 1.3 Students create documents that are meaningful to them, and describe their production procedures.
INF 1.1 Students identify different forms of information.
INF 1.2 Students use simple techniques for presenting information.
SYS 1.1 Students identify familiar systems and describe how these are used in everyday life.
SYS 1.2 Students sequence steps to carry out familiar tasks.

LEARNING EXPERIENCES

Information Literacy Skills

- Use visual clues for navigation of Web pages and commercial packages like Microsoft Word and KidPix (e.g. hyperlinks, buttons, icons, drop down menus, task bars).
- Gather information from Web pages by recognising headings, text and pictures.

Use of Peripherals and operating features

- Turn the computer on and off (shut down) correctly
- Log on and Log off correctly.
- Open and Close programs
- Use mouse efficiently
- Operate CD Rom programs
- Use correct names for basic parts and peripherals of computer
- File Management – create folders, Save and Open work
- Print work and retrieve printing

Software Applications

- Use Drawing packages (e.g. Kid Pix) to create pictures and illustrate documents and to answer design challenges.
- Type simple word processed documents using a publishing program (Microsoft Word)
- Experiment with publication features of word processing (e.g. Clip Art, font size and colour, page borders and Word Art)

Ethics / Safe Practices

Introduction to the Internet and safe use practices (e.g. age appropriateness, process to follow if disturbed by the page)

14

YEARS 3, 4 and 5

LEVEL STATEMENT

Students recognise a variety of forms of information used in everyday life. They use simple techniques for accessing and presenting information. They organise information to communicate their ideas. They identify, sequence and follow production procedures to plan and create products. Students compare their plans with the final product. They identify, describe and use the components in familiar systems.

CORE LEARNING OUTCOMES

TP 2.1	Students organise knowledge, ideas and data and use this information when meeting communication challenges.
TP 2.2	Students generate ideas, acknowledge the ideas of others and communicate their ideas using plans.
TP 2.3	Students identify, sequence and follow procedures to make documents and presentations of their own design.
INF 2.1	Students recognise different forms of information and use the information in different ways.
INF 2.2	Students use simple techniques for accessing and presenting information for themselves and others.
SYS 2.1	Students identify and describe the components in familiar systems.

LEARNING EXPERIENCES

Information Literacy Skills

- Access the Internet using search engines
- Search the Internet for desired data using simple queries
- Access CD Rom and online encyclopedia
- Use the Outline feature of Microsoft Word to plan and create PowerPoint presentations
- Recognise and use combination of drop down menus and shortcut icons to perform desired tasks
- Select and use the appropriate presentation tool for the given task
- Act as editor/critical advisor to others

Use of Peripherals and operating features

- Use correct names when identifying computer parts (eg. monitor, CPU, mouse, keyboard)
- Create folders in Windows Explorer
- Save their work to folders
- Open saved work
- Access CDRom activities
- Toggle between open documents/spreadsheets/presentations using the Window feature on the tool bar
- Use the keyboard efficiently
- Copy document from different drives into own directory
- Use Windows Explorer to browse, create folders, copy, cut, paste, and delete
- Take photos using the digital camera and save into own folder
- Access programs from MA32+

15

- Choose appropriate printer for printing of documents

Software Applications

- Use keyboard shortcuts – Ctrl S, Ctrl A, CtrlC, CtrlV, CtrlX, CtrlZ
- Create a simple PowerPoint presentation with and without transitions, text effects, sound, custom animation
- Send and receive e-mail and e-mail attachments
- Copy pictures from the Internet and paste them into Word documents and PowerPoint presentations
- Insert a picture from a file
- Use page set up or Zoom to check document format
- Word – create and customise dot points
- Word – create a table, manipulate table borders
- Word – format pictures
- Word – format a page – text alignment, page layout, margins, orientation
- Word – Complete electronic forms
- Excel – create graphs – assisted
- PowerPoint – create presentations – with sound
- Publisher – create advertising poster, card, brochure
- Use the 'undo' feature effectively
- Create picture in paint and insert into other documents or presentations
- Manipulate digital images – crop, save as JPG

Ethics / Safe Practices

- Select and remember personal password.
- Demonstrate an awareness of password security
- Display understanding of rules of school network use.
- Aware of e-mail safety and etiquette as well as security and viruses

NUMERACY LINK

Students' numeracy skills are further developed by an introduction to the Microsoft Excel software and its ability to display numeric information in graphical form.

16

YEARS 6 and 7

LEVEL STATEMENT

Students examine information gathered. They generate ideas, communicate these in a variety of ways, and develop and follow procedures to make products. Students develop and follow production procedures to make products that reflect their design ideas. They evaluate the effectiveness of their own and others' processes and products. Students describe the advantages and disadvantages of different forms and sources of information. They generate, modify and present information for different purposes. They identify inputs, processes and outputs in systems.

CORE LEARNING OUTCOMES

TP 3.1 Students examine knowledge, ideas and data from a range of sources and establish the relevance of this information.
TP 3.2 Students collaboratively generate design ideas and communicate these using presentations terms.
TP 3.3 Students develop and follow production procedures to make products that reflect their design ideas.
INF 3.1 Students describe advantages and disadvantages of different sources and forms of information.
INF 3.2 Students select and use techniques for generating, modifying and presenting information for different purposes.
SYS 3.1 Students identify and describe inputs, processes and outputs in systems.

LEARNING EXPERIENCES

Learning Experiences in Years 6 and 7 include a focus on understanding and competence in the areas of Software Applications, Peripherals & Operating System Features and Ethics/Safe Practices.

***Software Applications** (TP3.2, TP3.3, INF 3.2)*

- Design, make and appraise
  - a multimedia project using Microworlds / Powerpoint that demonstrates the insertion of text boxes, programmed page buttons, sound/voice and imported pictures.
  - spreadsheets using a spreadsheet program, eg Microsoft Excel, to manipulate data, create graphs and store information
  - electronic presentations, using Microsoft PowerPoint and the outline feature in Microsoft Word
  - web pages that demonstrate the insertion and naming of pages, the insertion of text, graphics, formatted tables, banners, marquess and buttons that link pages and the use of file management skills to create folders for documents, images, sounds and animations
  - simple databases, using Microsoft Access and
  - brochures using Microsoft Publisher
- spreadsheets using a spreadsheet program, eg Microsoft Excel, to manipulate data, create graphs and store information
- electronic presentations, using Microsoft PowerPoint and the outline feature in Microsoft Word
- web pages that demonstrate the insertion and naming of pages, the insertion of text, graphics, formatted tables, banners, marquess and buttons that link pages and the use of file management skills to create folders for documents, images, sounds and animations
- simple databases, using Microsoft Access and
- brochures using Microsoft Publisher

Use of Peripherals and Operating System Features (INF 3.2, TP 3.3, SYS 3.1)

- Scan photographs and documents into a range of programs, eg Microsoft Office, ULead Photo Impact 8

17

- Manipulate digital images using Ulead Photo Impact 8 or Paint shop Pro, by cropping, resizing, reducing resolution and saving as JPG
- Use Print Preview and Page Zoom to format and edit before printing
- Complete a Typing Tutor program ,eg Type Quick and demonstrate efficient use of the keyboard and its features
- Insert documents, images, sounds, animations from A, C, H, and G Drives, the Internet and CD Rom.
- Use right click on the mouse to open shortcut menus
- Differentiate between the menu, tool, formatting and task bars
- Save and open documents to and from discs – A Drive/USB Drive

Ethics/Safe Practices

- Demonstrate an awareness and understanding of safe practices on home and College computers
  - Virus protection
  - Personal protective behaviours on the Internet and in chat rooms

Information Literacy Skills (TP 3.1, 3.2, INF 3.1, INF 3.2)

All Learning Experiences are underpinned by Information Literacy Skills – at MBC these are the 'Big 6' – which are reinforced in all subject areas. ICT's are used when students

- Locate and access information using the Internet as an interactive resource and research tool
- Refine Internet searches using Boolean Search techniques ,eg inverted commas, +, -, "and" **and** a range of 'up-side down pyramid' techniques, eg
  - Brainstorming prior knowledge
  - Examining the available abstract for purpose, suitability, relevance and age appropriateness
  - Using visual clues, eg site maps, button links, hyperlinks and images
- Using critical literacy skills to assess the accuracy, currency (date), perspective and bias through examination of site references
- Cluster and organise information by creating Mind Maps and diagrams. eg, Inspiration
- Present using a variety of programs, eg, word processing, electronic presentation, web development, spreadsheet, and database
- Access and manipulate commercial databases and on-line encyclopaedias
- Participate in on-line, corroborative projects, eg Murder Under the Microscope

18

YEAR 8

LEVEL STATEMENT

Students examine information gathered. They generate ideas communicate these in a variety of ways, and develop and follow procedures to make products to predetermined standards. Students evaluate the effectiveness of their own and others' processes and products. They describe the advantages and disadvantages of different forms and sources of information. They generate, modify and present information for different purposes. They identify inputs, processes and outputs in systems.

CORE LEARNING OUTCOMES

TP 3.1 Students examine knowledge, ideas and data from a range of sources and establish the relevance of this information.
TP 3.3 Students develop and follow production procedures to make products that reflect their design ideas.
TP 5.3 Students meet predetermined standards as they follow production procedures to make quality products.
INF 3.1 Students describe advantages and disadvantages of different sources and forms of information.
INF 3.2 Students select and use techniques for generating, modifying and presenting information for different purposes.
INF 4.2 Students apply techniques for transforming and transmitting information for different audiences.
SYS 3.1 Students identify and describe inputs, processes and outputs in systems.

LEARNING EXPERIENCES

Information Literacy Skills

- Locate, access and evaluate information using the Internet as an interactive resource and research tool
- Compare resources and list advantages and disadvantages of different sources and forms of information.
- Refine Internet searches using Boolean Search techniques ,eg inverted commas, +, -, "and" **and** a range of 'up-side down pyramid' techniques
- Access and manipulate commercial databases and on-line encyclopaedias
- Search the Oliver catalogue
- Create a bibliography
- Explain the following information literacy steps: Task definition, Information seeking, location and access, use of information, synthesis, evaluation

Software Applications

- Use the principles of professional layout to design and present using a variety of programs, eg, word processing, electronic presentation.
- Use **Groupwise** to:
  - Read and reply to an e-mail message
  - Delete an e-mail message
  - Send an e-mail to another user
  - Create folders
  - Move e-mail message into folders
  - Demonstrate the use of Rules/filtering

19

- Use **Internet Explorer** to:
  - Demonstrate how to browse the web
  - Copying text and pictures from the web
  - Explain how to evaluate a web site
  - List the common web search engines
  - Demonstrate simple and complex (Boolean) web searches
- Use **Microsoft Word** to:
  - Use save and save as to save a document
  - Explain the common shortcuts in Word
  - Print a document
  - Switch between page layout and normal view
  - Use the show/hide codes
  - Select text
  - Format text using bold, underline, italics
  - Change font size
  - Centre, right or left justify text
  - Delete characters or words in a document
  - Explain the difference between the delete and backspace keys
  - Select, delete, move and copy sentences
  - Select, delete, move and copy paragraphs
  - Use numbering and bullets
  - Use spell check for a document
  - Change the margins for a document
  - Use the following display features
    - Numbered paragraphs
    - Justification
    - Text Boxes
  - Import a picture into a document
  - Create a simple table
  - Create a chart in a spreadsheet
  - Insert a chart into a word document
  - Insert a graphic
  - Explain the common shortcuts in Word
- Explain the difference between the delete and backspace keys
- Use **PhotoImpact or PaintShop Pro** to:
  - Resize a graphic
  - Crop an image

20

- Save an image using the image optimizer
- Explain the basic design rules of publishing
- Explain the purpose of templates
- Explain the difference between numbers, labels and formulae
- Describe common data formats :number, currency, date, time
- Use **Microsoft Excel** to:
  - Enter values and labels into a spreadsheet
  - Demonstrate the use of the following formulae:
    - Add/subtract/multiply/divide
    - average
    - sum
  - Copy cells in a spreadsheet
  - Sort cells in a spreadsheet
  - Create a chart in a spreadsheet
  - Format cells and borders
  - Insert/move/delete worksheets/rows/columns
  - Print a spreadsheet
- Use **Microsoft Publisher** to:
  - Experiment with templates
  - Explain the importance of white space and layout
  - Setup margin guides and grid guides
  - Use a text box, to enter text
  - Copy information from Word to a text box
  - Demonstrate the use of WordArt to create a heading
  - Import various forms of images (clipart/scanned/digital photos) into a document
  - Demonstrate consistency in design with regard to font type, font size and layout.
  - Demonstrate the use of page and text box borders.
- Identify the features of a good web site
- Be able to apply a design methodology for web page development
- Use **Macromedia Dreamweaver** to:
  - Create a web page
  - Insert pages
  - Know and use correct techniques for naming pages
  - Insert text and graphics
  - Insert and format buttons that link pages
  - Insert and format banners, marquees
  - Insert and format tables

21

Use of Peripherals and Operating System Features

- Categorise the parts of a PC as Input, Output and processing
- Know the meaning of the terms: hardware, software, RAM, GUI, CPU, MHz, Kilobyte, Megabyte, Gigabyte
- Classify common software as: application, operating system, programming
- Understand the terminology for the Windows desktop environment
- Minimise, maximize and close a Window
- Change a Novell password
- Start programs using the toolbar and START menu
- Explain the meaning of common file extensions
- Identify different views in windows explorer
- Search for files
- Create, delete and rename folders
- Salvage files using the Novell file salvage option in Windows Explorer
- Use Windows Explorer to identify file sizes and determine file properties
- Sort files by date, size, extension and name
- Move, copy and delete files
- Understand backup procedures and the different drives (A, C, D, G, H)
- Use NetStorage to transfer files between home and school
- Burn a CD
- Capture an image from the web, by scanning or by digital camera
- Explain the purpose of the different image types ie. Tiff, gif, bmp, jpg
- Scan a USB drive using VirusScan
- Explain good practices for virus protection
- Explain and demonstrate correct computer usage techniques including
- Correct ergonomic posture
- Correct finger use
- Correct touch typing technique

Ethics/Safe Practices

- Demonstrate an awareness and understanding of safe practices on home and College computers
- Explain basic e-mail etiquette
- Explain correct computer usage techniques including: Correct ergonomic posture, correct finger use, correct touch typing technique

NUMERACY LINK

Students' numeracy skills are further developed by using the Microsoft Excel software to explore the relationships and patterns between numeric data.

22

YEAR 9

LEVEL STATEMENT

Students examine information gathered. They generate ideas, communicate these in a variety of ways, and develop and follow procedures to make products. They make use of the expertise of others when following production procedures to meet predetermined standards. Students evaluate the effectiveness of their own and others' processes and products. They describe the advantages and disadvantages of different forms and sources of information. They generate, modify and present information for different purposes. They identify inputs, processes and outputs in systems.

CORE LEARNING OUTCOMES

TP 3.1 Students examine knowledge, ideas and data from a range of sources and establish the relevance of this information.
TP 3.2 Students collaboratively generate design ideas and communicate these using presentations terms.
TP 3.3 Students develop and follow production procedures to make products that reflect their design ideas.
INF 3.1 Students describe advantages and disadvantages of different sources and forms of information.
INF 3.2 Students select and use techniques for generating, modifying and presenting information for different purposes.
INF 4.2 Students apply techniques for transforming and transmitting information for different audiences.
INF 6.2 Students use specialised techniques for managing the organising the presentation of information to meet detailed specifications.

LEARNING EXPERIENCES

Information Literacy Skills

- Locate, access and evaluate information using the Internet as an interactive resource and research tool
- Compare resources and list advantages and disadvantages of different sources and forms of information.

Organise and transform information (eg: writing outline view and transforming into ppt and gathering information via MSWord and transforming efficiently into Publisher)

Software Applications

- **E-mail**:
  - Policy
  - Etiquette
  - Folders
  - Folder maintenance
  - Distribution lists
  - Filtering
  - Signatures
- **File Management**
- **Microsoft Word**:
  - Use the principles of professional layout to design and present using a variety of programs, eg, word processing, electronic presentation
  - Converting text to tables

23

- Converting text to columns
- Converting text to numbered paragraphs/bullets
- Columns
- Headings over columns
- Watermarks
- Multicolumn footers (using a table with no lines – except top)
- Sourcing text/graphics
- Styles for headings
- Paper layout changes within documents
- Section breaks
- Find/replace
- Superscript & subscript
- Special characters
- Right aligned tabs with leader dots

- **Microsoft PowerPoint**:
  - Professional presentations (revision of learning experiences covered in Year 8 INF)
  - Action buttons
  - Using defaults
  - Making own
  - Assigning actions
  - Hotspots
  - Watermarks
  - Graphics as backgrounds
  - Connectors
  - Grouping objects
  - Inserting tables
  - Inserting hyperlinks
  - Inserting Excel worksheets
  - Compressing pictures
  - Automatic progression
- **Assignment Presentation**
  - Report/Assignment Title pages
  - Main sub and side headings
  - Page numbering
  - Page breaks

24

- Line spacing
- Hanging paragraphs
- Quotes
- Direct
- Indirect
- Associated reference
- Styles/headings
- Using defaults
- Creating own
- Automatic table of contents
- Updating table of contents

- **Microsoft Excel:**
  - Margins
  - Naming sheets
  - Headers and footers
  - Distance from top and bottom
  - Customize
  - Sheet names
  - Printing gridlines/row and column headings
  - Formulas (add/subtract/multiply/divide/average)
  - Copy data
  - Link cells
  - Link worksheets
  - Merge cells
  - Text alignment
  - Sorting
  - Charts
  - Format cells
  - autofill
  - advanced formulas (vlookup, count, countif, count blank)
  - linking worksheets
  - sorting specific data from excel workbook and merging with word

Use of Peripherals and Operating System Features

- Scan photographs and documents into a range of programs, eg Microsoft Office and ULead Photo Impact 8

25

Ethics/Safe Practices

- Know the main e-mail etiquette rules

NUMERACY LINK

Students' numeracy skills are further developed by using the Microsoft Excel software to explore the relationships and patterns between numeric data.

26

YEAR 10

LEVEL STATEMENT

Students examine information gathered. They generate ideas, communicate these in a variety of ways, and develop and follow procedures to make products. Students evaluate the effectiveness of their own and others' processes and products. They describe the advantages and disadvantages of different forms and sources of information. They generate, modify and present information for different purposes. Students make use of the practical expertise of others to meet detailed specifications to present information in innovative ways using specialised techniques. They identify inputs, processes and outputs in systems.

CORE LEARNING OUTCOMES

TP 3.1 Students examine knowledge, ideas and data from a range of sources and establish the relevance of this information.
TP 3.2 Students collaboratively generate design ideas and communicate these using presentations terms.
TP 3.3 Students develop and follow production procedures to make products that reflect their design ideas.
INF 3.1 Students describe advantages and disadvantages of different sources and forms of information.
INF 3.2 Students select and use techniques for generating, modifying and presenting information for different purposes.
INF 4.2 Students apply techniques for transforming and transmitting information for different audiences.
INF 5.2 Students compare and select techniques for processing, managing and presenting information for specific users.
INF 6.2 Students use specialised techniques for managing the organising the presentation of information to meet detailed specifications.
SYS 3.1 Students identify and describe inputs, processes and outputs in systems.

LEARNING EXPERIENCES

Information Literacy Skills

- Locate and access information using the Internet as an interactive resource and research tool.

Software Applications

- **Microsoft Word:**
  - standard letters
  - mail merge using Word
  - mail merge using excel or access
  - adding/deleting fields
  - sorting fields
  - forms/fill in fields
  - memos/faxes templates
  - creating and saving
  - linking documents in Word/Excel
  - letterhead, memos, fax, with compliments slip, business cards
  - organizational charts/diagrams in Word
  - Brochures in Word

27

- **Access**
  - **Structure/planning a database**
  - explanation of terms
  - field names
  - data cells
  - records
  - tables
  - primary field
  - advantages
  - **Tables**
  - field names
  - descriptions
  - input masks
  - validation rules
  - ensure data is entered into a cell
  - 'Yes' and 'No' data type
  - **Forms**
  - alternate input
  - lock out other information
  - create
  - change layout
  - data labels
  - data fields
  - find a record
  - **Queries**
  - symbols and meanings
  - criteria options
  - formatting a field
  - **Reports**
  - formulas
  - Inserting text boxes
  - add a field
  - headers and footers
  - field layout

28

- Importing data from another package
- **PowerPoint/Multimedia**
  - Compare and then select and justify technique chosen (from ppt, PhotoStory, MovieMaker, Web) to develop a promotional presentation for College use in Reception

Selection nof techniques:

Use of Peripherals and Operating System Features

- Scan photographs and documents into a range of programs, eg Microsoft Office and ULead Photo Impact 8

Ethics/Safe Practices

- Demonstrate an awareness and understanding of safe practices on home and College computers
  - Virus protection
  - Explain what hoax viruses are

NUMERACY LINK

Students' numeracy skills are further developed by using the Microsoft Excel software for more advanced numeric manipulations.

29

9. RESOURCE LIST

9.1 Textbooks

Glynn, N. and Dixon, S. 1997, *Designing Databases*, McGraw-Hill, Australia.

Lloyd M, Kerans, S and Netscher K. 2004, *Connections: Challenges in ICT Education*, Heinemann, Australia.

Offer, K. and Thompson, C. 1991, *Information Processing and Technology*, Jacaranda Press, Brisbane.

Queensland Studies Authority. *Years 1 to 10 Technology Syllabus*, 2003

Queensland Studies Authority. *Years 1 to 10 Information and Communication Technology Education Syllabus*, 2003

Savage, K. 2005, *Information and Intelligent Systems*, Toowoomba Education Centre, Queensland.

Savage, K. 1999, *Applied IT*, Toowoomba Education Centre, Queensland.

Savage, K. 2004, *ICT Activities*, Toowoomba Education Centre, Queensland.

Savage, K. 2001, *Algorithms, Programming and Delphi*, Toowoomba Education Centre, Queensland.

Summers, G. 2004, *Developing Databases with Access*, Thomson Learning, Australia.

9.2 Software

Microsoft Office 2003: Word, Excel, Access and Publisher
Microsoft Producer 2
Novell Groupwise
Ulead PhotoImpact 7
ULead VideoStudio 8
Jasc Paint Shop 8
Macromedia Suite 2004: Dreamweaver and Flash
Photo Story 3
Platypus Animator
ES Builder

30