

**School of Education**

**Switching roles: An investigation into the use of reverse-mentoring by students to encourage teachers' uptake of ICT in their pedagogical approach**

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**Doctor of Philosophy**

**of**

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## Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Signature: .....

Date: .....

## Acknowledgements

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## Abstract

The literature provided evidence that the integration of teaching and learning with ICT was critical to support learner centred pedagogies. There was also clear evidence that a number of key barriers were impacting on the ability of teachers to integrate ICT in their classrooms. These barriers include teachers' perceptions of the lack of usefulness of the technologies and a lack of knowledge of how to use the technologies. The literature also noted that female teachers were less likely than their male colleagues to take up ICT in their teaching—the so-called gender barrier. Teachers are adult learners and have special needs associated with adult learning such as the need for individual and personalised learning programmes delivered at a time of their choosing. One approach to meet those special needs and overcome barriers preventing the uptake of ICT was through reverse-mentoring which is the use of students to help teachers with ICT issues in a timely and relevant manner. The benefits of reverse-mentoring have not been widely explored in the literature and this study provided evidence that the programme delivered both timely and relevant professional development for the participant teachers. Also the concept of students helping their teachers to develop skills with ICT fitted well with constructivist learning theory and this helped overcome many of the barriers associated with adult learning. The research design employed mixed methods multiple case studies which provided complementary lenses through which quantitative and qualitative data were assessed. The data analysis was complemented through the use of Activity Theory. The research also investigated the extent the reverse-mentored programme assisted female teachers' uptake of ICT in their teaching.

*Keywords:* teachers, ICT professional development, reverse-mentoring, adult learners, pedagogy change, gender barriers, Activity Theory.

## Table of Contents

<b>DECLARATION.....</b>	<b>II</b>
<b>ACKNOWLEDGEMENTS.....</b>	<b>III</b>
<b>ABSTRACT.....</b>	<b>IV</b>
<b>TABLE OF CONTENTS .....</b>	<b>V</b>
<b>CHAPTER ONE — BACKGROUND .....</b>	<b>15</b>
INTRODUCTION.....	15
SIGNIFICANCE OF THE STUDY.....	15
OBJECTIVES.....	16
RESEARCH QUESTIONS.....	17
DEFINITION OF TERMS.....	17
THESIS STRUCTURE.....	19
<b>CHAPTER TWO — LITERATURE REVIEW.....</b>	<b>21</b>
INTRODUCTION.....	21
REVIEW FOCUS.....	22
BARRIERS TO THE UPTAKE OF ICT BY TEACHERS IN SECONDARY AND INTERMEDIATE SCHOOL CLASSROOMS .....	22
TEACHERS' PROFESSIONAL DEVELOPMENT AS ADULT LEARNERS .....	25
TEACHERS' PROFESSIONAL DEVELOPMENT WITH ICT.....	29
<i>Timeliness.....</i>	<i>37</i>
<i>Relevance.....</i>	<i>38</i>
<i>Ownership of the issues to be resolved. ....</i>	<i>39</i>
<i>Gender as a barrier. ....</i>	<i>40</i>
<i>Adequate time.....</i>	<i>42</i>
<i>Change management and support with change.....</i>	<i>45</i>
<i>Lack of resources as a barrier. ....</i>	<i>48</i>
SUMMARY: BARRIERS TO THE USE OF ICT BY TEACHERS IN THEIR CLASSROOMS .....	56
THEORIES OF ADULT LEARNING .....	57
<i>Andragogy. ....</i>	<i>60</i>

<i>Self-directed learning</i> .....	66
<i>Transformative learning</i> .....	71
SUMMARY: ADULT LEARNING THEORIES .....	73
ICT INTEGRATION INTO THE CURRICULUM .....	74
SUMMARY: ICT INTEGRATION INTO THE CURRICULUM .....	83
MENTORING .....	83
<i>Reverse-mentoring</i> .....	86
SUMMARY: REVERSE-MENTORING .....	89
UNRESOLVED ISSUES IDENTIFIED IN THE LITERATURE .....	89
RESOLVING BARRIERS .....	92
SUMMARY: LITERATURE REVIEW .....	95
<b>CHAPTER THREE — CONCEPTUAL FRAMEWORK .....</b>	<b>99</b>
ACTIVITY THEORY .....	99
<i>Application of Activity Theory and activity systems</i> .....	110
SUMMARY: CONCEPTUAL FRAMEWORK .....	115
<i>Activity Theory</i> .....	115
<b>CHAPTER FOUR — PARADIGMS, EPISTEMOLOGIES AND THEORETICAL PERSPECTIVES, 116</b>	
<b>CHAPTER FIVE — METHODOLOGY AND RESEARCH DESIGN .....</b>	<b>125</b>
OVERVIEW .....	125
RESEARCH DESIGN .....	127
SCHOOL SELECTION .....	129
THE SCHOOLS .....	129
THE TEACHERS .....	130
THE STUDENTS .....	131
DATA COLLECTION .....	133
<i>Data collection alignment with research questions</i> .....	134
<i>How the data were collected</i> .....	135
EVENT LOGS .....	135
ETHICS .....	135
CONFIDENTIALITY .....	136

PARTICIPANT CONSENT AND FEEDBACK.....	137
SUMMARY: ETHICS.....	137
BIAS AND VALIDITY .....	137
<i>Experience bias</i> .....	138
<i>Participant bias</i> .....	138
<i>Participant maturation</i> .....	138
<i>Instrumentation</i> .....	139
SUMMARY: BIAS AND VALIDITY .....	139
LIMITATIONS OF THE STUDY .....	139
<i>Andragogy</i> .....	139
<i>Activity Theory</i> .....	140
<i>Population size and scope of the study</i> .....	141
SUMMARY: METHODOLOGY.....	141
<b>CHAPTER SIX — QUANTITATIVE DATA FINDINGS.....</b>	<b>142</b>
INTRODUCTION.....	142
THE SAMPLE GROUP .....	143
PART ONE: DATA FROM BASELINE QUESTIONNAIRES.....	144
<i>Baseline demographic data</i> .....	144
Teaching subjects by gender.....	144
Teachers' positions in schools .....	145
Teaching experience .....	146
Teachers' full-time use of NZ Ministry of Education laptops for teachers' scheme.....	147
Teachers' access to the Internet outside the school environment.....	147
<i>Baseline questions on professional development</i> .....	148
Frequency of teachers' formal ICT professional development in last two years.....	148
Frequency of teachers' ICT focussed conferences in the last two years .....	148
Teachers' preferences for learning through working on own with written support materials.....	149
Teachers' preferences for learning though working one-to-one with mentor.....	149
Teachers' preferences for learning through informally working with others.....	149
Teachers' preferences for learning through working in a small group.....	149
Teachers' preference for learning through working in a large group.....	150
Teachers' preferences for learning with the help of an ICT technically competent student.....	150

Teachers' preferences for working with others with the same or similar skill levels.....	150
Teachers' learning preferences for working with others in the same school .....	151
Teachers' learning preferences for working with members of own department or syndicate .....	151
Teachers' learning preferences for using adult facilitators or student mentors.....	151
Teachers' preferences for ICT professional development through after school sessions .....	152
Teachers' preferences for ICT professional development on occasional Saturday mornings .....	152
Teachers' preferences for ICT professional development on several Saturday mornings .....	153
Teachers' views on ICT professional development on whole or half day during school holidays .....	153
Teachers' views on ICT professional development for whole day during school holidays .....	154
Frequency of teachers' professional development for use of ICT in education in last two years.....	154
Frequency of teachers' participation in professional development online community.....	155
Teachers' focus on ICT issues in professional development this year.....	155
Teachers' preferences for ICT professional development through study group .....	155
Teachers' preferences for ICT professional development through technology coaches .....	156
Teachers' preferences for ICT professional development through technology mentors .....	156
Teachers' views on ICT professional development from on-the-spot student mentors.....	156
Teachers' preferences for ICT professional development through tutorials .....	157
Teachers' preferences for ICT professional development through workplace visits .....	157
Teachers' views on ICT professional development through retreats or intensive practicums .....	158
Teachers' preferences for ICT professional development through release time.....	158
Teachers' preferences for ICT professional development through online discussion groups.....	159
Teachers' preferences for ICT professional development through after-hours workshops or seminars	159
ICT can help improve curriculum provision in my classroom .....	159
Investment in ICT can be justified by teaching and learning outcomes .....	160
<i>Baseline levels of teachers' confidence in using ICT.....</i>	<i>160</i>
Baseline levels of confidence using ICT personally.....	160
End of programme levels of confidence using ICT personally.....	160
Baseline level of confidence using ICT with classes.....	161
End of programme levels of confidence using ICT with their classes .....	161
<i>Baseline levels of teachers' ICT concerns.....</i>	<i>161</i>
Concerns over access to equipment for student use.....	161
Concerns over insufficient or poor technical support.....	161
Concerns over making links between ICT and teaching and learning. ....	162
Concerns over a lack of ideas of how to use ICT with classes.....	162

Concerns over a lack of time to cope with it all. ....	162
Concerns over a need for on-going professional development. ....	162
Concerns over keeping up-to-date with required skills and knowledge on ICT developments. ....	163
Concerns over equipment technical reliability or equipment breakdown.....	163
<i>Baseline teachers' frequency ICT use.....</i>	<i>163</i>
Frequency of ICT use in finding or producing resources for lessons. ....	163
Frequency of ICT use in school administration. ....	164
<i>Baseline levels of achievement in ICT competencies.....</i>	<i>164</i>
Basic computer operations levels of attainment. ....	164
Current level of attainment with computer files management.....	164
Current level of attainment with word processing.....	165
Current level of attainment with spreadsheets. ....	165
Current level of attainment with databases.....	166
Current level of attainment with graphics.....	166
Current level of attainment in use of the Internet.....	167
Current level of attainment in use of telecommunications.....	167
Current level of attainment in use of multimedia. ....	168
Courses completed on the use of computers in education. ....	168
Proportion of units of work in the last year which contained ICT based learning.....	168
<i>Baseline levels of student use of ICT.....</i>	<i>169</i>
Average times in last year students used text and picture presentation for communication.....	169
Average times in the last year students used multimedia presentation for communication.....	169
Average times in the last year students used on-line interaction for communication.....	169
Average frequencies in the last year students used ICT for creativity. ....	170
Average times in the last year students used ICT for information gathering and processing. ....	170
Average frequencies in the last year students used ICT for problem solving.....	171
Average frequencies in the last year ICT was used for curriculum practice. ....	171
Average frequencies in the last year students used ICT technical skills. ....	172
Average times in the last year students used ICT for collaborative learning/social interaction.....	172
Average frequencies in the last year for reward for motivating students' ICT work. ....	173
<i>Baseline levels of teachers' support in their use of ICT in classes.....</i>	<i>173</i>
Frequency of informal advice to colleagues about using ICT for teaching and learning. ....	173
Frequency of informal or impromptu technical support for other staff using ICT with their classes.....	174
Teachers' technical skills and knowledge in relation to computers.....	174

Teachers' technical skills and knowledge in relation to the Internet. ....	174
Teachers' levels of teaching experience using computers in the classroom. ....	175
Level of support from other staff for using ICT in your teaching. ....	175
Level of support you receive from your Principal and Board of Trustees for using ICT in teaching. ....	175
Levels of support in using ICT received from students in your school. ....	176
Teachers' current knowledge of recent ICT developments in New Zealand education. ....	176
<i>Baseline levels of teachers' use of ICT in pedagogies. ....</i>	<i>177</i>
Percentage of use of ICT's class on a weekly basis. ....	177
Teachers' assessment of current experience with implementing ICT for learning and teaching. ....	177
Has the advent of ICT changed your teaching philosophy? ....	178
Teachers' levels of success at integrating ICT into the school curriculum. ....	178
Teachers' Current Levels of confidence with using ICT for learning and teaching. ....	178
PART TWO: DATA FROM END OF PROJECT QUESTIONNAIRES .....	179
<i>End of programme evaluation of teachers' confidence in using ICT's .....</i>	<i>179</i>
Teachers' levels of confident with using ICT's personally. ....	179
Teachers' levels of confidence with ICT's with their classes. ....	179
Teachers' levels of confidence in using students to help with ICT's in the classroom. ....	180
<i>End of programme evaluation of teachers' competence in using ICT's .....</i>	<i>181</i>
Teachers' levels of competence in basic computer operations. ....	181
Teachers' levels of competence with file management. ....	181
Teachers' levels of competence in the use of word processing. ....	182
Teachers' levels of competence in the use of spreadsheets. ....	182
Teachers' levels of competence in the use of databases. ....	183
Teachers' levels of competence in the use of graphics. ....	184
Teachers' levels of competence in the use of the Internet. ....	184
Teachers' levels of competence in the use of telecommunications. ....	185
Teachers' levels of competence with multimedia and presentation media. ....	185
Teachers' levels of competence in accepting help from technically capable students. ....	186
<i>End of programme evaluation of teachers' frequency of ICT use. ....</i>	<i>186</i>
Teachers' frequency of ICT use for school administration. ....	186
Teachers' frequency of ICT use for finding or producing resources for lessons. ....	187
<i>End of programme evaluation of teachers' integration of ICT in units of work. ....</i>	<i>187</i>
The extent teachers have integrated ICT into their units of work. ....	187
<i>End of programme evaluation of teachers' changes in classroom practices. ....</i>	<i>188</i>

Extent teachers' classroom practice changed through the reverse-mentored programme. ....	188
<i>End of programme evaluation of the programme's impact on understanding of teaching and learning</i> .....	188
The extent programme has contributed to understanding of teaching and student learning. ....	188
<i>End of programme evaluation of the frequency of students' use of ICT</i> .....	189
Frequency students were guided to use ICT where communication (text and picture presentation) was the main purpose of the activity.....	189
Frequency students were guided to use ICT where communication (multimedia presentation) was the main purpose of the activity. ....	189
Frequency students were guided to use ICT where on-line interaction was the main purpose of the activity. ....	190
Frequency students were guided to use ICT where creativity was the main purpose of the activity.....	190
Frequency students were guided to use ICT where information gathering or processing was the main purpose of the activity.....	191
Frequency students were guided to use ICT where problem solving was the main purpose of the activity. ....	191
Frequency students were guided to use ICT where curriculum practice was the main purpose of the activity. ....	191
Frequency students were guided to use ICT where the use of technical skills was the main purpose of the activity.....	192
Frequency students were guided to use ICT where collaborative learning and social interaction was the main purpose of the activity. ....	192
Frequency students were guided to use ICT where motivation or reward for engagement was the main purpose of the activity.....	193
<i>End of programme evaluation of teachers' integration of ICT into teaching and learning. ....</i>	194
Extent of effective integration of ICT into classroom teaching and learning. ....	194
<i>End of programme evaluation of extent goals/expectations met by the programme. ....</i>	194
Extent goals/expectations met for technical skills development. ....	194
Extent goals/expectations met for ideas for using ICT's with classes. ....	194
Extent goals/expectations met for quality teaching and learning enhancement. ....	195
Extent goals/expectations met for using ICT's for administration. ....	195
Extent goals/expectations met for using ICT's to gain a qualification. ....	196
<i>End of programme evaluation of the influence of the programme on ICT use</i> .....	196
Extent increase in ICT use attributable to programme.....	196

<i>End of programme evaluation of teachers' concerns over using ICT's in schools.</i> .....	197
Concerns about access to equipment for student use.....	197
Concerns about insufficient technical support.....	197
Concerns about making links between ICT and quality teaching and learning.....	198
Concerns about a lack of ideas on how to use ICT's with classes. ....	198
Concerns about a lack of time to cope with it all. ....	199
Concerns about a need for ongoing professional development. ....	199
Concerns about keeping up-to-date with skills and knowledge on ICT developments.....	199
Concerns about technical reliability/equipment breakdown.....	200
<i>End of programme teachers' evaluation of the significance of the programme</i> .....	200
Degree of significance reverse-mentored programme in teacher development. ....	200
<b>PART THREE: DATA FROM PAIRED QUESTIONS</b> .....	201
<i>Teachers' confidence with using ICT's</i> .....	201
Paired-samples: Teachers' confidence with using ICT personally.....	201
Paired-samples: Teachers' confidence with using ICT with classes.....	202
<i>Teachers' frequency of use of ICT's</i> . ....	202
Paired-samples: Teachers' frequency of use of ICT to find or produce lesson resources.....	202
Paired-samples: Teachers' frequency of use of ICT for school administration.....	203
Paired-samples: Teachers' competence with basic computer operations.....	203
Paired-samples: Teachers' competence with computer file management. ....	204
<i>Teachers' competence in the use of ICT's</i> . ....	205
Paired-samples: Teachers' competence with word processing.....	205
Paired-samples: Teachers' competence with spreadsheets. ....	205
Paired-samples: Teachers' competence with databases.....	206
Paired-samples: Teachers' competence with graphics.....	206
Paired-samples: Teachers' competence with Internet use.....	207
Paired-samples: Teachers' competence with telecommunications.....	207
Paired-samples: Teachers' competence with presentation and multimedia.....	208
<i>Teachers' integration of ICT based learning</i> .....	209
Paired-samples: Teachers' integration of ICT based learning in units of work. ....	209
<i>Students' frequency of use of ICT's</i> . ....	209
Paired-samples: Students' frequency of use of communication through text/picture presentation .....	209
Paired-samples: Students' frequency of use of communication through multimedia presentation .....	210

Paired-samples: Students' frequency of use of communication through on-line interaction.....	210
Paired-samples: Students' frequency of use of creativity using ICT.....	211
Paired-samples: Students' frequency of use of information gathering/processing.....	211
Paired-samples: Students' frequency of use of ICT for problem solving.....	212
Paired-samples: Students' frequency of use of ICT for curriculum practice. ....	213
Paired-samples: Students' frequency of use of ICT technical skills.....	213
Paired-samples: Students' frequency of use ICT for collaborative learning and social interaction. ....	214
Paired-samples: Students' frequency of use of ICT for motivation or reward.....	214
SUMMARY: QUANTITATIVE DATA FINDINGS .....	215
<b>CHAPTER SEVEN — QUALITATIVE DATA FINDINGS .....</b>	<b>219</b>
INTRODUCTION.....	219
THE EXTENT OF TEACHERS' FOCUS ON ICT PROFESSIONAL DEVELOPMENT AT THE START OF THE PROGRAMME .....	220
<i>Teachers' views on professional development for using ICT in the classroom.....</i>	<i>220</i>
<i>Teachers' primary goals by gender for ICT professional development.....</i>	<i>221</i>
<i>Teachers' secondary goals by gender for ICT professional development. ....</i>	<i>225</i>
<i>Teachers' minor goals by gender for ICT professional development.....</i>	<i>228</i>
CHANGES TO CLASSROOM PRACTICE AS A RESULT OF THE PROGRAMME .....	229
THE EXTENT THE PROGRAMME HAS CONTRIBUTED TO UNDERSTANDING OF TEACHING AND LEARNING GENERALLY .....	230
BENEFITS FOR USING STUDENTS TO HELP WITH TEACHERS' USE OF ICT .....	232
ASPECTS OF THE PROGRAMME MOST APPRECIATED .....	233
ASPECTS OF THE PROGRAMME LEAST APPRECIATED .....	236
FACTORS INVOLVED IN THE INCREASED USE OF ICT WITH CLASSES.....	237
SIGNIFICANCE OF THE PROGRAMME ON OVERALL TEACHER DEVELOPMENT.....	238
TEACHERS' COMMENTS ON STUDENT MENTOR HELP WITH ICT .....	239
SUMMARY: QUALITATIVE DATA FINDINGS .....	245
<b>CHAPTER EIGHT — THE RESEARCH QUESTIONS AND CONCLUSIONS.....</b>	<b>248</b>
INTRODUCTION.....	248
THE FIRST RESEARCH QUESTION.....	248
THE SECOND RESEARCH QUESTION.....	254

CONCLUSIONS.....	265
<b>CHAPTER NINE — RECOMMENDATIONS.....</b>	<b>268</b>
RECOMMENDATION ONE—EFFECTIVENESS OF REVERSE MENTORING IN OTHER SCHOOLS .....	270
RECOMMENDATION TWO—FURTHER RESEARCH INTO GENDER BARRIERS .....	270
RECOMMENDATION THREE—FURTHER RESEARCH INTO SUSTAINABILITY OF REVERSE-MENTORING ....	272
RECOMMENDATION FOUR—FURTHER RESEARCH ON POTENTIAL OF USING REVERSE MENTORING IN OTHER SUBJECT AREAS.....	273
<b>LIST OF TABLES.....</b>	<b>275</b>
<b>LIST OF FIGURES.....</b>	<b>276</b>
<b>REFERENCES.....</b>	<b>278</b>
<b>APPENDIX A .....</b>	<b>289</b>
BASELINE DATA SURVEY .....	289
ICT Competencies .....	294
END OF PROJECT EVALUATION .....	299
<b>APPENDIX B .....</b>	<b>306</b>
INFORMATION FORM FOR PARENTS .....	306
CONSENT FORM FOR PARENTS .....	309
PARTICIPANT INFORMATION FORM.....	310
PARTICIPANT CONSENT FORM .....	311

## Chapter One — Background

### Introduction

This research is important at local and international levels for teachers and school administrators alike as it may provide solutions to barriers to the uptake of ICT by secondary and intermediate school teachers. The research is also important in that it will contribute to our knowledge associated with educational change processes and the factors that influence those processes. A number of writers assume integration of ICT with pedagogies to be necessary in schools today. For example, Bitner and Bitner (2002) argued that not only was the integration of ICT and pedagogies necessary to help students achieve, but teaching paradigms had to change to accommodate that integration. Also, the New Zealand Ministry of Education (2007a) stressed that the integration of teaching and learning with ICT was critical to support learner centred pedagogies.

### Significance of the Study

This study is significant in four major areas. The first is the focus on barriers to teachers' use of ICT. The literature provides clear evidence that a number of key barriers are impacting on the ability of teachers to integrate ICT in their classrooms. For example, barriers can arise from teachers' perceptions of the lack of usefulness of the technologies (Cox, Preston, & Cox, 1999; Snoeyink & Ertmer, 2001). Also, there are likely to be barriers if teachers do not know how to use the technologies (Larner & Timberlake, 1995). Teachers' anxieties arising from a lack of competence in the use of technologies can also create barriers (Yuen & Ma, 2002).

The second focus relates to the likelihood of a better understanding of the barriers when they are identified and classified. Ertmer, et al., (1999) see barriers falling into two classes—

one is external to the teacher and the other internal. The external barriers include factors outside the teacher's control, such as a lack of access to computers, lack of support, a lack of access to appropriate professional development or a lack of time. The authors' internal barriers include resistance to using the technology because of an apprehension, concern, or a lack of confidence. The third focus follows advice from Jones (2004) who recommended the practice of trialling interventions which may give insights into helping teachers' use of ICT.

The fourth focus relates to the use of significant amounts of public money in New Zealand and elsewhere which is spent on ICT professional development programmes. Fullan (1991; 1993) suggested that teachers are significant change agents. Cuban (2001) pointed out that teachers will not change unless they see a reason to do so. Watson (2001) argued for more research and consideration prior to forcing pedagogical change. For the money so far spent by government, there is little to show there has been progress in helping teachers to 'integrate' ICT in their lessons through changed pedagogies or otherwise (Ministry of Education, 2005a). Also, the Ministry's funding may be more successful if the links between ICT and teaching and learning (including the clarification of key terms) are recognised and applied.

## **Objectives**

The purpose of the study was twofold. The first was to identify the advantages and disadvantages teachers perceive in the use of a reverse-mentored approach to ICT professional development. The literature provides few reported cases of reverse-mentoring in schools where teachers are mentored by their students. If teachers are to use ICT in their classrooms, they need access to specialist help for them to learn and use technologies. Such specialist facilities are unlikely in most schools because of availability and cost. The use of technically knowledgeable students guided by the school's ICT coordinator to help their

teachers (reverse-mentoring) may provide an alternative method of professional development and support for teachers. This study is important because of the paucity of research on the use of reverse-mentoring to help teachers change their pedagogies to use ICT in their classrooms. Accordingly, this study will hopefully add to the body of knowledge in this regard.

The second purpose was to identify the influence reverse-mentoring has on the frequency and use of ICT in teachers' pedagogies. This has not been fully investigated to date and this current research will also add to the body of knowledge relating to teachers' professional development in their pedagogical use of technologies.

### **Research Questions**

The specific research questions are:

1. What do teachers perceive as the advantages and disadvantages arising from a reverse-mentored approach to ICT professional development?
2. What influence does a reverse-mentored approach to ICT professional development have on the type, frequency and use of ICT in teachers' subject areas?

### **Definition of Terms**

*ICT* (Information and Communications Technology or Technologies) has been defined as an umbrella term that includes any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them, such as videoconferencing and distance learning. ICT's are often spoken of in a particular context, such as ICT's in education, health care, or libraries (SearchCIO, 2009).

**Intermediate schools** in the New Zealand compulsory education system are those which have only Years 7 and 8 students.

**Professional development** means the process of obtaining the skills, qualifications, and experience that allow you to make progress in your career (Macmillan\_Dictionary). In this study it refers to teachers improving their effectiveness in raising student achievement.

**Reverse-mentoring** generally means a younger person teaching or ‘mentoring’ a more senior person. In this study, it refers to students mentoring teachers in the use of ICT which is regarded as a reversal of the traditional roles of students and their teachers.

**Secondary schools** in the New Zealand compulsory education system are those which cater for students either from Years 7 to 13 or students from Years 9 to 13.

**Technology** refers to ICT and or digital technology.

## **Thesis Structure**

**Chapter One** provides the background to the research which includes detail on the significance and objectives of the study, the research questions and a definition of terms used in the study.

**Chapter Two** details the literature review which includes:

1. Focus on the use of ICT by teachers of secondary and intermediate students;
2. Barriers to the uptake of ICT by those teachers;
3. Adult learning theories, integration of ICT into the curriculum;
4. Mentoring and reverse-mentoring;
5. Unresolved issues identified in the literature;
6. Resolving barriers; and
7. Chapter summary.

**Chapter Three** provides discussions on Activity Theory, bias and validity.

**Chapter Four** provides discussions on the theoretical basis for the research

**Chapter Five** provides a discussion on the design of the methodology used in the research as well as a discussion on paradigms and epistemologies, school selection, data collection, ethics and limitations of the research.

**Chapter Six** provides detailed analysis on the quantitative data gathered in the study.

**Chapter Seven** provides details of the qualitative data collected in the study.

**Chapter Eight** is concerned with the research questions and conclusions.

**Chapter Nine** describes the recommendations resulting from the research

**The main body of the report is then followed by:**

**List of Tables**

**List of Figures**

**References—bibliography**

**Appendix A** contains copies of the baseline questions forms and the end of project forms.

**Appendix B** contains copies of the Ethics Committee documents and Participant Forms.

The literature review in Chapter Two explores researchers' views on key issues relating teachers' uptake of ICT in their classrooms. Those issues include barriers to that uptake, the need for pedagogical change to use ICT in the classroom and how teachers could gain sufficient skills and knowledge to use ICT's pedagogically.

## Chapter Two — Literature Review

### Introduction

Phelps, Graham and Kerr (2004) regard ICT as the new literacy of the 21st century and its use in business and society generally, has been commonplace for a number of years. In one form or another, ICT is appearing at every level of the education process but some issues are proving hard to resolve. Included in these issues are the disappointingly low levels of routine and authentic use of ICT in enhanced learning contexts. For a number of researchers, however, enhanced learning through technology remains contentious. For example, Reynolds, Treharne and Tripp (2003) were concerned with what they saw as excessive optimism over the role of ICT to enhance student learning and conducted a small scale survey of teachers in an attempt to find the reasons for that optimism. They concluded that any potential of ICT to enhance student learning is being hampered by the low level of adoption of ICT by teachers. They suggested "...that more research is needed to improve the expectations and effectiveness of ICT provision and utilisation" (p. 51).

The literature review is organised in nine parts. The first part outlines the *review focus* which describes the educational settings upon which the review is based; the second part discusses data drawn from the literature relating to *barriers to the uptake of ICT in classrooms*; the third part addresses issues raised in the literature related to adult learning and which in turn identified specific needs related to the concepts of providing *teachers' professional development as adult learners*; the fourth part presents anomalies which were debated in the literature relating to the *integration of ICT into the curriculum*; the fifth and sixth parts discuss the few models available from the literature relating to *mentoring* and *reverse-mentoring* to help teachers develop skills and knowledge in the use of ICT pedagogically; the literature review also identified a number of *unresolved issues* relating to

teachers' use of ICT pedagogically and many of these are discussed in the seventh part; the eighth part discusses suggestions on *resolving barriers to professional development which have been identified in the literature*. Finally, part nine *summarises* the Literature Review Chapter.

### **Review Focus**

The review focus was on teachers of Years 7-13 students (secondary and intermediate levels) and included research data from other areas which may have had application for secondary teachers. An example of this is the research by Ertmer, Addison, Lane, Ross and Woods (1999) who examined teachers' beliefs about the role of technology in the elementary classroom—a level of education which in New Zealand includes intermediate teachers. The authors provided a useful organisation of barrier types. The focus on New Zealand secondary and intermediate teachers was important because these are areas of teaching in which there are generally low levels of uptakes of ICT and technology to enhance student learning.

The studies reported in this review ranged in size. They included large programmes such as the British Government's £230 million New Opportunities Fund programme which involved tens of thousands of teachers (Conlon, 2004) and relatively small studies such as that of Cuban, Kilpatrick and Peck (2001) which involved staff and students in two Californian High Schools.

### **Barriers to the Uptake of ICT by Teachers in Secondary and Intermediate School**

#### **Classrooms**

The literature indicated three key issues relating to barriers to the use of technologies by teachers in their classrooms. The first issue was that teachers have to see a *need* to use

computer technologies. Without that need, Cox, Preston and Cox (1999) and Snoeyink and Ertmer (2001) suggested that the technologies simply will not be used.

The second issue related to teachers' need to learn *how* to use the technologies. Russell, Finger and Russell (2000) are among researchers who identified teacher anxieties caused by a lack of skills and competence in using computers. The third issue related to problems caused by ill-defined concepts of a number of important terms. For instance, there is little agreement on what 'integration' means, even though it is used frequently in the context of teachers' use of ICT. The New Zealand Ministry of Education report identified the lack of a consistent definition for 'integration' (Ham et al., 2002). Milton (2003) also noted the difficulties created through a lack of consensus on the meanings which have become problematic. For example, without agreement as to what 'integration' is or how it can be measured, it is difficult deciding when successful 'integration' has taken place. Additionally, without a defined end-point, dealing with barriers which hinder 'integration' can be confusing.

In their rationale for teacher professional development in ICT, (Anderson, Baskin, & Halbert, 2002) outlined a number of key ICT drivers as providing the necessary conditions for successful learning with ICT. Three of those drivers were integrating ICT into subject and curriculum areas; ensuring teachers can effectively use ICT; and putting in place innovative support systems to free up teachers so that they can concentrate on teaching and learning.

Cuban (2001) pointed out there is a dearth of research into the complexities of how teachers *actually* incorporate technology in their teaching. Zhao, Pugh, Sheldon and Byers (2002) agreed with Cuban and noted that there is an important gap in the literature regarding

how integration can or should take place. Although the lack of agreement on the meaning of frequently used terms may be partly addressed through specific professional development at a local level, the more important wider consensus remains without solution.

Unfortunately barriers to the uptake and use of ICT by teachers are frequently interrelated and it is difficult to deal with one in isolation from the others. Cuban (1999a), Cuban, Kirkpatrick et al., (2001), and Auxter (2002) have pointed out that learners need both sufficient time *and* the availability of suitable resources to become confident and familiar with the use of technologies.

This research focused on a number of barriers to the uptake of ICT which have been identified in the literature, some of which concern the need for appropriate professional development programmes for adult learners. Barriers can be identified and broadly grouped in a number of ways. Ertmer, Addison, Lane, Ross and Woods (1999) provided one useful classification of the barriers as a result of a study which was carried out in the USA at a K-5 school of 281 students and seven teachers over a period of six weeks. They saw the barriers falling into two classes—one is external to the teacher and the other internal. The external barriers include factors outside the teachers' control, such as a lack of access to computers, lack of support, a lack of access to appropriate professional development and a lack of time. The internal barriers identified by the authors include resistance to using the technology because of a general apprehension, concern, or a lack of confidence.

Barriers to the uptake of ICT in secondary and intermediate school classrooms which have been identified in the literature include a lack of appropriate professional development for teachers, gender issues, a lack of time for professional development, a need to understand

how ICT integration into the curriculum can take place, a lack of ICT resources and a need for teachers to change their teaching paradigms to accommodate ICT in their pedagogies.

### **Teachers' Professional Development as Adult Learners**

The future of good research on teacher learning of professional knowledge lies in our ability to weave together ideas of teacher learning, professional development, teacher knowledge and student learning; fields that have largely operated independent of one another. (Wilson and Berne, 1999, p. 204)

Guskey (2000) defined professional development as a set of processes which “...enhance the professional knowledge, skills and attitudes of educators so that they might, in turn improve the learning of students” (p. 16). In their research on understanding teacher development, Hargreaves and Fullan (1992) noted that teachers’ pedagogical development should equip them with the knowledge and skills to “... increase their ability to provide improved opportunities to learn for all their pupils” (p. 2) and to provide greater subject knowledge and better classroom management practices. These are general definitions and, as Jackson (1992, p. 67) pointed out in his discussion on how to help teachers develop their skills and learning, there are countless ways through which teachers might consider their interaction in the classroom and what they might do and “...come to a deeper, broader and richer understanding” (p. 67).

Professional development in education is a loose educational term which is often used to describe activities which enhance a teacher’s ability to enhance student learning. In their report to the New Zealand Ministry of Education, Fullan and Mascal (2000) offered a simple definition of professional development, which is “...the sum total of learning through formal and informal experiences” (p. 38). This study focused principally on learning through informal experiences. Lassman (1996) referred to several elements which made up a broad definition of professional development and these included study groups, action research, skill

building and group planning. She saw a need to upscale the term to ‘quality professional development’ which embraced “...a better balance between philosophy and action” (p. 1). The author concluded that part of the upgrade was recognition that teachers as well as students construct their understandings. She also noted that the elements of selection, implementation and collaboration should receive more focus. Ang (1998) agreed that professional development programmes should be collaborative and added that they should also be integrative and interesting. Ang also wrote that such programmes should be “...appropriate to the teachers who are involved in them and they should be at a time that suits them” (p. 25).

Finding an appropriate definition of professional development is not necessarily as problematic as confirming if a particular programme actually works for the teacher. The literature has many examples of programmes which are less than effective and for some teachers the very term ‘professional development’ can have negative undertones. For example, according to Clark (1992), who researched the effects of teacher self-directedness in their learning, the phrase professional development “...implies a process done to teachers; that teachers need to be forced into developing; that teachers have deficits in knowledge and skill that can be fixed by training; and that teachers are pretty much alike” (p. 75). Clark’s (1992) comments were reinforced in the Education Queensland (1998) report on the development and delivery of professional development. According to that report, professional development “...is most effective when it is embedded in the life and work of the school; it is done by teachers, not to them” (p. 3).

What is not clear in the literature, as Wilson and Berne (1999) pointed out in their examination of professional development research, is how to identify and measure ‘effective’ professional development for teachers. They wrote that although there has been a call for

more research on teacher learning, the “scattered and serendipitous” nature of that learning has made research tasks difficult (p. 173). They also noted there were barriers to teacher learning which have “...traditionally been a patchwork of opportunities ... stitched together into a fragmented and incoherent ‘curriculum’” (p. 174). They went on to say that the multiple and different learning environments and what they regarded as the “cobbled-together non-system” which stand for teacher learning have created difficulties for quantification or qualification of any learning which might have taken place. Wilson and Berne (1999) also suggested that effective teacher professional development can occur informally through everyday work with colleagues. However, they specifically noted that whatever teachers may learn formally or informally has been difficult to measure because of the lack of research into teacher learning.

Wilson and Berne (1999) are joined by a number of researchers in their criticism of the focus by schools’ managers on traditional ‘one-off’ in-service professional development programmes. In their discussion on professional development and communities of practice, Schlager, Fusco and Schank (2002) argued that the “hit-and-run” workshops provided by traditional in-service days are usually “...unconnected with their work and immediate problems of practice” and do not give teachers “...time to work with or observe other teachers” (p. 6). Downes, Fluck, Gibbons, Leonard, Matthews, Oliver, Vickers and Williams (2002) discussed the integration of ICT into pedagogies and considered traditional professional development models which used one-off training courses were ineffectual in improving teacher practice. The authors claimed that “... modelling new ‘pedagogies’ in non-specific and decontextualised ways has been demonstrated not to work” (p. 51). Guskey (2000) was also critical of the view taken by some educators, that professional development programmes are “... special events that are restricted to 3 or 4 days during the school year” (p. 14). In his view, this perception tends to reinforce an undesired separation of professional

development from the on-going day-to-day activities of teachers. Like Wilson and Berne (1999), Guskey (2000) called for more research for an understanding of "... the subtleties of change processes and the procedures that create highly productive learning environments" (p. 39).

Guskey (2000) researched how to measure the effectiveness of professional development programmes and suggested that the programmes should include the following three important characteristics—they should be *intentional*; *on-going*; and *systemic*. He appeared to be in agreement with writers such as Wilson and Berne (1999) with regard to one-shot workshops when he argued that programmes should be a *purposeful* and *intentional* processes rather than a series of random unrelated activities without clear direction or intent. The processes should also be *on-going* because education is a dynamic profession with continuous change and he preferred a *systemic* approach involving all organisational levels. Guskey (2002) also seemed to be in accord with Wilson and Berne (1999) and others in his suggestion that professional development can include less formal activities such as "... study groups, action research, collaborative planning ... peer coaching, mentoring and so on" (Guskey, 2002, p. 46). Guskey (2000) also argued for recognition that educators need to be kept abreast of changes in their dynamic professional fields and use those changes to "... continually refine their conceptual and craft skills" (Guskey, 2000, p. 16). For professional development to be successful there should be mechanisms in place to measure progress and this implies a continuous or sustained process. The authors of the New Zealand Ministry of Education (2003) report agreed with the need for sustained and relevant assistance if teachers are to be successful in integrating ICT into the curriculum. Sustained assistance seems to be a key phrase for successful professional development.

From his research into teacher professional development involving a number of British case studies, Dadds (1997) argued that professional development programmes should be delivered in a way which builds on the expertise and prior experience of the teacher, nurturing the expert within rather than “filling an empty vessel” (p. 32). In her discussion on adult learning theory, Merriam (2001) stated that adult learning should be viewed as holistic. The learning process is complex and transformative and the context in which learning takes place dynamically changes with each learner’s needs.

Marsick and Watkins (2001) studied the effects of ‘informal and incidental learning’ and argued that individual adult learning includes not only the learner’s acquisition of meaning, knowledge and skills, but also includes the intrapersonal processes of generating meaning. This view seems to be in accord with the description of informal learning through everyday interaction with colleagues expressed by Wilson and Berne (1999) and Guskey (2000).

### **Teachers’ Professional Development with ICT**

In a study undertaken in four New Zealand secondary schools, Ward (2003) recommended a new professional development model which provided teachers with intrinsic motivation to use computers to provide learning outcomes not readily achievable without the use of ICT. She was critical of the New Zealand Ministry of Education’s spending on ICT professional development, saying that the current professional development model in many schools focuses on skills through “one-size-fits-all” workshops (p. 11). In this, she appears to be in accord with Guskey (2000) and with the New Zealand Education Review Office (2005).

The authors of the New Zealand Education Review Office (ERO) (2005) report considered that individual teachers’ needs are important elements in the learning process.

The report included a recommendation that ICT professional development should be based on individual teacher needs rather than the traditional one-size-fits-all model which had been criticised by a number of researchers. The report authors appear to be in agreement with Guskey (2000), Ward (2003) and Scrimshaw (2004) who recommended individually tailored professional development programmes due to the individual personal characteristics and individual experiences of teachers being important influences on their learning.

Holland (2001) recommended that professional development in ICT should heed three important points. Her first point was that teachers develop individually in their knowledge and use of ICT. Her second point was that even though professional development may start with conventional in-service training it should quickly move to include efforts that support teachers' development as professionals in their classroom teaching. Her third point was that teachers specifically need help and support in integrating new knowledge and skills into their classroom practice and that the help should be continuous.

Classroom teachers are encouraged to teach to the individual needs of each student. Teachers are trained to constantly evaluate the needs and ability of each student and teach to those needs. McKenzie (2003) considered a teacher with an effective pedagogy as one who "orchestrates" classroom learning. He said that pedagogy is at its finest when the teacher acts as a 'guide on the side' and that a lack of devotion to pedagogic concerns is one reason why new technologies have failed to reach their potential in classrooms. He also claimed that to be effective, teachers must learn how to reach each student individually and give that student the lesson needed. McKenzie's (2003) observations underscore the need for professional development which helps or creates pedagogical change to allow teachers to use the advantages offered through the integration of technology.

In contrast to McKenzie's (2003) view which stressed the importance of individual needs are the typical group sessions in which teachers are expected to learn ICT related topics at the same rate as their fellow attendees. This type of group instruction would seem to ignore the needs and ability of the individual teacher/learner. One interpretation is that because they are teachers, they will cope with having to remember much more than solutions to immediate problems.

Although popular, teachers' group workshops for professional development programmes are not recommended by Ang (1998) who suggested that such programmes should be designed for the teacher participants and run at a time that suits those teachers. The New Zealand secondary school teachers' union (PPTA) has expressed frustration with the 'one size fits all' ICT courses. The PPTA authors also shared an opinion with Sandholtz and Reilly (2004) and others that although the teachers recognised that they needed assistance with integrating the technology into their subject areas, the training teachers received was too techno-centric (PPTA, 2004). Group sessions have to be planned in advance and accompanied by significant logistics yet they are still being used in ICT professional development. Group sessions take place at all levels of ICT professional development and the struggle to assimilate course content is not restricted to classroom teachers alone. Even university professors sometimes have difficulties with this form of professional development:

'Click on the start button,' Professor Larry D. Smith began. As the lesson progressed, there were the usual befuddled scowls and outcries of 'wait!' and 'how?' But this was no usual class. The students in the Charleston Southern University classroom were all full-time professors ...two hours later; the professors-turned-students shut down their laptops and [left] for the weekend. Hite, the business dean, said he has a lot of experience using Microsoft Excel in class and he likes it. He is no computer novice. 'But this is hard for me,' he said of the new software program. 'This is more than you can remember' (Gore, 2002, p. 110).

The experiences of the professors-turned-students in the Gore (2002) anecdote reinforce the frustrations of the 'one size fits all' delivery method. This sort of professional development is hard work for the teacher-turned-student. The 'one size fits all' style reported

by Gore (2002) crams data to the point of overload for some students and creates a paradox for teachers-turned-students.

The paradox is a conflict of expectations in teaching methods. Teachers are encouraged to teach to individual student needs but are themselves expected to learn as a group. In the Gore (2002) anecdote the classroom guide-on-the-side and orchestrated individual learning discussed by McKenzie (2003) are absent. Absent also were the success factors outlined by Ang (1998) which included appropriate programmes for each teacher that were integrative and collaborative. The 'students' were expected to learn in step with one another like soldiers marching. Each was expected to progress at the same pace as the others, inching towards the pre-determined and assumed successful conclusion. Furthermore, teachers-as-students are expected to retain learning which may not be currently relevant to their work just because it may be easier to deliver those pre-set objectives through group training. It appears that under the group-training scheme, there was one pedagogy for school students and a very different pedagogy for teachers in training. Group sessions cannot cater for individual needs and often the teachers-as-students leave the session confused, with a bundle of notes which may never be opened.

Further problems with ICT professional development through group learning sessions are associated with the lack of individual attention and the lack of relevancy to the issues individual teachers may be experiencing. Tutors sometimes justify teaching ahead of their students' needs because the skills may be useful later. Some classroom teachers are guilty of the 'one size fits all' expediency, but most good classroom teachers adopt pedagogical philosophies similar to those of expressed by McKenzie (2003). One possible reason for teachers not being provided with individual learning programmes is cost. Another reason may be a lack of skilled ICT professional development providers. Additional skilled

resources are needed to accommodate the potential of as many sets of learning needs as there are course participants. Also, those needs are likely to be a great deal more diverse in the case of teachers-as-students, because of the wide range of backgrounds, prior ICT experience, and immediate pedagogical needs and so on.

Zehr (1997) reported that adequate training for teachers in ICT is hard to come by. She wrote that when teachers take training courses, they find it difficult to remember everything when they return to their work in the classroom. The business dean in the Charleston report (Gore, 2002) made a similar observation when he complained that he found the course hard because there was more content than he could remember. Zehr (1997) recorded one teacher-turned-student as saying that she found it easier to learn as she worked, making the learning fit the pattern of work. She also mentioned that although a stopping point or barrier may be trivial in hindsight, the resulting embarrassment may discourage a teacher from attempting to use a computer in the classroom.

In her three year study, Mensing-Triplett (2001) looked for professional development elements which helped in-service teachers integrate computer technology. She detailed six elements that school districts should provide to help teachers in the successful integration of technology. A summary of those elements include *skills training*; *experience with teaching with technology in the classroom*; *mentoring support*; *support for curriculum planning*; *supervision of instruction*; and *collaboration* with other teachers using the technology in similar ways. She reported that more than 90% of teachers interviewed had perceived that good access to just-in-time mentoring support had improved their skills. She also found that over 95% found they had a sense of empowerment with hands-on computer training. Over 90% felt that collaboration with colleagues improved their skills. This finding on informal learning appears to be in agreement with the views of Wilson and Berne (1999), Guskey

(2000) and Marsick and Watkins (2001). Skills acquisition in this study related to use of the technology, not to the technology itself. Mensing-Triplett's comments on the increase in user skills from hands-on experiences were in accord with those of Zehr (1997) who argued that hands-on learning with the opportunity to experiment together with readily available support are factors which enhance successful use of technology in the classroom.

Prestridge and Watson (2003) conducted an investigation of ICT professional development programmes. They looked for aspects of what they considered 'effective' ICT professional development and concluded that although skills based ICT professional development was in demand from teachers, skills alone, "...may not enable the transition to a more constructivist approach to the use of ICT in the classroom" (p. 13). The authors noted that it may also lead to a skill/drill use of technologies in classroom practices. Researchers such as Grant (1996), and Ertmer (2005) have expressed similar views to that of Prestridge and Watson (2003) in that skills based learning alone is insufficient for the pedagogical changes needed to use technologies in the classroom.

Ertmer (2005) also pointed out that computers and their software were merely tools which by themselves, could not compensate for, or remedy inadequate practices or underdeveloped educational philosophies. Grant (1996) also investigated the underlying principles of professional development for technology and is among a growing number of researchers who considered that teachers should develop their pedagogies and classroom practices to enable new or advanced understandings which support inquiry based learning. The author agreed that skills based ICT professional development may not help teachers to look beyond just skills acquisition and that more was required for teachers to use technologies to develop their pedagogies and practices. However, Preston, Cox and Cox (2000) and Snoeyink and Ertmer (2001) did not agree that there should be a move away from the teaching of skills. Preston

Cox, et al., (2000) considered teachers needed training to be able to solve basic technical problems and Snoeyink and Ertmer (2001) suggested that teachers' training in the basics of hardware and software should precede pedagogical training.

Encouraging teachers to use ICT in their subject areas involves learning basic skills for use in their daily work. However, those skills are not only critical but also complex. They are critical because without knowing how to use the technology, teachers will again simply avoid using computers in their work. They are also complex because ICT professional development generally involves factors which impact on teacher learning. For example, the timing of the programme; how the programme is actually delivered; the availability of resources; relevance for the teacher's work at the time; and the status of the teacher as an adult learner. In a paper in which she researched techniques to support pedagogical change, Ertmer (2001) suggested that teachers could be introduced to the level of technology which can support their current and immediate needs. She explained that this technique may give teachers confidence for increasing their use of ICT. In later research on the integration of technologies and pedagogies, Ertmer (2005) was concerned that effectiveness of the incremental use technique has not yet been borne out in the literature and recommended more research into the use of technologies by stages to help pedagogical changes.

Wilson and Berne (1999) recorded a list of 'truisms' which they argued identified the need for teachers to have ownership and control of their own professional development. They included advice that teachers should be treated as active learners who construct their own understanding and that they should be treated as professionals. This was also a concern identified by Lai (2001) who researched professional development in a number of areas involving ICT. Knowles, Holton and Swanson (2005) also argued for these features to be

part of adult learning. Ross-Gordon (2003), Lawler (2003) and Knowles et al., (2005) also expressed similar views on the need for teachers to have ownership and control of their professional development and learning.

In his research on how teachers best learn to use technologies, McKenzie (2001) pointed out there has been "...little adjustment made for learning styles, developmental stages or personal preferences" (p. 2). The author recommended replacing the ICT training model with one that was concerned with "...engaging the learner on a daily and perhaps hourly basis and ... includes an emphasis upon self-direction, transformation and experience. One learns by doing and exploring ... by trying, by failing, by changing and adapting strategies and by overcoming obstacles after many trials" (p. 2). He explained that the skills training model is usually characterised as being outside of context and limited in transferability to work practices. He recommended the importance of an understanding of how adult learning supported self-direction, transformation, prior experience as well as the encouragement to use the new found knowledge and skills in the workplace.

In her report on the integration of technologies with pedagogies, Ertmer (2005) also argued for a recognition of teachers' current pedagogical beliefs which she said "...can be ignored only at the innovator's peril" (p. 36). Programmes compatible with those beliefs may increase teachers' confidence for using technologies "...so that, over time, higher level uses become more plausible" (p. 36). However, like Wilson and Berne (1999) and Guskey (2000), she called for more research to determine what further changes are required.

What is 'appropriate' professional development is difficult to define in general terms and the definition depends largely on situation, circumstance and the needs of the learner at the time. However, some elements which can be identified on a case-by-case basis include:

**Timeliness** for the learner ('just-in-time') as reported by McKenzie (2001), Granger, Morbey, Lotherington, Owston and Wideman (2002), Ward (2003), the New Zealand Education Review Office (2005) and the New Zealand Ministry of Education (2005b);

**Relevance** to the learner's needs ('just-for-me') discussed in Cox, Preston et al., (1999), McKenzie (2001) and Yuen and Ma (2002);

**Ownership of the issues to be resolved**, ('just-for-me') the learner has control of the learning as reported in Knowles (1984), and Jones (2004);

**Gender divide** in which female teachers are sometimes less inclined to use computers as reported by researchers such as Yuen and Ma (2002);

**Adequate time** for the learner to become confident and familiar with the technologies as noted by Cuban (1999a), Preston, Cox et al., (2000), Cuban et al., (2001), Snoeyink and Ertmer (2001) and Auxter (2002);

**Change management and support with change** which occur with the use of ICT reported by a number of researchers including Hargreaves (1992), Fullan (1993), Watson (2001) and Lloyd and Cronin (2002);

**Lack of resources** is seen by researchers such as Smerdon, Cronen, Lanahan, Anderson, Iannotti and Angeles (2000) and Pelgrum (2001) to be a substantial barrier to the use of ICT by teachers. However, others such as Ertmer, Addison, Lane, Ross and Woods (1999) and Cuban (2001) argued that resources are only part of problem in getting teachers to use ICT in their classrooms. The teachers have to be willing to use the equipment.

**Timeliness.** 'Just-in-time' is a term which implies the assistance or learning takes place at the time it is needed and often involves short, frequent sessions to solve issues as they arise. Granger, Morbey et al., (2002) reported in a qualitative case study of four

Canadian elementary schools that successful ICT implementation is enhanced by the use of informal ICT professional development. In particular they discussed the value of 'just-in-time' delivery of assistance to individual teachers.

In his discussion on professional development, McKenzie's (2001) recommendation for "...engaging the learner on a daily and perhaps hourly basis" (paragraph 37) appears to fit well as one strategy to make the professional development both relevant and timely. The barriers of lack of ownership and/or relevancy of the assistance are overcome because the *learner* decides the specific learning intentions and outcomes at the time of the call for assistance.

Both Ward (2003) and the New Zealand Education Review Office (2005) recommended the 'just-in-time' professional development model which can also accommodate elements of the adult learning model such as readiness to learn, motivation, self-directedness, relevancy, ownership of the learning, and timeliness. In this model the timing and relevance of the professional learning is critical to its success.

**Relevance.** It may be axiomatic that professional development programmes should be designed with the users' requirements in mind (just-for-me), but this has not always been so. For example, the most complex ICT professional development programme ever undertaken in the United Kingdom failed because of a lack of 'appropriate' ICT professional development programmes. The failure of the British Government's £230 million New Opportunities Fund (NOF) programme could have been avoided through appropriate professional development, adequate resources and sufficient time for the teachers to acquire the pedagogical shift necessary for successful integration (Conlon, 2004; Kirkwood, Van Der Kuyl, Parton, & Grant, 2000; Scrimshaw, 2004). The NOF programme was intended as a

training programme to raise the level of student learning through increased teacher expertise and use of ICT in the classroom.

Conlon (2004) explained the NOF ICT programme for teachers operated from 1999 to 2003 and involved tens of thousands of teachers and hundreds of mediators. The failure was a “shocking result” which could have been avoided as an important and foreseeable influence for the failure was the unattainable targets for the knowledge and skills components (Conlon, 2004, p. 136). The teachers did not have the skills needed to use the technologies.

In the United States of America, a reported 80% of the teachers in the Smerdon et al., (2000) study said they were hindered in their use of computers by the lack of professional development for *using* the technology. These findings appear to be in agreement with those of Preston, Cox et al., (2000) and Snoeyink and Ertmer (2001) with regard to the need for skills in the use of computers. The Smerdon et al., (2000) authors used extensive data sources to establish teachers’ classroom use of ICT and their preparedness in the use of ICT in public schools in the USA. The survey data came from the 50,000 household monthly Current Population Survey supplied by the Bureau of the Census and from the National Center for Education Statistics (NCES) Fast Response Survey System (FRSS).

**Ownership of the issues to be resolved.** Ownership is an important factor identified by a number of authors. In their list of ‘truisms’, Wilson and Berne (1999) identified the need for teachers to have ownership and control of their own professional development. This was also a concern identified by Lai (2001) and Knowles et al., (2005). Wilson and Berne included further advice that teachers should be treated as active learners who construct their own understanding; and that they should be treated as professionals. These views are also in accord with those of Ross-Gordon (2003), Lawler (2003) and Knowles et al., (2005).

**Gender as a barrier.** According to Cuban et al., (2001) “There was little difference in computer use between ... male and female teachers” (p. 826). Their study was conducted in two Silicon Valley high schools in an area “...filled with modest to affluent homes...” (p. 818). The lack of gender related difference noted by Cuban et al., (2001) could be explained by the suggestion the research psychologists Cooper and Weaver’s (2003) reported that “...wealthier Americans have more access [to computers] regardless of race or gender” (p. 3). However, Cooper and Weaver (2003) argued that even with the wealth factor “...compared with men, women are under-represented in their use and ownership of computers” (p. 5). Their conclusions regarding the causes of gender based barriers were largely from analyses of data from other researchers.

The gender divide which disadvantages females has been noted by other researchers. For example, the evaluation of the 2003-2004 ICT Professional Development (ICTPD) School Cluster programme (Ministry of Education, 2005a) found that female secondary teachers’ and primary teachers’ confidence in using ICT increased as their professional development progressed. This was notable as they started the programme as being less confident than male secondary teachers. The School ICTPD Cluster programme was a Ministry funded scheme designed to assist in the development of teachers’ ICT competencies. The report also noted that by the end of the programme, female secondary teachers and primary teachers had increased their usage of ICT more than male secondary teachers. Additionally, the evaluation noted that the primary teachers reported more positively than secondary teachers on the way in which the ICTPD programme enhanced their teaching and learning. The report’s conclusions were generated from data from multiple surveys of approximately 1400 participant teachers between 2003 and 2005 (Ham, Toubat, & Williamson-Leadley, 2006). However, the conclusions lacked definitive evidence that the

changes were largely from their prescribed programmes. Another criticism of the conclusions in the Ministry's report was the lack of comparative data from (for instance) a control group. The absence of comparative data may render the conclusions incomplete at best.

The gender divide was also identified in a study of 186 teachers by Yuen and Ma (2002) in which female teachers were found to be less inclined to use computers unless they saw the application to be both useful and easy to use. The authors suggested professional development was a key factor in changing negative perceptions in order to develop positive attitudes towards the use of ICT by women. Yuen and Ma (2002) also suggested that professional development should be used to help *integrate* ICT with sound pedagogical practice but unfortunately they stopped short of defining 'integration'. They observed that a lack of knowledge and experience with ICT were common reasons for teachers' negative attitudes towards computers. They commented that teachers needed to accept that the technologies are useful in their teaching and student learning before they could elect to use them. Yuen and Ma (2002) warned, however, that computer experience and skills alone were not sufficient to ensure teachers will use technologies in their lessons.

It may be that professional development generally can provide an answer to the gender barrier, but a solution is perhaps more basic. A reason for the lack of use may be because ICT is not seen as potentially useful—teachers lack reasons *why* ICT may be important. Researchers such as Cuban (2001), Baumgartner et al., (2003), Ward (2003) and Knowles et al., (2005) have pointed out that teachers need *reasons* to learn something before setting about learning *how* to use it.

**Adequate time.** Time is considered to be one of the most scarce resources for teachers. It is also almost universally considered the most important barrier to teachers participating in effective professional development activities. In his discussion on the provision of sufficient time for professional development, Guskey (2000) was one of a number of authors who regarded the provision of adequate time crucial to the success of professional development. Cuban (1999b) related one lack of success in using the technology in curriculum areas to the lack of time for professional development; lack of time to practice with ICT; and the lack of time for teachers to add to or change their pedagogy so that ICT can be used with success.

In Auxter's (2002) view "...teachers are expected to be shown once and magically transform into masters of the technology" (p. 7). In his criticisms of current ICT professional development practices, Auxter identified time as a barrier. He noted that there was never enough time for 'staff training' for teachers to provide them with the technology skills and knowledge necessary to use ICT in their curriculum areas. The author pointed out that the provision of time for teachers' professional development was unrealistic. He observed that businesses often spend as much as two or three days a month to train staff whereas teachers get two or three days a *year*.

Cook (1997) considered professional development to be a complex task. Teachers need continuous support and substantial time to try new ideas and evaluate those ideas to make learning more meaningful. Cook is also of the opinion that far more time is needed for professional development than is currently available; professional development must become part of the daily life of teachers and not be seen as a singular event scheduled on a particular day. These are similar to McKenzie's (2001) views.

A reported 80% of the teachers in the Smerdon et al., (2000) study reported that the lack of time was a barrier to their use of computers. A total of 37% of the respondents considered the lack of time to be a “great” barrier (p. 3). The authors used the 1999 US Department of Education’s Fast Response Survey System (FRSS) data from approximately 1,000 teachers. Cuban et al., (2001) speculated that time was a barrier to changing from a teacher-centred instructional practice to a student-centred pedagogy through the use of technology in the classroom. Time for training and “...time to find and evaluate software” (p. 826).

The lack of available time is closely linked to workloads according to the Australian Council for Education Research (ACER) investigating New Zealand secondary teachers’ workloads (Ingvarson et al., 2005). The ACER study first canvassed all New Zealand schools in late 2004 and received responses from 357 secondary schools which included “...1150 teachers, 936 managers and 235 school principals” (p. 5). The survey was followed up with detailed case studies in six schools which the authors considered were a representative range of schools with respect to size, location, and social context. The authors reported that the uptake and use of ICT by teachers, managers and principals was not great. They wrote that there was a low uptake of ICT among the 1150 secondary teachers surveyed and they proposed that teachers could use ICT more to alleviate workloads. The authors noted that teachers who used ICT regularly “...appeared to be more organised and more in control of their workload than those who did not” (p. 9). However, with regard to teacher workloads, the authors added a caution that the average workloads of teachers reported in the survey (47 hours) were in fact higher than those determined through face to face interviews (43 hours).

On a contrary note, the Post Primary Teachers' Association (PPTA) was critical of the potential of ICT to reduce workload. The authors of the report commented that "...too much ICT development has relied on the goodwill of teachers. The problem of workload must be addressed urgently" (PPTA, 2005 p. 7). The criticism of increased workloads was based on literature research—which included the ACER (2005) report—and on informal surveys in secondary schools which indicated that teachers have not been able to acquire sufficient skills to use ICT to reduce workloads (PPTA, 2005b). The authors noted that it has "...not so far been the experience of secondary teachers that ICT use has reduced the administration and compliance burden, perhaps the reverse..." (p. 8). Apart from the growing burden of 'administrivia' in schools through the advent of ICT, the PPTA authors highlighted the increased workloads were also associated with the perceived importance of ICT-based pupil-centred learning. They warned that this concept required teachers to have a thorough understanding of their subject pedagogy and that the need to tailor programmes for individual students in this way "...is a more intensive use of teacher time than whole class teaching so there are implications for student:teacher ratios in this principle" (p.3).

The PPTA authors also noted the lack of support for teachers using ICT. They explained that support was in the form of workplaces and facilities as afforded other professionals and suggested that for teachers, this lack is "...likely to act as a further brake on creativity and innovation" in the use of ICT (p. 6). Ingvarson, Kleinhenz et al., (2005) also identified the lack of this support for most teachers using ICT.

Further New Zealand studies identifying the lack of time as a barrier to the uptake of ICT in schools include the New Zealand Education Review Office (2000) report which is based on data from 50 secondary and composite schools; and the Lai, Pratt et al., (2001a) study which used data from 25 Otago secondary schools. The issues with the lack of time for

professional development for the use of ICT are at the heart of the ‘just-in-time’ professional development proposals from Granger et al., (2002), Ward (2003) and the New Zealand Education Review Office (2005).

**Change management and support with change.** Pedagogical change and support are considered important to the use of technologies by teachers in secondary classrooms.

...unless teachers are able to change their teaching practices and become capable of adapting to new technologies continued expenditure on ICT will have little impact on student learning and classroom practices. (Ward, 2003, p. 12)

Prensky (2001) offered similar advice. He argued that the 21<sup>st</sup> Century classroom was divided into ‘digital natives’ (students) and ‘digital immigrants’ (teachers). He claimed that today’s students are born into the digital culture and they have learned the language of that environment easily. He went on to say that students of today

... forcefully resist using the old. Smart adult immigrants accept that they don’t know about their new world and take advantage of their kids to help them learn and integrate. Not-so-smart (or not-so-flexible) immigrants spend most of their time grousing about how good things were in the “old country”. (Prensky, 2001, p. 3).

Prensky also argued that to be effective, teachers *have* to use their students to guide and help them develop methodologies for all subjects, at all levels which are aligned to the world of the students as ‘digital natives’.

This current study is located within the general area of educational change as it relates specifically to pedagogical changes through the use of technologies. According to Fullan (1993) teachers are central to most educational change which to be successful, must be sustained over time. Hawley and Valli (1999) argued that professional development resulting in pedagogical change must be integrated into both the school day and the school year in ways that enable teachers to use the innovations from the professional development. Cuban (2001) went further with his assertion that pedagogical change is needed *before* teachers will

embed technologies in their classroom teaching. He also argued that teachers will not make those changes without being sure of beneficial returns for students.

In a case study involving five teachers and eleven student technology trainers Hruskocy (1999) described a relationship between technology and change. In her study, students were used as tutors who helped their teachers and fellow students with skills acquisition and answered how-to questions. In that study, each teacher was assigned two or more ICT specialist students to their homerooms. The author considered that there was a relationship between technology and change and there was evidence to suggest that technology can foster changes in a school in a technology enriched classroom. Hruskocy (1999) went on to say that the traditional teacher/student roles change with the use of technology as both students and teachers emerge as co-learners as they construct the learning and knowledge together. She further explained that because technology is a recent phenomenon, models for successful integration are lacking. She discussed integration as a three stage process, *enhance*, *extend*, and *transform*.

The first stage (*enhance*) related to how technology can be used as a learning tool as well as how to deliver the specific curriculum content. She explained that this level does not change the school schedule or structure. The second stage (*extend*) is when teachers used technology to move the curriculum beyond the existing school structure. Hruskocy (1999) used the example of including telecommunications in a lesson. The third stage (*transform*) is where the traditional school model is altered. She explained that this is a stage which few teachers reach as systemic change is required. Change such as this is nearly impossible for most people she said, because it requires change of thinking, change of actions, and a change of the school setting.

In Hruskocy's terms, teachers using technology are likely to stay at the *enhance* stage. However, it is unlikely that a teacher who is prepared to take that first step will in fact stop there. Good teachers have the initiative to move at least to that stage which is why they are good teachers. According to Brown (1998) good teachers tend to use whatever is available to enhance learning in their classrooms.

Cox, Preston et al., (1999) researched barriers and factors which supported teachers' use of ICT in a British study involving 54 secondary school teachers and 18 from the primary sector. The authors were concerned with the need for change in teaching practice if technologies were to be adopted for use in the classroom. They pointed out that "...if teachers see no need to question or change their professional practice then ... they are unlikely to adopt the use of ICT" (Cox et al., 1999, p. 18). The authors concluded that professional development should include more emphasis on pedagogical issues "...if teachers are to be convinced of the value of using ICT in their teaching" (p. 20).

Lesgold (2002) maintained that technology is generally not a direct cause for change, but rather a facilitator or amplifier of a number of educational practices. He went on to say that when technology is used for teachers' professional development there is the problem in that the technology must "land in an appropriate infrastructure" and to stimulate student learning, the resulting changes in teacher competence must find their way into classroom changes. In Lesgold's opinion, teachers can facilitate and amplify their pedagogical practices through the use of technologies. If a teacher can ask for assistance with using ICT in a school, they are likely to be using the technology. If they are comfortable with the support they are getting, they are likely to use the technologies more and as their efficiencies grow the technologies may well exert sufficient influence to promote a change in their pedagogical philosophies and practices.

Robertson (2008) was in agreement with Cox, Preston et al., (1999), Hruskocy (1999) and Cuban (2001) when he maintained that fundamental change in teaching practice requires more than simply providing technical level skills in the use of ICT's. Robertson considered there was a need for professional development to address teacher beliefs as to what constitutes good teaching practice so that sustainable changes in teaching practice can be made. He advised that to be effective, the professional development should require practitioners to engage in dialogue to review and revise their theories so that sustainable changes to their pedagogies can be made.

However, Watson (2001) disagreed that pedagogical change should be driven by technology and argued for a re-think on the relationships between ICT and pedagogies. He explained that blaming teachers for the low uptake of technologies is too simplistic as pedagogies—not technologies—determine what knowledge or changes are needed in the 21<sup>st</sup> century. He further argued that technologies should be tools for change, not catalysts. Watson (2001) also considered that barriers "...to the adoption of computers in schools are simply specific examples of barriers to change in general" (p. 260).

**Lack of resources as a barrier.** The lack of resources is an oft-quoted reason for the failure of ICT use in the classroom. There are two main issues identified in the literature which relate to this barrier to ICT use. The first is that a sufficient number of reliable computers should be available for use and the second is that there should be effective ICT professional development provided for teaching and learning processes using ICT. Smerdon et al., (2000) reported that 78% of the surveyed public school teachers (using the teacher data from the 1999 FRSS surveys detailed earlier), believed the lack of computers to be a barrier to use, with 38% reporting they considered the lack to be a "great" barrier (p. 3).

In a review of the literature on factors affecting teachers' use of ICT, Mumtaz (2000) argued that resistance to change pedagogies to embrace ICT in the classroom could be based on "...an unclear understanding of what change should constitute and the reasons why change should take place in the first place" (p. 336). In Mumtaz's opinion, "...even if teachers are provided with up-to-date technology and supportive networks, they may not be enthusiastic enough to use it in the classroom" (p. 338). Mumtaz (2000) suggested that to accept ICT in the classroom, teachers need to be given evidence that the technology is useful to them and their pupils.

In a qualitative study involving teachers, school staff and students at two high schools in the technology rich Silicon Valley, Cuban et al., (2001) found that access to equipment and software, seldom led to widespread teacher and student innovative use. They reported that most teachers were occasional users or non-users and their use tended to sustain rather than change their pedagogical practices. Some of the barriers identified were a lack of appropriate professional development; a lack of time to find, practice and use appropriate software; and a lack of suggestions for strategies on how to exploit the pedagogical advantages of technology. Cuban et al., (2001) also identified significant contextual factors such as the location of computers, how the school day is structured and the culture of the school as contributing to barriers to ICT uptake. Yuen and Ma (2002) proposed similar reasons for gender barriers.

Condie, Munro, Seagraves and Kenesson (2007) were commissioned by the British Department of Education to study the impact of ICT in schools across the United Kingdom. Like Cuban et al., (2001), they found actual classroom use varied within the study schools. Although Condie, Munro et al., (2007) found a steady increase in the number of computers in

schools they warned there was a "...considerable variation within and across schools with regard to regular access to reliable technologies" (p. 3). They also pointed out that even with increased numbers of computers available, much of the evidence relating to the impact of ICT in teaching and learning has been drawn from "...small-scale case studies and there is a paucity of large-scale, methodologically rigorous research from which generalisations can be drawn" (p. 5). The authors went on to say that the "...little systematic evidence that exists indicates that good resources can have an impact on motivation and attainment", but they noted a concern that there is insufficient understanding of how teachers can use the technologies to support pupil learning (p. 6). The Condie, Munro et al., (2007) authors went on to say the literature provided little information on either the changing dynamics between teacher and pupil through the use of ICT or the potential impact on classroom relationships generally through the use of ICT to support learning. They reported they found some evidence that as individual teachers undertook relevant and appropriate professional development, they "...experienced a reduction in some aspects of their workload" (p. 4).

In an examination on the lack of adequate training for teachers using technology, Zehr's (1997) findings complemented those of Cuban et al., (2001) and Ward (2003). Zehr (1997) considered that providing technology without appropriate professional development was a waste of money. Teachers must know how to use the technologies effectively. Cuban et al., (2001) compared the access to and the use of computers in two Californian high schools with national averages derived from data from the Bureau of the Census Current Population Survey (Census Bureau, 1998). The authors noted that in both schools access to computers in the classroom did not guarantee their use. One of their recommendations was that professional development programmes be re-designed to be more responsive to teacher needs, rather than organisational needs. They also found that very few researchers entered

classrooms to see how computers are actually used but when they did, the researchers found that claimed usage was higher than actual usage.

In their research into differences between actual and reported use by teachers of ICT in the classroom Hakkarainen, Muukonen, Lipponen, Ilomaki, Rahikainen and Lehtinen (2001) also found discrepancies between what teachers claimed and what they actually did with regard to their pedagogical principles. The authors noted that a number of teachers who claimed to be constructivist practitioners made less use of ICT in their teaching and learning.

Unlike Cuban (2001), Pelgrum (2001) claimed that a substantial barrier to teachers' use of ICT was indeed a lack of equipment. Pelgrum used data from his worldwide survey of 26 countries (including New Zealand) that indicated that the first major barrier to classroom use of technology *was* an insufficient number of computers. He considered the second major barrier was the teachers' lack of knowledge and skills in using the technologies. In this he was in agreement with Zehr (1997) and furthermore he may not necessarily be in disagreement with Cuban et al., (2001), Cuban (2001) and Ertmer, Addison et al., (1999), who argued that more than just access to computers is needed for their use. Pelgrum's (2001) first position was that the equipment has to be available for use. Importantly, he noted that this was not generally so in most educational systems in his survey. He found that 'available' computers were used by a limited number of teachers who were involved in teaching students *about* computers. Once that barrier of a lack of resources was overcome, Pelgrum's (2001) second major barrier, the lack of professional development, had to be dealt with. Like Preston, Cox et al., (2000) and Snoeyink and Ertmer (2001), he considered that teachers needed professional development to first *use* the technology so that they could develop pedagogically effective ways to enhance student learning.

Ertmer, Addison et al., (1999) warned that even if *all* the external barriers were removed (including the lack of resources), teachers “would not automatically use the technology” (p. 51). Cuban’s (2001) views are consistent with those of Ertmer and her colleagues as he also found that the presence of computers did not guarantee their use. He wrote that after some twenty years of computers being available in schools and in spite of the swift spread of computers into all other facets of American life, teachers were still reluctant users of the technology. Cuban (2001) advanced a number of reasons for the lack of use, among which were the unreliability of the classroom equipment; the complexity of the software; and the lack of control over additional commercial features not needed by teachers.

The issue as to whether or not there are sufficient resources is still not clear. Even acknowledging the comments from Mumtaz (2000), Cuban (2001), Zhao, Pugh, Sheldon and Byers (2002) and others, the New Zealand Education Review Office (2005) report identified equipment shortages and recommended improving access to ICT resources for students and teachers alike. The reviewers also recommended a continued focus on integrating e-learning into teaching programmes to improve students’ learning.

Cuban (2001) suggested that as a medium for teaching and learning, computers are incompatible with current pedagogies and his comments are in accord with those of Zhao et al., (2002). Cuban considered that teachers, as ‘gatekeepers’ to what happens in their classrooms, will not change their pedagogies without being sure that the changes will be of benefit. He pointed out that with the increasing workload teachers face, it is simply too hard for most teachers to incorporate student computer use in their instructional practice. Robertson (2008) also considered that the teachers themselves are “... gatekeepers for change ... and many educational change projects have foundered ... due to a lack of consideration for teachers’ beliefs and values about teaching and learning” (p. 824). He appeared to support

Cuban (2001) and Zhao et al., (2002) when he argued that a teacher's "...deep-seated notions about what constitutes good teaching are critical in shaping a teacher's practice" and those notions and assumptions about how students learn "...affect the choice and use of technology for teaching and learning" (p. 822). Robertson (2008) reinforced Cuban's (2001) assertion that teachers—rather than school administrators—controlled change in the classroom:

If teacher's practice is to change in a fundamental way there is a need for professional development to move beyond simply providing technical level skills in the use of e-technology to address teachers' beliefs about what constitutes good teaching practice. (Robertson 2008, p. 824)

In a study using data from 516 United States computer using teachers who completed subject specific questionnaires or telephone surveys, Becker (2000) developed a screening process to find those teachers whom he classified as exemplary computer users which resulted in 45 teachers from the initial group. One objective of his study was to identify and understand the differences between exemplary teachers and their colleagues so that barriers to extending exemplary teachers' practices to others could be removed. He reported a 'striking' statistic from his data analysis which suggested the exemplary computer using teachers downgraded "...the salience of some curriculum content in exchange for computer activities that may have enabled more in-depth concentration on other content" (p. 286). He suggested that one of the biggest barriers to curriculum reform was the inability of teachers to drop existing content. He went on to suggest that his survey data supported the role of computers which "...may actually be an effective vehicle for getting rid of weak or out-dated content in academic curricula" (p. 287). According to Becker (2000), the exemplary group were as likely to be found in low-income, low socio-economic-status schools as in other schools. He observed that although classroom-located rather than lab-located computers "...may be more easily integrated into important teaching/learning activities" exemplary teachers were likely to use computers in either location (p. 278).

Cuban (2001) reflected Zehr's (1997) opinion when he suggested that even if computers were available, if the teachers did not understand the technology or could not readily use it within their teaching programmes, they simply would not use it. Becker and Ravitz (2001) disagreed with Cuban (2001). They admitted that Cuban may have been right in a statistical sense but a survey of 1,100 schools from across the United States which provided data relating to pedagogies, computer use and teaching environments of 4,100 teachers, indicated that qualified circumstances showed a different picture. Those circumstances included teachers' adequate technical expertise, adequate classroom access to computers and a philosophy that supported meaningful learning around group projects. Becker and Ravitz (2001) drew distinctions between the technology and software available in the mid-1980's and relative ease of use of modern systems. However, they agreed with Cuban (2001) in that where computers were available for use in the classroom, that use has not transformed the teaching practices of a majority of teachers, particularly teachers of secondary academic subjects. They said this could have been a result of personal philosophies and the way in which teachers worked. Teachers who were most likely to enhance both teaching and learning through the use of ICT were those who supported a student centred pedagogy in which students could collaborate on projects that they partly defined. However, for that to happen, teachers had to have at least "moderate skills in using computers and be personally comfortable in using those skills" (pp. 3-10).

The data from the Becker and Ravitz (2001) survey supported Pelgrum (2001) as it indicated barriers to integration which included the lack of technical skills *as well as* access to computers. Becker and Ravitz (2001) also pointed out that pedagogies which favour constructivist teaching practices were most likely to provide effective ICT integration. They suggested that teachers who have a constructivist-oriented (e.g. project-based, inquiry-based) teaching practice and who themselves were actively and professionally engaged as well as

being active computer users, were likely to have students who were also active computer users. In their view, these same teachers "...may over time be influential in how other teachers come to view and use this technology" (p. 4). The authors did not explain the conceptual or methodological bases for these views.

Granger et al., (2002) presented views similar to that of Pelgrum (2001) in that both suggest that teachers cannot integrate ICT with various curricula, or teach, or learn computer skills without having computers that actually work! The New Zealand Ministry of Education (2005b) also reported that the lack of access to reliable equipment presented a potential barrier to ICT use in the classroom by both primary and secondary teachers. The Ministry urged the provision of more equipment.

Murray and Campbell (2000) surveyed 532 New Zealand schools for their report on teacher ICT professional development. Their classification of three groups of barriers is not as detailed as those identified by Ertmer et al., (1999) and the barriers are principally related to a lack of resources. The barriers were:

1. Limited teacher skills in the use of ICT and a lack of training;
2. Lack of time to use the technologies and workload pressures; and
3. Lack of resources which include working with usable equipment.

Scrimshaw (2004) also discussed the differences between teacher-centred and student-led approaches in using ICT. He reinforced two issues recurring in the literature; the need to learn how to use the technology and the need to fundamentally change how to teach.

### **Summary: Barriers to the Use of ICT by Teachers in Their Classrooms**

The literature suggested that barriers to the use of ICT in classrooms are often linked to each other. For example, teachers first need *reliable computers* to use and then have *time for appropriate adult focused professional development* to assist in understanding *how* to effectively use computers in the classroom.

The need for *reliable computers* is the first important requirement but those machines will be of little use for curriculum integration if teachers are not able to use them. Teachers are adult learners and must have *time* for adult focussed *professional development* which writers such as Guskey (2000), Ward (2003), Scrimshaw (2004) and Knowles et al., (2005) have pointed out that professional development through decontextualized one-size-fits-all does not work for them. Adult learners have specific learning needs and the delivery of professional development for teachers should acknowledge those needs.

*Effective use* is linked to an understanding of 'integrating' ICT into the curriculum. The literature is unclear on what 'integration' means in this context of pedagogical ICT integration and there are strong recommendations to clarify this important term.

*A lack of time* is a prominent barrier which overarches both professional development and the effective use of computers. Without time to develop the knowledge and skills to use ICT pedagogically, many teachers will continue to struggle with the ever-changing technologies. The literature also identifies the need for teachers to adopt a student centred teaching practice and, as Becker (2000) suggested, there is a need for *change to existing curriculum* content to accommodate a new way of teaching and learning.

Yuen and Ma (2002), Cooper and Weaver (2003) and Ham, Toubat et al., (2006) are among a number of authors who have identified a *gender barrier*. Compared with men, women are under-represented in the use of computers generally. Research suggests that women are more likely to be reluctant users of ICT's in their pedagogies unless they are able to see advantages in using those technologies in their classrooms and of course, they have time to develop competence in their use.

### **Theories of Adult Learning**

Teachers are adult learners. 'Learning' is a frequently used term and has many meanings dependent on the context and subject. The Shorter Oxford English Dictionary (OED) provided a starting point; to learn is "to get knowledge of (a subject) or skill in (an art, etc.) by study, experience, or teaching" (Onions, 1970, p. 1121). The distinction between 'education' and 'learning' is important for this discussion because of where the emphasis is placed. Knowles et al., (2005) regard education as focusing on the educator and learning focusing on the person in whom the expected change happens, with the process of learning being the gaining of knowledge. That definition focused on acquisition but failed to clarify the arguments put forward by Knowles et al., (2005) as to whether learning is a product, process, or function.

A definition of individual adult learning provided by Marsick and Watkins (2001) included not only the acquisition by the learner of meaning, knowledge and skills, but also included the intra-personal processes of generating 'meaning'. The addition of 'meaning' argued for a decade earlier by Mezirow (1991), extends the OED definition given above.

When Mezirow (1991) argued for the inclusion of 'meaning' in learning theories, he noted the importance of social conditions and other influences which helped construct

meaning. Those influences are important in understanding experience. He also argued that 'reflective discourse' was an important component to effective learning through meaning. Reflection was also considered important by Kitchener and King (1990) who argued that because there are no absolutely true answers for many problems which learners face in today's complex world, 'reflective thinking' is an essential tool for discovering meaning and problem solving. Furthermore, the data obtained by Kitchener and King (1990), suggested that reflective thinking is a function of adulthood which, the authors argued, developed at an age in the late twenties or early thirties.

Mentkowski (2000) commented that a study of 'learning' was necessary to provide a definition of learning which would help researchers, teachers and the learners themselves. However, Minnich (1990) argued that a definition of 'learning' was complicated in that it is both process *and* outcome (often intertwined) and that any observations of what is being learned are often inseparable from epistemology and the relationships of meaning systems.

De Corte's (1995) definition of learning added a number of elements which include such qualifiers as constructive, cumulative, self-regulated, goal oriented, situated and collaborative. Mentkowski (2000) also provided a number of additional qualifying elements which included activities which are integrative, recursive and heuristic and which involve thinking through the personal, disciplinary, or contextual frameworks that bear on a situation. She also included among desirable attributes of effective learning, experiential learning, explorative learning and a range of reflective practices.

Due to the changes caused by situation and influencing elements, there is not yet a universal definition of 'learning'. Wilson and Berne (1999) recommended that a study of how teachers learn is necessary because teachers and researchers need to agree on a definition

so that it becomes more accessible to both parties; learners and teachers. In this she is in accord with the views on learning of Guskey (2000).

Some programme developers considered ‘professional development’ as a synonym for ‘training’ but Phelps, Graham and Kerr (2004) say this should not be so. In their research involving 550 teachers in ten New South Wales secondary schools, the authors argued that “...for too long ‘professional development’ has actually been ‘training and development’...” (p. 50) and there should be a change in emphasis as to how professional development is carried out. They recommended (among other things) that there is a need to move away from simply skills objectives and focus also on teachers’ approaches to learning. They also preferred an approach to professional development which is reflective and ‘metacognitive’ which the authors describe as the development of “...knowledge concerning one's own cognitive processes and the active monitoring and consequent regulation of these processes in the pursuit of goals or objectives.” (Phelps et al., 2004, p. 51)

A consideration which is sometimes overlooked by those who deliver ICT professional development—indeed any sort of professional development for teachers—is that the students in those sessions are really adult teachers. Auxter (2002) warned against treating teachers as ‘novice students’. They are experienced learners and generally they have limited time and they have strong habits. They also need to see results. Auxter further cautioned that failure to recognise these special attributes can result in a general professional development failure.

Wilson and Berne (1999) reviewed contemporary professional development for teachers and observed that “...teacher educators and staff developers should model the approaches they are promoting...” (p. 176). In other words, those delivering teachers’

professional development programmes should have an understanding of the special needs of adult learners; of how that learning takes place; and how to use that knowledge in their programmes.

Phelps, Graham et al., (2004) argued for the delivery of any learning or professional development programme to take into account adult learning traits as teacher learning must be reciprocally related to adult learning. The authors recognised that adult learning traits such as flexibility; intuitiveness; self-directedness; independence; and the ability to adapt to change; provided teachers with a better chance of success than "...those dependent on structured routines or guidelines..." (p. 51). Researchers such as McKenzie (2001), Merriam (2001), Brash (2003), Baumgartner, Lee et al., (2003), Lawler (2003), Ross-Gordon (2003), Selwyn (2004) and Knowles et al., (2005) also supported recognition of adult learning needs, often referred to as 'andragogy'.

**Andragogy.** A useful starting point in a discussion on andragogy is what is meant by the more frequently used term 'pedagogy' which is widely used with reference to the art or profession of teaching *per se*. Although a large number of teachers do not discriminate between adults and young people in their global use of 'pedagogy', the OED defined a pedagogue as a person who has the oversight of a child or youth. Changing social and economic conditions are causing more adults to take up learning and that expanding demand has renewed the need to differentiate adult learning from that of youthful students (Baumgartner et al., 2003; M. S. Knowles et al., 2005; S. B. Merriam, 2001).

Heimstra and Sisco (1990) argued for the separation of the philosophies of adult and child learning. They considered the use of pedagogy to describe the learning of both children and adults was a contradiction in terms. The authors noted that pedagogy is often teacher

directed instead of student self-directed and didactic instead of student self-motivated. They turned to the Greek origins of pedagogy—which emphasises the teaching of children—to reinforce their argument that different approaches are needed for adult learning. They also claimed the pedagogical model has elements which are *not* adult-centric. These included the teacher having full responsibility for what will be learned, how the learning will occur, when the learning will take place and determining if the learning has taken place.

In addition to the above, Heimstra and Sisco (1990) commented that the teacher-directed nature of pedagogical instruction required the student to submit to the teacher's directions and obey the teacher's instructions. Knowles (1984) claimed this form of instruction also assumed that the learners needed only know that which the teacher determined. Knowles regarded this as a learning situation which actively promoted dependency on the instructor. He also argued that the pedagogical model did not account for adult developmental changes which he claimed, produced resentment, tension and resistance on the part of the adult. This brings the discussion to the Knowlesian model for adult learning—*andragogy*.

The term 'andragogy' was first coined in Germany in 1833 and was promoted by Lindeman (1926) to identify the underlying principles involved in the teaching and learning of adults as opposed to pedagogical approaches which are utilized when engaging with children. The Knowlesian andragogical model for adult learning, developed and refined by Malcolm Knowles over a number of years, provides the basis for adult learning principles. The model assumes that adults come to the learning situation with a considerable amount of *experience*; that they have a *readiness* to learn; that they are typically *task-* or *problem-centred* learners; and that they are internally *motivated* to learn. Additionally, the andragogical model includes the

elements of *self-directedness*; *timeliness* (just-in-time) and *relevance* (just-for-me) (Knowles, 1968, 1975, 1980a, 1980b; Knowles, 1983; Knowles et al., 2005; Merriam, B., 2001).

Rachal (2002) reviewed the andragogical movement and found it wanting. His research found empirical examinations of andragogy tended to "...be inconclusive, contradictory and few..." and noted that this state of affairs was likely to remain as long as "...an operational, researchable definition of andragogy continues to elude researchers" (p. 211). In short, he found that the current muddle of definitions and implementations had stalled research as to whether or not andragogy is a sound practice. However, Rachal left the door open a little. He strongly advocated an agreed-upon testable hypothesis to support andragogy, which he still regarded as the most persistent and best known construct of adult learning in thirty years. He also noted that despite his own reservations, there would be little disagreement among adult educators over using as much of the spirit of the andragogical model as possible in adult learning situations.

Pratt (1993) also complained that after twenty-five years of operation, there was still no tested basis for Knowles' andragogical model to be a theory of adult learning. He too, was concerned that the central concept of andragogy was still missing consensus on the clarification of underlying values and beliefs and the central concept of learning had still not been defined. He also warned there is no value-neutral position in adult learning discussions and that we should guard against the hegemony of representing our own values as the universal values of andragogy. In his view, the debates on andragogy have been "...fractured along philosophical lines [and] there can be little hope for agreement as to definitions, antecedents, means and aims of adult learning" (p. 9). However, in spite of the rejections and lack of definitions, he too, recognised Knowles' place in the history of adult education to be both secure and significant through his promotion of andragogy. Rachal (2002) noted that in

the face of the increasing number of competing newer theories on adult learning, the *Social Sciences Citations Index* "...revealed that Knowles has garnered more journal citations over the last 6 years than any of the half-dozen of the field's most well-known and well-published authors, with the one exception of Friere" (p. 212).

Whatever the outcome of the current debate on the nature of andragogy—whether it is a philosophy, a theory, a model, or a set of assumptions—it has become an established and relatively effective model for adult learning. It has appeal because unlike pedagogy, it focuses on important elements of adult learning which include self-directedness, critical reflection and it eventually promoted the development of transformative learning (Heimstra & Sisco, 1990; M. S. Knowles, 1968, 1975, 1980b; M. S. Knowles, et al., 1984; Lindeman, 1926; Mentkowski, 2000; J. Mezirow, 1991; J. Mezirow, et al., 1990; Pratt, 1993; Rachal, 2002; Wlodkowski, 2004).

Heimstra, Sisco et al., (1990) argued that the pedagogical model was particularly unsuitable for adult learners as it did not account for a number of established behavioural adult traits and this produced resistance on the part of the adult learners. Daines, Daines et al., (1993) added that traits such as established attitudes, patterns of thought and fixed ways of doing things; meant that adults are also unlikely to be satisfied with learning as a lengthy process. In contrasting the two models, Knowles et al., (2005) noted that while the pedagogical model *excluded* andragogical assumptions, the andragogical model *included* some pedagogical assumptions. The authors also proposed that the andragogical model recognised adults' need "to know why they need to learn something; [and] adults maintain the concept of responsibility for their own decisions" (p. 272). Additionally, Knowles et al., (2005) argued that adults are more responsive to internal rather than external motivation.

Motivation to learn is critical to the andragogical model. According to Knowles, Holton et al., (2005), adults are motivated to learn when they see a need to learn. That need is generally based on their current life situation whereas under the pedagogical model, youthful students learn because that is what the teacher directs and their motivation is often competition for grades. Wlodkowski (2004) took the issue of motivation much deeper. He dealt with cultural diversity, the wide range of perspectives and experiences existing in adult society and the need for all adults to make sense of their world. He maintained there is a natural inclination in all adults to be competent in matters they hold dear and that inclination is what fuels the motivation to learn.

However, motivation is often ephemeral. Wlodkowski (2004) warned that however desirable learning may be, human energy is finite and motivation has limits and can disappear with a snap of the fingers if not nurtured. Nurtured, that is, by the adult educator who faces considerable barriers in the teaching of adults. Some of the barriers can be as simple as distraction, tiredness, low test scores, boring discussions and frustration. He added to these, the complexities of cultural diversities and prior experiences, which combined, tend to make the teaching of adults an enormous challenge.

In her discussion on future learning theories and perspectives, Baumgartner (2003) wrote that even though Knowles' andragogical model is not an all-encompassing theory of adult learning, it still sparks debate. She agreed with Merriam (2001) that a single adult learning theory will never be sufficient in itself, as adult learners' needs are too complex. In Baumgartner's opinion, the adult learning principles of andragogy have at least one significant weakness in that they are based on white male middle class majorities which invariably disadvantages minority groups. Even so, Baumgartner predicted that far from being dead, Knowlesian andragogy is one of the important tesserae of adult learning and may

be developing into a more complex model through a combination of current adult learning theories.

Heimstra, Sisco et al., (1990) reviewed the Knowlesian andragogical model reasonably positively. The authors considered that not only had Knowles brought considerable attention to the phenomenon of adult education as a separate science, but applied correctly, the andragogical approach to the teaching and learning of adults can have a positive impact on the adult learner.

Knowles (1968) originally argued that the differences between the two models were quite clear. Pedagogy was for beginning (youthful) learners and andragogy was for adult learners. The models were antithetical, one bad and one good, depending on the stance of the observer in the age-related domain. Since the 1960's when Knowles began his work, there have been changes of perspective and now the differences are not quite so clear. The andragogical model has been applied with some successes in primary and secondary schools as well as in adult learning. Both andragogy and pedagogy are beginning to be accepted as being on the same continuum—pedagogy *to* andragogy—because sometimes elements of one model work in the domain of the other:

Children and youths seemed to learn better in many circumstances when some features of the andragogical model were applied ... Also, a number of ... teachers of adults described situations in which they found that the andragogical model did not work. (M. S. Knowles et al., 2005, p. 69)

The 2005 findings indicate that differences between the two models are becoming blurred. This progress is most likely because of the on-going lively research and discussion and may also have come through the process described by Baumgartner, Lee et al., (2003) in which the andragogical model itself is being affected by new learning theories. Whatever the case, it appears that not only are some elements of the andragogical model enduring and

developing, the model itself may well survive through hybridisation from continued research in areas such as transformative learning and self-directed learning.

**Self-directed learning.** Perhaps the most comprehensive and most debated of the andragogical elements is that of self-directed learning. Knowles (1975) defined self-directed learning as:

... a process in which individuals take the initiative, with or without the help of others in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies and evaluation learning outcomes (Knowles, 1975, p. 18).

However, Leach (2000) warned that although we all probably assume we know what self-directed learning is, there is no single accepted definition; rather there is a confusion of meanings used in various ways by different people.

Knowles (1980b) wrote that the pedagogical model included teacher directed activities; the teacher told the student what to learn. Andragogy, on the other hand allowed for 'self-directivity' through which adults can take responsibility for their own learning. He went on to say that adults are motivated by learning things they see they need to learn. He reasoned that learners who take initiative in educational activities seem to learn more and learn things better than their passive counterparts. He included yet another reason which is the individual and collective survival of learners who do not know how to learn without being taught. Those learners are put at risk when they find themselves confronting constant and rapid change without the security of a teacher determining what it is they should be learning.

When they addressed self-direction and motivational issues, Knowles, Holton et al., (2005) reinforced one contrast with the pedagogical model which was that adults have a need to know—prior to that learning—what it is they are learning. The authors explained that the need to know has three broad aspects; *how* the learning will be conducted, *what* is to be

learned and *why* the learning is necessary (Table 1). The authors added that the need to know affects the motivation to learn, the shape of the learning outcomes and finally putting the learning into practice—praxis. They noted an interesting development which was that most researchers no longer accepted the duality of self-teaching and personal autonomy in every learning situation. Where this takes us is uncertain, but what is certain is that those findings will not be allowed to rest without further testing and clarification.

Table 1

*Comparisons Between Pedagogy and Andragogy (Knowles et al., 2005, pp. 61-68)*

	<b>Pedagogy</b>	<b>Andragogy</b>
<b>The need to know</b>	Teacher directed and not generally related to passing credits or having application to their lives	<i>"Adults need to know why the need to learn something before undertaking to learn it."</i> Sometimes part of the learning may not be relevant to the learner's needs.
<b>The Learners' self-concept</b>	<i>"... learner's self-concept eventually becomes a dependent personality" on the teacher</i>	<i>"Adults have a self concept of being responsible for their own decisions [and] ... need to be seen by others and treated by others as being capable of self-direction. They resent and resist situations in which they feel others are imposing their wills on them."</i>
<b>The role of learners' experiences</b>	<i>"The learner's experience is of little worth as a resource for learning: the experience that counts is that of the teacher [and] the textbook writer"</i>	<i>"Adult come into an educational activity with both a greater volume and a different quality of experience than that of youths. ... Any group of adults will be more heterogeneous in terms of background, learning style, motivation, needs, interests, and goals than is true of a group of youths... To children experience is something that happens to them; to adults experience is who they are ... rejecting [their experience is] rejecting themselves as persons."</i> This could also be a barrier in that learners may feel threatened if their experience is different from the learning programme. This may reinforce the need to adhere to previous experience rather than expand it.
<b>Readiness to learn</b>	<i>"Learners become ready to learn what the teacher tells them they must learn if they want to pass and get promoted."</i>	<i>"Adults become ready to learn those things they need to know and be able to do in order to cope effectively with the real-life situations."</i> Learners often accept new programmes when they see relevance to their lifestyles.
<b>Orientation to learning</b>	Subject centred approach to learning. <i>"... learning experiences are organized according to the logic of the subject matter".</i>	<i>"In contrast to children's and youths' subject-centered orientation to learning ... adults are life-centered (or task-centered or problem centered in their orientation to learning. Furthermore, they learn new knowledge,, understandings, skills, values, and attitudes most effectively when they are present in the context of application to real-life situations."</i> There is a need here to make the learning highly relevant to the learner's life.
<b>Motivation</b>	Learners are motivated by external elements such as grades, peer and parental pressures.	<i>"... the most potent motivators are internal pressures (the desire for increased job satisfaction, self-esteem, quality of life, and the like."</i>

Grow's (1996) Staged Self-Directed Learning model (SSDL) detailed four important stages of adult learning and corresponding teaching styles which assumed that learners moved progressively through stages of increasing self-directedness with teaching styles helping or hindering their progress. His model started with learner dependency and authoritative teaching; then moved to interested learner and motivating teaching; then to involved learner and facilitating teaching; and concluded with self-directed learner and consultant teaching.

Grow (1996) argued that his SSDL model infused andragogical assumptions at all levels of education and all methods of teaching when they are integral to the development of self-direction. He also claimed that his SSDL approach was independent of subject matter and that teaching style should be governed not by subject matter but by the balance between teacher directedness and student control. In Grow's view, the specific teaching styles in his model are generally appropriate for each stage although this does not preclude a range of teaching styles in any of the stages when the outcomes are those which are desired. However, the degree of control should be set by the student's level of ability to work in a self-directed, self-motivated way.

Ross-Gordon (2003) also noted that the self-directed assumption is one of the most challenged in the andragogical model and it has become a distinct body of theory and research in its own right. She advised faculty in tertiary education to make adjustments in levels of support to cater for diversity both within and among adult learners.

Lawler (2003) shared the concern of adult learner diversity. She argued that adults are diverse in, for example, life experiences, education, personalities, learning styles and

learning strategies. Not only are these diversities found *across* adult learners but as individual learning matured, diversities appear *within* the individuals themselves.

According to adult education researchers Leach, Neutze and Zepke (2001) there should be changes in the way adult learning is assessed. The authors explained the parts of a typical (and traditional) assessment as being "...teachers defining tasks and instructing learners in the performance of the tasks; learners replicating the prescribed tasks; teachers judging the learners/work, marking and grading and conferring credentials. The teacher is central to the decision making..." (p. 294). The authors argued that what the teachers think is the knowledge to be assessed may be quite different from that which the learners present to them for assessment. They also pointed out that there is "...always some doubt about teachers' understanding of learners' work or subject matter ... teachers will always view learners' work through changing filters of, for example, values, beliefs, personal attraction or aversion, health or mood" (p. 296). The authors further argue that because adult learners bring a variety of knowledge to the learning situation, the learners should be able to make some decisions with regard to their learning and in particular "...exercise some control over how their learning is assessed" (p. 304).

In her paper addressing the future of self-directed learning, Merriam (2001) described self-directed learning and andragogy as two pillars of adult learning theory. She suggested that although self-directed learning "...remains a viable arena for theory building related to adult learning" (p. 11), it appears to be at a juncture with regard to which direction research should take to explore and enhance our understandings of adult learning. The future of self-directed learning research was also raised in a report from an analysis of 122 articles published on self-directed learning between 1980 and 1998. The analysis was carried out by Brockett, Stockdale, Fogerson, Cox, Canipe, Chuprina, Donaghy and Chadwell (2000) who

recorded a decline in the numbers of articles on self-directed learning since the mid-1980's. Brocket, Stockdale et al., (2000) suggested that rather than move away from decades of research on self-directed learning, "...the real challenge... is how to take the study of self-direction to a new level" (p. 543). Merriam (2001) agreed and commented that both andragogy and self-directed learning are now so much part of adult learning that "...relegating them to the status of historical artefact is inconceivable ... a more likely scenario is that both these "pillars" of adult learning theory will continue to engender debate, discussion and research" (p. 11).

Mentkowski (2000) described self-directed learning as a form of independent learning in which students understand implicitly their role in constructing their own experience. She also argued that self-directed learning is linked to an ability to value multiple perspectives on a topic as well as helping students broaden their learning goals. She advised that although teachers can prepare students to develop a broader purpose, help must be limited to assisting them to become "active agents in their personal meaning making" (Mentkowski, 2000, p. 204). She added that self-directed learning is an important step towards independence and can also nourish the transformative learning process.

**Transformative learning.** In Baumgartner's (2003) opinion, the development of transformative learning is a prominent example of the developing adult learning theories influencing one another. The andragogical model and in particular, the assumption of self-direction led to the transformative learning theory of adult learning which was developed and proposed by Mezirow et al., (1990). The theory of transformative learning presents another large and distinct body of research which makes a concise definition difficult. Mezirow offers a short explanation:

Meaning schemes and perspectives that are not viable are transformed through reflection. Uncritically assimilated meaning perspectives, which determine what, how and why we learn, may be transformed through critical reflection ... Transformative learning involves a particular function of reflection: reassessing the presuppositions on which our beliefs are based and acting on insights derived from

the transformed meaning perspective that results from such reassessments. (Mezirow et al., 1990, p. 18).

Mezirow et al., (1990) addressed ways in which teachers can encourage learning. He defined 'learning' as the use of experiences to create new or revised interpretations of those experiences. He argued that once the interpretations are established, they will guide subsequent actions, appreciations and reactions. Mezirow et al., (1990) proposed that rationality in thought and action are the desired outcomes of adult learning which does not end in the classroom—praxis is also needed. He also proposed that the frame of reference developed through experience is a powerful influence on what we see and do and what we do not see and do not do. In his view, it is not possible to understand adult learning in the absence of the habits and experience which influence the way in which meaning is constructed.

Transformative learning is not one-sided. Mentkowski (2000) argued that although it was important for learners to reflect on the quality of their decision making, educators must take an active role in promoting and supporting their students in critical self-reflective practices. She noted that individual differences in how students approach learning and assessment play an important part in drawing out the learning potential from individual experiences. In Mentkowski's view, teachers of adults should encourage their students to take responsibility for their learning by acting as a guide-on-the side rather than by didactic instruction. In this she appeared to be in agreement with McKenzie (2003) who proposed similar views discussed earlier. Her argument for independence in learning was similar to that proposed by Knowles (1975) who maintained that independence in learning promoted sustainability in the face of changing conditions and settings. The student should be able to learn without being constantly taught how to learn. Even though learning is constructed individually, Mentkowski (2000) advised that there should also be an element of

collaboration which she explained is different from just interaction or cooperation; it also included learners' understanding the perspectives of others and sharing with them the responsibility for the study outcomes.

In the opinion of Baumgartner, Lee et al., (2003), transformative learning will continue as an influence in adult learning in the foreseeable future. She recorded more than thirty dissertations on transformative learning during the previous year and noted that research continues to be high. Merriam (2001) also agreed that the transformative learning theory should continue to generate fresh ideas and critical reflection. Merriam pointed out that transformative learning has expanded understanding of how adults learn by explicating the meaning-making process of *how* we know things rather than *what* it is that we know.

Merriam (2001b) defended andragogy, self-directed learning and transformative learning from being labelled as 'old'. She regarded each as distinct in that they have all developed interest by educators in separating adult learning from that of children. She maintained that all three are now part of the adult education literature base. Although transformative learning—the latest in the trio—seemed to have eclipsed the other two, Merriam (200b) was confident that all three are alive and well and generating yet more theorising and discussion.

### **Summary: Adult Learning Theories**

The preceding discussion is biased towards the separatists' views that there *should* be a distinct domain for adult learning but we are a long way from general agreement on separateness. We are also a long way from a widely accepted understanding of what adult learning is and there is still a lack of clarity of key terms such as 'learning' and 'self-directed learning'. Additionally, the different stages of learning—childhood, adolescent and adult—

are no longer as clear cut and separate as previously believed and adult learning has yet to find its special place in relation to the other two on the learning continuum (Brookfield, 1995; M. S. Knowles et al., 2005). There are concerns over the universality of the andragogical assumptions (Pratt, 1993, Rachal, 2002 and Baumgartner, 2003). There are also real problems with how adult learning should be modelled. So far, no one model is universally effective because of the complexities of adult learning and those complexities are increasing with the rate of research. Merriam (2001) calls for more tenable and inclusive theories which will allow a single phenomenon to be studied from the different viewpoints.

In the face of those difficulties, adults *are* returning to learning in increasing numbers and their special needs *should* be accommodated by educators (Kasworm, Polson, & Fishback, 2002; Kelly, 2005; Giancola, Munz, & Trares, 2008). In Merriam's (2001) view we need to remember that adult learning is *holistic*, the *learning process* is complex and transformative and the *context* in which learning takes place is dynamically changing with each learner's needs. Separatism may well be the accommodation needed for effective learning by adults.

### **ICT Integration into the Curriculum**

Integration is a term which is loosely used throughout the literature relating to the use of ICT in education. Milton (2005) discussed ICT integration and recognised difficulties in establishing when this takes place. She defined 'integrating' as "...combining parts so they work together [to] make a whole..." (p. 2). Milton listed the 'parts' to be combined as including the school context; the available technologies; technical skills of teachers; pedagogical skills of teachers; technical support for installation/maintenance of the technologies; and the skills and motivations of the students. The author concluded that integrating ICT in schools is a complex proposition. But what actually *is* 'integration'? Can

it be measured? Is it a process or an output, or both? Unfortunately, the currently available literature lacks a clear set of guidelines. Also the literature does not provide clear guidelines as to the relationship technology ‘uptake’ in education has on the integration of that technology in teachers’ pedagogies. However, in their survey of lecturers and students in three teacher training institutes in Northern Ireland, Murphy and Greenwood (1998) appeared to agree with Smerdon et al., (2000) and Pelgrum (2001) in that ‘uptake’ is “...dependent on access to the required technology” (p. 414). The authors argued that acceptance and use of computers (uptake) precedes strategies for integration into the various curricula.

Just because technology is present, integration is not guaranteed to follow. In his article on the integration of instructional technology into public education, Earle (2002) wrote “Integrating technology is not about technology—it is primarily about content and effective instructional practices” (p. 7). He maintained that technology is like reading, it is content free and integration is defined by how and why the technology is used within the instructional processes.

Earle (2002) warned that we should disregard the myopic view that the use of computers is a cure for many of the challenges facing education. In the author’s view, that use must be seen as an on-going process of innovation—a process which meets the objectives of improving student learning—with the focus of the integration on the pedagogy, not the technology. He argued that not only must the technologies be pedagogically sound, they must also go beyond merely retrieving information and promote problem solving and allow “...new instructional and learning experiences not possible without them; promote deep processing of ideas; increase student interaction with subject matter ... and free up time for quality classroom interaction”. He summarised his points simply with the plea to “improve the pedagogy” (p. 6). Earle stressed the integration of technology into pedagogies must focus

on curriculum and learning. He considered that integration should be defined “...not by the amount or type of technology used, but by how and why it is used” (p. 7).

Innovation is important. Zhao, Pugh et al., (2002) ask “...the large question of ‘why don’t teachers innovate when they are given computers?’ rather than whether computers can improve student learning” (p. 482). They studied 12 teachers from a variety of American grade schools (K-12) for over a year. The Zhao, et al., authors set out to address empirically the question of why there seems to be a lack of innovation. They were critical of in-service workshops which, they say, ignore pedagogical or curricular needs. The authors recommended the use of professional development which supported teaching practices and curricula goals as well as teaching *how* to use the technologies. They did not provide a concise definition of ‘innovation’ but instead they outlined a number of case studies as examples of what they see as degrees of innovation.

Zhao, Pugh et al., (2002) appear to agree with Cuban (2001) that in spite of the unprecedented rise in the availability of computers in American schools, technology use remains low. The Zhao, et al., authors addressed the interaction of technology and school realities in an attempt to identify the reasons for the low uptake. However, they reported that there is a dearth of research into the complexities of how teachers *actually* incorporate technology in their teaching.

One of the conclusions made by Granger, Morbey et al. (2002) was that a number of conditions have to be in place before there is any prospect of integration. Those conditions include computers that work, the provision of full time technical support and teacher ICT professional development—preferably using the just-in-time and the just-for-me delivery approaches discussed earlier.

Earle (2002) argued that technology is content-free and the real question must lie on the “completeness or wholeness” (p. 15) of the use of technology in teaching practices and learning experiences. He considered that we should overcome artificial separations and regard technology as *one* of the elements in the learning process, not the sole element. He added that we must “weave technology into the fabric of learning” (p. 20) and the curriculum must be the vehicle for technology. Even accepting Earle’s suggestions, teachers still need criteria to measure if they are to be sure successful integration has (or has not) taken place.

In his review of educational reform, Fullan and Mascal (2000) observed that technologies are appearing at every level in education and teachers have less freedom to choose whether or not to use them. Eventually teachers must become experts in pedagogical designs which factor in the use of technologies. The authors explained that technology “...generates a glut of information but has no particular pedagogical wisdom—especially regarding new breakthroughs in cognitive science about how learners must construct their own meaning for deep understanding to occur” (p. 582). They warned that as technology becomes more powerful, good teachers become more indispensable.

Like Earle (2002), Milton (2005) considered technology to be a tool to shift the focus from teaching to learning and “to ask what it can do, is tantamount to asking what a pencil can do” (p. 2). She explained that in the absence of explicit objectives and desired outcomes, it is difficult to define what successful ICT integration looks like. However, before Milton’s objectives and outcomes can be implemented, there is the matter of the relationship between teachers’ ICT skills and its implementation.

Zhao, Pugh et al., (2002) referred to classroom technology integration as a “complex and messy process” (p. 482). The research of this process has been predominantly survey studies which tend to neglect the process “through which teachers’ struggle to negotiate a foreign and potentially disruptive innovation in their familiar environment” (p. 483). The authors proposed a three element model for the successful classroom technology user. The first element is that the most successful teachers using ICT are first very good teachers with superb understanding of their subject and who have progressive pedagogical practices and beliefs. Their use of technology is for the teaching of the subject rather than using it as a motivational tool. In this, the authors parallel the observations of Brown (1998) who considered it was important to be a good teacher first and a competent ICT practitioner second. They also appeared to be in agreement with Becker and Ravitz (2001) who considered a successful classroom technology user is likely to be a constructivist teacher with reasonable computer skills.

The other two elements from Zhao, Pugh et al., (2002) were a good understanding of the technology being used and good political skills to ensure they had the appropriate resources and support. In contrast to Earle (2002) and Milton (2005), Zhao, Pugh et al., (2002) rejected the premise that technology is functionally neutral. The authors considered that certain technologies are better at certain tasks than others and this leads to a need for a teacher’s choice of technology to be compatible with that teacher’s pedagogy.

The need for appropriate resources and support in the Zhao, Pugh et al., (2002) three element model is reinforced by Tondeur, Cooper and Milton (2010). The Tondeur authors reported on their four year longitudinal case study which examined the role of curriculum coordination in the integration of ICT in seven Australian primary schools. They concluded the roles of coordinator and school leaders were critical in “...the complex process of ICT

integration in schools” (p. 296). The argued that success was more likely if the process of integration was “...driven by the specific teaching needs of the teachers [who had] one-to-one support, role modelling, scaffolding, peer collaboration and peer support” (p. 305). The reference to specific teaching needs reflects the views of a number of researchers such as Cuban (2001), Ward (2003), Baumgartner et al., (2003), and Knowles et al., (2005) who maintained that before teachers willingly use ICT in their pedagogies, they first needed to accept the relevance of doing so.

Tondeur, Cooper et al., (2010) and Lloyd and Masters (2006) argued that integration is a process rather than an endpoint. They maintained that it occurs when the use of ICT becomes critical in supporting the learning environment through becoming part of the background of classroom learning. The Lloyd and Masters (2006) study was a small-scale pilot involving one school in Queensland, Australia in which they discussed the problems of defining the complex phenomenon of ICT integration. In their view that ICT integration was complex, they appear to be in accord with Earle (2002), Ham, Gilmore et al., (2002) and the New Zealand Education Review Office (2005).

Even teachers skilled in the use of technology may not use ICT much of the time. Bauer and Kenton (2005) conducted a study of the teaching practices of 30 teachers skilled in the use of computers in four American schools (elementary, middle and high schools) to establish how the obstacles to integration were overcome. The researchers set the integration benchmark occurring when the lesson delivery relied on technology for success and when the computers failed, the lesson also failed. However, they found that as “...skilled and enthusiastic as they were, the teachers in this study were only occasional practitioners of [ICT]” (p. 11). Bauer and Kenton noted that 80% of the teachers reported using computers less than 50% of the time “... clearly suggesting that real integration had not taken place” (p.

12). However, Bauer and Kenton's benchmark of technology failure causing lesson failure may be considered somewhat artificial in the light of the diverse environments which make up classrooms. An important component of learning success is the quality of teaching (with or without ICT) as discussed by Brown (1998) and Becker and Ravitz (2001).

There is a continuing need for teachers to develop ways of "...appropriately 'integrating' ICT use into their existing teaching and learning programmes" (Ham et al., 2002, p. 98). The authors' review of the New Zealand Ministry of Education's 23 ICTPD Schools Cluster programme (1999-2001) also recorded that most teachers could not achieve the complex tasks of fully integrating ICT into their teaching programmes, or to use ICT to "...significantly improve over time the educative quality of their students... or the use of ICT as a medium for learning" (p. 99). The authors did not comment on links between, or evidence of, the use of ICT and pupil learning.

In a later report to the New Zealand Ministry of Education on trends in the ICT PD School Cluster programme (Ministry of Education, 2005a), the authors noted that a majority of teachers in the survey—both primary and secondary—reported changes in their classroom practices as a result of the programme. However, the secondary teachers' figures indicate that only 16% of practices changed "to a large extent" whereas 84% reported changes "to some extent, very little, or not at all" (p. 25). The most common change identified was the 'integration' of ICT into units of work but it is not clear as to what is meant by 'integration'. Neither is it clear if the secondary teachers' data builds on, or is separate from those data in the Ham, Gilmore et al., (2002) evaluation. A further New Zealand Ministry of Education report noted:

"...the lack of technology integration into the curriculum is rather evident in New Zealand schools. According to the OECD approximately one third of all 15 year

olds in New Zealand rarely or never use a computer when at school” (Ministry of Education, 2007b, p. 8).

The authors of the report provided what they considered a ‘roadmap’ to improve the integration of ICT with teaching and learning to improve student learning outcomes. Apart from strongly recommending teachers receive appropriate professional development to facilitate the integration, the report is silent on just how the integration should take place. However, the authors suggested that to be effective, the integration of ICT with teaching and learning “...is best achieved at the level of the individual school” (p. 16). This, they argued, was because the integration process required not only a good knowledge of the needs of the school and those students in that school, but also required sound content knowledge and an understanding of good teaching practice. An unstated implication from requirements was that the ‘integrator’ should be a teacher rather than an ‘expert’ from outside the school.

Later in the report, the authors recommended three types of on-going ICT professional development; the first was to cover teachers’ basic skills through in-house or just-in-time assistance; the second type was to help with the identification and development of opportunities using ICT to shift pedagogies towards integration with teaching and learning; and the third type of ICT professional development was to provide for “...a designated ICT leadership role ... provided as a staffing entitlement” (p. 24).

Lai et al., (2001a) also reported a lack of ICT integration in the results of their study of 27 Otago Secondary schools. The lack of integration in New Zealand schools was also noted by Ward (2003) and by the New Zealand Education Review Office (ERO, 2001). Becker and Ravitz (2001) and Cuban (2001) are among a number of researchers who confirm this trend in other countries.

The New Zealand Education Review Office Report (2005) defined ‘integration’ as the “institutionalised use of a wide variety of ICT’s in contexts that optimise student learning” (p. 4). This indicated that ICT became ‘institutionalised’, when it is there “...as a matter of course—embedded into the daily life of the school and classroom, rather than an add-on” (p. 4).

Ham, Gilmore et al., (2002) agreed that the literature does not offer a clear definition of ‘integration’ or how to evaluate it. They offer parameters of their own which they suggested may help in definition. Their five parameters of integration are *curricula* (relating directly to curricular goals); *temporal* (relating to other concurrent activities in the classroom); *spatial* (the extent to which ICT is separated in place or location from other activities); *pedagogical* (relating to the consistency of the use of ICT with the pedagogical philosophies of the teachers and the learning styles of the students); and *attitudinal* (the transparency or invisibility factors of ICT).

Lloyd and Masters (2006) adopted four of the dimensions of ICT integration identified by Ham, Gilmore et al., (2002). They accepted the classifications of curricula, temporal, spatial and pedagogical integration. Lloyd and Masters considered the fifth dimension—attitudinal integration—identified by Ham, Gilmore et al., is best measured as *capacity* which they defined as including the attitudes, knowledge and skills, needed to effectively use ICT as a learning tool.

One of the conclusions from the 23 School Project recorded by Ham, Gilmore et al., (2002) his colleagues was that although the majority of teachers had managed to incorporate some use of ICT in their teaching, “...relatively few had managed to achieve full

'integration', in the sense of the transparent and almost subconscious absorption of a variety of technologies into the accepted and unproblematic routine of daily classroom life" (p. 129).

### **Summary: ICT Integration into the Curriculum**

The literature identified 'integration' as being without consensus with regard to definition. It could be argued that the lack of definition provides greater scope for teachers to weave the technology into the fabric of learning as Earle (2002) suggested, with the choice of 'fabric' being determined by the teacher. However, the mechanisms and philosophies of 'integration' follow, not precede, the need for teachers to master the use of technology and this requires 'appropriate' professional development tailored to suit individual adult learners. Such programmes could be delivered through mentoring.

### **Mentoring**

In Greek mythology, Mentor was Odysseus's trusted counsellor who also guided and taught Telemachus. The modern day term 'mentor' has come to describe a wise and trusted counsellor or teacher. Mentoring is usually understood to involve a more senior or experienced person (the mentor) helping one who is younger or less experienced (the mentee). According to Jamissen and Phelps (2006), mentoring in the teaching profession has played an important part in the development of beginning teachers or teachers in pursuit of career advancement. The authors noted that ICT mentoring was less common in secondary schools than in higher education. They also noted that the traditional age related mentoring roles were likely to be reversed in ICT with younger or junior technology knowledgeable persons becoming ICT mentors for senior professionals.

In her report on her three year study of ICT professional development, Mensing-Triplett's (2001) found that more than 90% of her teacher respondents reported an

improvement in their use of computer technology in their classrooms though just-in-time mentoring support from other teachers. Writers such as Zehr (1997), Ang (1998), Wilson and Berne (1999), Guskey (2000), Holland (2001), Gore (2002), Scrimshaw (2004), PPTA (2004), and Chuang and Thompson (2005), were critical of the 'one-shot' or 'one-size-fits-all' workshops used as professional development models as this type of model often failed to meet the specific needs of teachers. They argued that successful models were based on mentoring programmes which provided not only one-on-one support but also timely and relevant assistance for ICT issues.

Jamissen and Phelps (2006) reported on a number of mentor-oriented professional development case studies involving ICT in Norway and in Australia. The Norwegian studies involved 1400 teachers in 30 schools and were supported by 15 externally based mentors. The Australian studies involved 12 secondary schools, 34 primary schools and one University. There were some 200 teachers involved in the Australian schools. Participants in the Australian study were encouraged to identify individually "...appropriate mentors who might be school colleagues, family or friends" (p. 297). However, mentoring in the Norwegian study was more formally arranged with mentors external to the study participants "...selected by central project leader and introduced to the schools as 'critical friends'" (p. 299). The Australian participants were encouraged to record the strategies used by mentors to support their learning, "...their own help seeking and problem solving behaviour, and the changing dynamic between participants and their mentor as they gained greater independence and learning confidence" (p. 297). The authors' aim was to compare the successes, similarities and differences between the two sets of ICT professional development projects through the lenses of metacognitive reflection and mentoring.

Jamissen and Phelps (2006) appeared to have built on earlier work by Phelps, Graham et al., (2004)—reported earlier—with regard to metacognitive reflection and have coupled this activity with appropriate mentoring. Jamissen and Phelps (2006) reported that their analysis of the Norwegian and Australian projects provided valuable comparisons which were “...beneficial in informing further developments in both countries” (p. 309).

Chuang and Thompson (2005) reviewed the literature relating to technology mentoring models used in higher education and in K-12 schools. The authors reported that their study identified common but critical elements in a variety of successful technology mentoring models. These elements included:

...visions for the use of technology in teaching and learning, individualizing technology support (personal fit), breaking down hierarchical structure, establishing open dialogue and collaborative relationships, providing mutual benefits for mentors and mentees, and establishing learning communities (Chuang & Thompson 2005, p. 4).

Chuang and her colleagues argued that each person has a unique learning cycle and mentors in ICT “...must start where the learner is” (p. 4). They pointed out that their findings showed that one-to-one mentoring offered not only individualised technology support but also provided the mentees time to work at their own pace. Their conclusions indicated some successes using mentor support for faculty in higher education and for some K-12 teachers. The mentored support scaffolded the use and integration of technology through one-to-one mentoring programmes. The authors also identified the GenY (2007) programme in which secondary students worked as ICT mentors for their teachers. According to Chuang and Thompson (2005), the GenY (2007) project which was established in 1996, was probably one of the most extensive student mentoring programmes in the United States of America. It was a comparatively new form of mentoring in schools and was notable for its success in supporting teachers “...as they integrate technology into the curriculum-

based projects and lesson plans” (p. 3). It was also an example of what has become known as ‘reverse-mentoring’; a programme in which students mentor their teachers.

**Reverse-mentoring.** Reverse-mentoring—often defined as a younger person teaching or guiding a more senior person—is not well reported in the literature with regard to students mentoring teachers. Cotunga and Vickery (1998) developed a mentoring project which reversed the traditional roles of students and their teachers. They used 28 technology capable students to teach dietetic professionals on a one-to-one basis, how to use computers and the Internet. The authors concluded that the “...unique reverse-mentoring roles ... worked well in this technology-based relationship” (p. 1168). They also noted that the pace of technology change makes students a valuable resource as potential mentors “...for those who want to keep abreast of these new information resources” (p. 1168). In an informal follow-up of the dietetics professionals who dropped out of the project, Cotunga and Vickery (1998) found some of the primary reasons not to continue related to distant locale, a lack of time, or a lack of resources. The authors noted that neither “...age differences or lack of comfort with the unusual mentoring relationship surfaced as a cause” (p. 1168) for the failure to continue in the programme.

De Miranda and Lipton (1998) considered reverse-mentoring in an academic faculty to be a value-added interactive process which provides for a mix of the skills of students with the wisdom of older staff; both assuming “...roles of the quiet advocate for each other” (p. 6). Leh (2005) argued that reverse-mentoring has benefits in technology training and constructivist learning environments as it helps promote student initiatives in constructing their own learning. Leh also pointed out that constructivist learning through reverse-mentoring “...fits in well with characteristics of digital technology” (p. 30).

If teachers have unrestricted access to an ICT specialist to help them use technologies in the classroom, they may use those technologies more (Becker & Ravitz, 2001). However, such a facility is unlikely in most schools because of the cost and availability of those specialists. The use of students to help their teachers with ICT issues in the form of reverse-mentoring may provide an alternative method of support which accommodates the traits in the andragogical adult model. Although the literature provides few reported cases of reverse-mentoring in schools where teachers are mentored by their students, there are two well documented student helpdesk programmes operating in the United States of America. The *MOUSE* (2007) (Making Opportunities for Upgrading Schools and Education) project was created in 1997 and now runs in about thirty New York schools (MOUSE, 2007). It was a student operated ICT help desk aimed at providing technical support for school management, teachers and students. In a review of the *MOUSE* project, Charp (2002) noted that the student helpdesk operated as a commercial operation through a central location in each school.

The second programme in the United States of America is known variously as the Generation Y programme, GenY, or GenYES programme (GenY, 2007). It was funded by a U.S. Department of Education Technology Innovation Challenge Grant and has been running for over 13 years, involving more than 1,100 schools. It is a structured programme, similar in nature to the *MOUSE* programme. Students with technology expertise worked with teachers to bring effective technology to the classrooms. This collaboration was reported to benefit both parties as the students were given study-based learning and the teachers received sustainable professional development.

In a further study which collected data from secondary and elementary schools in Washington State, Washington D.C. and Maryland, Chuang and Thompson (2005) reported

that both teachers and students benefited from the GenYES reverse-mentored programme. The authors found that that as a result of the programme, both students and their partner teachers benefited. The teachers benefited "...from continual on-going assistance from student mentors. The students also benefited by developing their technical, collaborative, and leadership skills" (p. 71) while working as mentors with their teachers. According to Chuang and Thompson (2005), the GenYES programme required the secondary students to undertake an 18 week course (elementary students required a 30 week course) before working with a nominated teacher. They concluded that the GenYES model trained "...students to provide a continual on-site content-related technology support to teachers" (p. 70).

The literature provides data on only one New Zealand school (Wellington Girls' College) which operated an ICT reverse-mentored professional development programme entitled Tech Angels (Bolstad & Gilbert, 2006). Another school (Hukarere Girls' College) started an ICT reverse-mentored programme in 2003 entitled the *Kaiawhina* (helper) programme and this was the subject of an unpublished peer reviewed M.Ed. (Otago) dissertation (Peterson, 2004). Both the New Zealand programmes provided help for teachers in the classroom as distinct from providing help through a central help desk as in the *MOUSE* and *GenYes* projects. The *Kaiawhina* students provided everyday support for the teachers when they were using ICT in the classroom or for management purposes. Some days, the students were called on as much as five or six times and other days there was little or no demand for their help. Typically a busy day would involve providing help with classroom programmes when the class was in session. For example, the students were often asked for simple procedural help in running an application. Typically the questions were "Can you help me to put this diagram over here?" or "How can I make this chart a different colour?" Often the teacher creating learning programmes needed only a little specific help. In a teacher learning situation, it was like the learn-as-you-go as described by (Zehr, 1997).

Unlike students in the *GenYES*, *MOUSE* and Tech Angels programmes, the *Kaiawhina* students accepted queries from any teacher needing help and their pre-programme training centred on dealing with adults when using reverse-mentoring. All students in the programme had technical backup from the school's ICT teacher.

### **Summary: Reverse-mentoring**

Although research into reverse-mentoring is not well developed in the literature, the participants in the few examples which are available considered this to be a useful vehicle for professional development in the ever changing world of ICT. Professional development for teachers delivered through reverse-mentoring may provide insights into, and solutions for, a number of barriers to teachers' uptake of ICT in the classroom. Although ICT reverse-mentoring is the focus of the current research, it is likely that further research will be needed to study more fully the effects of this type of programme.

### **Unresolved Issues Identified in the Literature**

There is little accord among researchers on what 'integration' is or how it can be measured. Even with Milton's (2005) suggested explicit objectives and desired outcomes and the suggested classifications from Lloyd and Masters (2006) and Ham, Gilmore et al., (2002), it is difficult to decide when successful integration takes place. The New Zealand Ministry of Education (2005b) report also identified the lack of a consistent definition for 'integration'. Without a defined end-point, dealing with barriers which hinder integration is confusing. Solutions to barriers which appear to work in one circumstance may be unreliable in another. Cuban (2001) and Zhao, Pugh et al., (2002) noted the lack of research into the complexities of how teachers *actually* incorporate technology in their teaching. Zhao, Pugh et al., (2002) also agreed there was an important gap in the literature as to *how* integration can or should take place.

Guskey (2000) has called for more research to enable an understanding of that which creates highly productive learning environments. Guskey (2000) is also concerned with the lack of research into the varying quality of professional development. He explained that a “...lot of good things are done in the name of professional development. But so are a lot of rotten things...” (p. 51) and he considered educators have failed to provide evidence of the difference between the two.

In the field of ICT the question has to be asked, professional development for what? A great deal of the literature confirms it is to eventually provide curriculum ‘integration’ of ICT to enhance teaching and ‘learning’, which takes us back to a need for agreement on what terms such as these mean. Wilson and Berne (1999) pointed out that the literature is not clear on how to measure ‘effective’ professional development for teachers. They also considered that there is a lack of research into how teachers learn in formal or informal circumstances. Leach (2000) warned that there is no single accepted definition of ‘self-directed learning’, rather there is a confusion of meanings used in various ways by different people which potentially affects how ICT professional development is delivered.

Even though a great deal of public money is spent on the New Zealand Ministry of Education’s ICT professional development clusters, the Ministry offered little if any guidance on how the professional development should be delivered (Ministry of Education, 2005a). There are no criteria to measure the delivery models for which the Ministry expected individual clusters to develop independently without direction. The lack of data from, or direction for, programme delivery creates difficulties in evaluating the effectiveness (or otherwise) of the initiatives.

The literature is weak in areas which link the use of ICT and pupil learning. For instance, because much of the research is from single sites or case studies, authors such as Higgins (2003) call for more comparative research to establish whether the use of ICT is better than more traditional pedagogical approaches which do not use ICT in their delivery. The New Zealand Education Review Office (2001) report noted that unlike other countries with more centralised school systems, the New Zealand curriculum is silent in terms of how its objectives are to be translated into programmes within schools.

Like Higgins (2003), Cox, Webb, Abbott, Blakely, Beauchamp and Rhodes (2003) noted that the specific relationships between teachers' use of ICT and pupil learning remain unclear. They reviewed the literature relating to ICT and pedagogy and recommended that any future comparative research should take into account data from classes who are *not* using ICT as this would help identify pedagogies specific to ICT. Cox, Webb et al., (2003) also suggested evaluations of teacher ICT professional development include comparative research to determine influences on pedagogical practices from "colleagues more experienced in ICT" (p. 35).

Comparative research may be desirable but it comes at a cost. Higgins (2003) warned that the slow nature of research and the rapid pace of technology innovation made comparisons between ICT enhanced learning and traditional learning difficult. He also warned that because research is rarely comparative, it is difficult to see if the use of ICT is better than other approaches or even if it is cost-effective. Additionally, it is difficult to disseminate evaluations of new technology effectively in the traditional manner of research because of the rapid pace of change. For instance, Higgins (2003) noted the delay in the research appearing in peer-reviewed publications can be two years or more, compared with Internet reports being almost instantly available.

Zhao, Pugh et al., (2002) considered it is essential for teachers to see a need to use technology "...as a means to an end, rather than an end itself..." (p. 492). A number of researchers have recorded similar opinions; for example Zehr (1997), Mumtaz (2000), Cuban (2000), Cuban et al., (2001), and Ward (2003).

Ward (2003) appeared to be in agreement with Mumtaz (2000) with her suggestion that the first step towards teachers using ICT as a teaching and learning tool, is to give them sound educational reasons for doing so. Ward (2003) added that those reasons must include desirable outcomes that are not readily achieved without ICT. A question which begs an answer is 'why use ICT?' If the claim is that teaching and learning can be improved through the use of ICT, then where is the evidence? The literature is weak in this regard and Higgins (2003) and Cox, Webb et al., (2003) call for comparative research to provide that evidence of links between the use of ICT and learning but as discussed earlier, logistically this research may be hard to deliver.

### **Resolving Barriers**

Reverse-mentoring as the form of professional development intended as a solution in this discussion is not quite the *intentional; on-going; and systemic* professional development programmes which Guskey (2000) described earlier. The content of the just-in-time assistance intended for teachers cannot be planned in advance and may appear to be a series of random, unplanned events, but the assistance is related, on-going, and purposeful and can be evaluated against the teachers' needs *at the time* of the request. Moreover, the assistance is systemic in that it can involve assistance across a range of levels of classroom use of ICT.

On a more positive note, reverse-mentored professional development has the potential to overcome some of the barriers, particularly those related to time, adult learning, and those associated with gender issues. Yuen and Ma (2002) and Bradley and Russell (1997) recommended professional development as a solution to impediments to ICT use such as anxieties and knowledge deficits.

At first sight, the barrier of a lack of resources appears easy to overcome—just provide more computers. However, the solution may not be that simple. A number of researchers have agreed with Cuban, Kirkpatrick et al., (2001) that the presence of computers is no guarantee they will be used. Both sufficient time and appropriate, timely professional development are also needed to overcome the barriers contributing to non-use. Access to timely and appropriate professional development ('just-in-time' and 'just-for-me') has always been limited because teachers are always short of time and there are simply not enough specialists to do the work of helping them with the use of their technologies.

Specialists may be scarce, but in every classroom there are students. There is evidence of students helping teachers with ICT problems thereby providing them with a first-level technical support in the form of reverse-mentoring. In the Hukarere reverse-mentoring model, students had no need to leave their lessons to join a traditional central help desk as described in other examples of reverse-mentoring in schools. They carried out their normal class and learning routines and provided help when asked. If teachers accept that students can provide support with ICT technical issues, they (the teachers) can be secure in their use of ICT and concentrate on providing the knowledge and pedagogical content of ICT related programmes.

The barrier of a lack of time for professional development becomes less important through the just-in-time delivery. This type of delivery has the support of Granger, Morbey et al., (2002), Ward (2003), and the New Zealand Education Review Office (ERO, 2005). The 'just-in-time' and 'just-for-me' learning provided through the immediacy of reverse-mentoring may also accommodate the self-directedness, relevancy, readiness, motivation, ownership of the learning and other traits discussed earlier in the Knowlesian adult learning model. The use of reverse-mentoring to deliver professional development in this way (Table 2) has the potential to overcome a number of the barriers discussed earlier:

Table 2

*Potential Solutions to Barriers through Reverse-Mentoring*

<b>Barrier</b>	<b>Potential Solution</b>
<b>Time</b>	Help with ICT issues can be in short frequent sessions to solve issues at the time they arise.
<b>Timeliness</b>	Assistance is <i>at the time it is needed</i> instead of through block sessions at some later time.
<b>Ownership</b>	The teacher decides the issues to be resolved and has control over the frequency and content of the help requested.
<b>Relevancy</b>	The teacher decides relevancy, unlike many one-size-fits-all professional development programmes.
<b>Flexibility</b>	The <i>reverse mentoring</i> programme can run at a time, place, and with content decided by individual teachers.
<b>Resources</b>	There is simply not enough traditional expert help available to teachers and the use of students through <i>reverse mentoring</i> provides additional support.
<b>Gender Issues</b>	This barrier is resolved because the assistance is provided at a personal level, regardless of gender.
<b>Motivation and readiness to learn</b>	The teacher decides what it is that is to be resolved. In this respect, the teacher is motivated and ready to learn.
<b>Experience</b>	The teacher's experience is key to establishing the course of the assistance which is individualised. Prior experience assists learning.
<b>Change</b>	The support structure provided by reverse-mentoring helps pedagogical change through the constant availability of assistance when it is required.

## Summary: Literature Review

The literature acknowledged that to improve teachers' use of ICT in their classrooms, a number of key issues should be addressed. The key issues are linked in such a way that each one affects the others.

The first key issue relates to *change*. The literature review strongly suggested that as agents for change, teachers should have sound professional reasons to make pedagogical changes to use ICT in their classrooms. How changes can be made was unclear in the literature. Writers such as Grant (1996), Prestridge and Watson (2003) and Ertmer (2005) considered that a skills-alone programme was insufficient for pedagogical changes needed. However, writers such as Preston et al., (2000) and Snoeyink et al., (2001) suggested that a skills programme is necessary to help teachers' pedagogical change and should be part of the overall programme.

Any professional development programme to change teachers' pedagogies should be sustainable. Writers such as Cox, Preston et al., (1999), Hruskocy (1999), Cuban (2001) and Robertson (2008) argued that fundamental change in teaching practice requires more than simply providing technical level skills in the use of ICT's. Robertson (2008) advised that to be effective, the professional development should require practitioners to engage in dialogue to review and revise their theories so that sustainable changes to their pedagogies can be made. The authors of the New Zealand Ministry of Education (2003) report supported the need for sustained and relevant assistance if teachers are to be successful in integrating ICT into the curriculum.

A second key issue which was widely discussed was that teachers have to see a *need* to use ICT pedagogically and having seen that need, they have to learn how to use the

technologies. Cuban (2001) pointed out that teachers are ‘gatekeepers’ for change in their classrooms and unless they can be persuaded on the need for pedagogical change, the *status quo* is likely to remain. The Cox et al., (1999) authors were among those who stressed that teachers had to see a need to change their pedagogical practices. The authors also noted that teachers should have a clear pathway of professional development and learning to use technologies in the classroom.

A third key issue from the literature was that important terms (such as *integration*) should be rationalised to enable *consistent definition*. A number of writers such as Bitner and Bitner (2002) argued that the integration of ICT and with pedagogies was necessary to help students achieve. Also, the New Zealand Ministry of Education (2007a) stressed that the integration of teaching and learning with ICT was critical to support learner centred pedagogies. However, the literature identified an important gap regarding how integration can or should take place. Writers such as Cuban (2001) and Zhao, Pugh, Sheldon and Byers (2002) agreed there is a dearth of research into the complexities of how teachers *actually* incorporate technology in their teaching. To be effective, teachers’ professional development must be able to be measured but this is difficult to do without agreement on what ‘integration’ actually is or how it takes place.

A fourth key issue found in the literature related to the barrier caused by the so-called *gender divide* in which female teachers were sometimes less inclined than their male colleagues to use computers unless they saw the application to be both useful and easy to use. Yuen and Ma (2002) suggested that professional development was a key factor in changing negative perceptions in order to develop positive attitudes in female teachers towards the use of ICT pedagogically. The authors also suggested that teachers of both genders needed to accept that the technologies are useful in their teaching and student learning before they

would elect to use them. Yuen and Ma (2002) warned, however, that computer experience and skills alone were not sufficient to ensure teachers will use technologies in their lessons. A reason for the lack of use may be because ICT is not seen as potentially useful—teachers lack reasons *why* ICT may be important. Researchers such as Cuban (2001), Baumgartner et al., (2003), Ward (2003) and Knowles et al., (2005) have pointed out that teachers need *reasons* to learn something before setting about learning *how* to use it.

A final key issue found in the literature relates to *how* teachers gain the skills and knowledge to use ICTs in the classroom. The literature strongly recommended teachers be treated as *adult learners* and this advice is widely discussed in the review. Teachers' professional development and learning needs are those of adult learners and these should be reflected in any professional development programmes. Writers such as Guskey (2000), Ward (2003), Scrimshaw (2004) and Knowles et al., (2005) have pointed out that professional development through decontextualized one-size-fits-all does not work for teachers. Adult learners have specific learning needs and the delivery of professional development for teachers should acknowledge those needs.

Phelps, Graham et al., (2004) were among a number of writers who argued for the delivery of any learning or professional development programme to take into account adult learning traits as teacher learning must be reciprocally related to adult learning. The authors recognised that adult learning traits such as flexibility; intuitiveness; self-directedness; independence; and the ability to adapt to change; provided teachers with a better chance of success than "...those dependent on structured routines or guidelines..." (p. 51). Researchers such as McKenzie (2001), Merriam (2001), Brash (2003), Baumgartner, Lee et al., (2003), Lawler (2003), Ross-Gordon (2003), Selwyn (2004) and Knowles et al., (2005) also

supported recognition of adult learning needs in teacher professional development and learning.

Chapter Three will explore the conceptual framework used in this study which includes the use of Activity Theory to evaluate teachers' progress in using ICT within their pedagogies. The use of a triadic Activity Theory model created from adaptations of the Engeström et al., (1999) design was used to evaluate and record influences which arise when teachers embark on the use of technologies. Activity Theory has been argued to be central to an understanding of Human-Computer- Interactions and those arguments and discussions on the perspectives provided by Activity Theory are discussed further in Chapter Three.

## Chapter Three — Conceptual Framework

### Activity Theory

Computers have already established themselves as one of the most important tools mankind has for transforming the world...Computers have embedded themselves at every level of human activity...Activity Theory is a powerful framework for understanding these activities (Waite, 2005, p. 5).

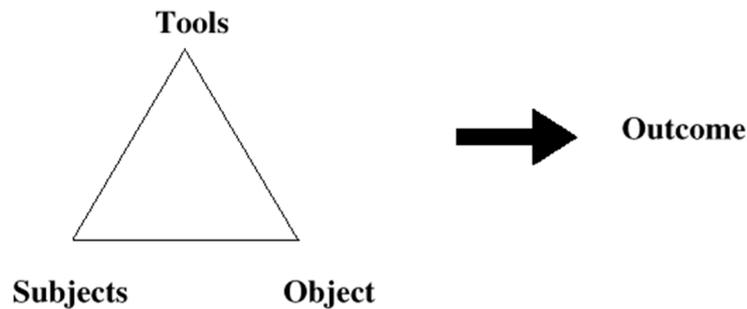
There is a growing agreement in the literature that Activity Theory is useful for the study of influences which arise when teachers embark on the use of technologies. Issroff and Scanlon (2002) record that “Activity Theory is being increasingly used to study a variety of contexts which involve technology...” (p. 77). Robertson (2008) claimed that a pedagogical activity system was a useful framework for use in the professional development of teachers’ sustainable e-learning. He argued that “...any change management towards sustainable e-learning must address the power dynamics that occur at the interface of the activity systems and that professional development for teachers must address teachers’ beliefs about what constitutes good teaching practice” (p. 825).

Lloyd and Albion (2005) revisited three case studies concerned with the adoption and integration of ICT in the classroom. They reported that they reassessed the data from interview transcripts and field notes and mapped them against an Activity Systems framework. They suggested Activity Theory was “of particular use in analysing interactions within workplaces (activity systems) where a common goal is shared but in which individuals hold differing contributory roles” (p. 3). The authors’ description of the environment and data is similar to that from the multiple case studies in this proposal. Lloyd and Cronin (2002) used semi-structured interviews and site observations in their study of computer based communications between students in a Far North Queensland school and their parents. They also analysed their data using an Activity Theory framework. However, they have not published the detail on how they managed their case study revisions using Activity Theory.

According to Issroff and Scanlon (2002), Activity Theory evolved from work by a number of Russian psychologists at the Moscow Institute of Psychology in the early 1900's. Psychologist Vygotsky (1978, 1987), was a member of a team which developed a completely new theoretical understanding of psychology which was described as a "...model of artefact-mediated and object oriented action" (Vygotsky, 1978, p.40) and which became the basis for Activity Systems models. Vygotsky and his colleagues maintained that the actions of human beings are influenced by both culture and access to tools and because of this; the relationships between people and environmental objects are therefore *mediated* by cultural, tools and signs.

Nardi (1996a) explained that in Activity Theory, the unit of analysis is an activity which is composed of subject, object, actions and operations. A *subject* is a person or a group engaged in an activity; an *object* is held by the subject and motivates activity (the object of the activity); *actions* are goal-directed processes undertaken to fulfil the object (different actions may be undertaken to achieve the same goal) and *operations* are a set of coordinated actions. Nardi (1996) added that the role of Activity Theory provided "orienting concepts and perspectives" (p. 7).

The function of mediation plays an important part within Activity Systems and any subsequent Activity Theories. Ryder (1998) explained the differences between mediated and unmediated activities with his example of an *unmediated* activity as simply picking a berry from a bush and eating it; a direct action between the subject and the object. However, such unmediated activity would be dangerous when applied to "...picking mushrooms in the forest and eating them without some form of mediation" (p. 3). He suggested the mushroom picker would benefit from mediation in the form of expert advice on how to identify safe-to-eat mushrooms.



*Figure 1.* Basic Activity Theory Framework (Issroff and Scanlon 2002, p. 78)

Ryder (1998) further explained that animals have only one world “...the world of objects and situations” whereas human beings have “...the vicarious worlds of others that they can invoke into the present through the use of language and artefacts” (p. 3).

The initial Activity Systems model (Figure 1) did not include reference to social elements and Engeström (1987) adapted the initial model to include social/community aspects of the mediation process which identified the subject who is motivated to find a solution to a problem or purpose and who is mediated by a number of tools in a community (Figure 2). The revised model’s elements now identified the subject (learner), object (task or activity) and the mediating factors of tools, community, rules, environment and division of labour. Berglund (2002) explained the graphic representation of an Activity System as a triangular model consisting of *nodes*. Each nodal label reflects “...the same activity, but emphasises or expresses different aspects of it, as different sides of the same coin” (p. 5).

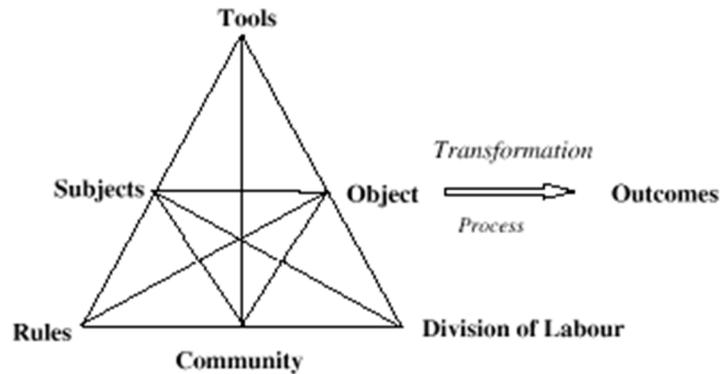


Figure 2. Engeström's (1987) Revised Activity Theory Framework (Issroff and Scanlon 2002, p. 78)

Ryder (1998) explained the benefits of mediation. He used his mushroom picking example to describe potential advantages if "...a more knowledgeable forager could serve in the capacity as foreman, dictating which mushrooms to pick and which to leave" (p. 3). He went on to suggest that the element of mediation in deciding safe mushroom collection could evolve further into a structured set of rules or the development of testing procedures to mediate the picking process.

What Activity Theory is or is not is widely debated in the literature. For example, Bannon (1990) considered the term "Activity Theory" a misnomer because although 'activity' is a central concept, there is not "...some monolithic theoretical structure that is accepting as defining the theory" (p. 262). Nardi (1996a) claimed that "Activity theory is a powerful and clarifying descriptive tool rather than a strongly predictive theory" (p. 7). Waite (2005) observed that although the theory and language of Activity Theory may seem daunting and foreign, it was a useful tool to examine issues which mediate human activities. In Kuutti's (1996) view, Activity Theory is not actually a theory as such in that it is not "a fixed body of accurately defined statements" (p. 25). He considered it to be a collection of broadly defined concepts which are open to interpretation. (Kaptelinin, Kuutti, & Bannon,

1995) also argued that although there are several interpretations of Activity Theory, in their view it is not a theory “...but rather consists of a set of basic principles which constitute a general conceptual system which can be used as a foundation for more specific theories” (p. 191). Jonassen (2006) stressed there is no best model of instruction or theory of learning. In his discussion on theories purporting to deliver the goals of functional contextualism, he argued that Activity Theory—even though it is not a theory of learning delivering methods of instruction—is “...a much richer, contextually dominated view of the world” (p. 44). Kuutti (1996) broadly defined Activity Theory as a “...philosophical and cross-disciplinary framework for studying different forms of human practices as developmental practices, both individual and social levels interlinked at the same time” (p. 23).

How Activity Theory actually works appears to be as complex or as simple as the data allow. Trulock (2008) explained an Activity System using a proposed football match with 11 people in each team, no referee and no spectators. Following the Activity System design, she has the subject as the footballers, the object as playing to win, and the artefacts/tools as the ball, goalposts and the markings on the ground. To apply Activity Theory to the situation, the rules have to be considered, as do the tactics employed and the roles of players in each team. The object of the activity is defined by the players (the subject) and the activities are local to the players and situated at an agreed time and place. Turlock concluded with the comment that ‘the object’ cannot necessarily be inferred or assumed by onlookers; the object is what the participants think it is.

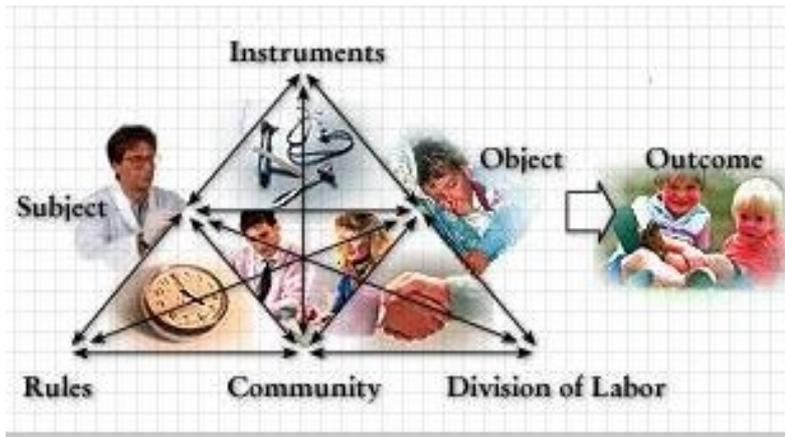


Figure 3. Activity System of Primary Care Physician (Helsinki University, 2009, p. 2).

The example of a physician's work (Figure 3) provided by Helsinki University (2009) is more complex than that of Turlock's (2008) football team. In this model the object of the physician's work is the health of his patients. The intended outcomes include recoveries and health improvement. There are also unintended outcomes such as complaints of low continuity of care and consequences of non-compliance with rules.

The instruments may include medical tests, X-rays and diagnostic/treatment methods. The community includes the clinic staff and the division of labour determines the roles and tasks of each of the employees. The rules regulate the use of time, the measurement of outcomes, and treatment procedures. In apparent agreement with Berglund (2002) who argued that the same reference nodes in the activity system triangles can express different aspects from the views of different participants, the Helsinki University (2009) authors pointed out that the views represented in their example were that of the physician and the same activity system would look differently from the view point of another subject in that community. In other words, an "Activity System is always heterogeneous and multi-voiced" (p. 2). The authors also maintained "there is constant construction and renegotiation within

the Activity System as tasks are reassigned, re-divided and rules are bent and reinterpreted” (p. 2).

There has been a lively discussion in the literature on the lack of elemental stability in Activity Theory structures. Nardi (1996) warned that objects “...can be transformed in the course of an activity; they are not immutable structures” (p. 37). Those changes do not necessarily occur on a moment-to-moment basis as there is some stability over time. The author noted, however, that when changes do develop, they are not trivial and can change the nature of an activity fundamentally. Issroff and Scanlon (2002) appear to be in accord with Nardi’s (1996) view on instability within the Activity Theory framework when they commented that “Activity Systems are almost always in flux as they are in the process of working through contradictions” (p. 78). Nardi (1996) also advised that “Activity Theory holds that the constituents of activity are not fixed and can dynamically change as conditions change” (p. 38) which may result in shifts in identity when actions became part of operations and the operations themselves became actions.

Berglund (2002) agreed that the dynamic nature of an activity means it is subject to change as it develops. He argued that the continuous changes create a history of their own and “...a historical analysis is often needed to understand its current state and development” (p. 7). Kaptelinin et al., (1995) argued that tools “...usually reflect the experiences of other people who have tried to solve similar problems at an earlier time and have invented/modified the tool to make it more efficient” (p. 192). Because the tools carry other people’s experiences, they must also be considered having history. Kaptelinin et al., (1995) concluded that the use of tools can properly be seen as a vehicle for the transmission of “social knowledge”. Berglund (2002) warned that the *object* in an Activity System should not be confused with conscious goals. He explained the “slippery and transitional nature” nature

of objects is caused by their relationships to the continuous and transitional changes caused by mediation. According to Engeström and Escalante (1996) “objects do not exist for themselves, directly and without mediation. We relate to objects *by means* of other subjects ... This means that objects have two fundamentally different roles: as subjects ... and as mediating artefacts or tools” (pp. 360-361, italics in original). Berglund (2002) illustrated the multiple and changing roles with the example of a compiler in a computer programme development. He explained that the compiler is normally a tool which transforms code but when the compiler malfunctions, its role changes to that of the *object* of an activity. When the problem is solved through mediation, the compiler returns to its role as a *tool* in the activity.

In a discussion on Activity Theory, Engeström (2001) described an interesting learning paradigm which he called ‘expansive learning’. The author explained ‘expansive learning’ as reflecting the natural and unstable state of learning. Moreover, the knowledge to be gained is *not* available ahead of time. Engeström (2001) suggested that the natural state of learning entailed learning new forms of activity as they arise. “They are literally learned as they are being created” (p. 138).

In the discussion on adult learning models (Chapter Two) writers such as Mezirow (1991), Mezirow et al., (1990), Merriam (2001a, 2001b) and Baumgartner (2003) agreed that transformative learning underpins the andragogical model. Davydov (1999) raised some concerns when *transformation* is applied within activity theory. The author explained that all too often, transformation is misunderstood as changing the object in the activity theory model. He went on to say:

...not every change is a transformation. Many changes of natural and social reality carried out by people affect the object externally without changing it internally.

Transformation means changing an object internally, making evident its essence and altering it (p. 42).

Davydov (1999) stressed that the transformation process in activity theory needs thorough study by both sociologists and logicians to see how and to what extent the ‘inner essence’ of the object is changed through human activity. He considered the lack of understanding of transformation within activity theory to be a serious barrier to understanding this key component of activity theory.

Issroff and Scanlon (2002) considered that the increasing use of technology has seen a movement towards increased use of Activity Theory as a framework to study “...a variety of contexts which involve technology” (p. 77). They suggested that Activity Theory is becoming central in an understanding of Human-Computer Interactions (HCI’s). The authors attributed Nardi (1996) as being one of the researchers who were instrumental in the use of Activity Theory to study HCI’s. Kuutti (1996) emphasised four perspectives provided by Activity Theory; a potential framework for HCI; multi-levelness of issues; studying interactions embedded in social context; and dealing with dynamics and development. In his discussion on HCI’s, Waite (2005) considered that “computers have already established themselves as one of the most important tools mankind has for transforming the world” (p. 5). HCI has become an important area as human activities are increasingly becoming mediated by computers. In Waite’s (2005) view, Activity Theory provides a powerful framework for understanding HCI’s.

Activity Theory is useful in determining how elements within HCI’s shape the way people interact with their environments. Computers are tools and the best way to understand how human beings work with computers is to model the overall activity of computer users. Kuutti (1992) argued that ‘activity’ is the least meaningful context for HCI—users’ needs are

more important. Computer users often needed assistance to discover and formulate their own needs. Cuban (2001) expressed similar concerns when he recommended that user needs came before organisational needs.

Customising a system (computer or otherwise) to support users' needs was not a universal solution according to Kaptelinin (1994) because not only are users individuals and require individual attention, often they do not know what it is they need to know. Kaptelinin supports the need for a conceptual organisational analysis through Activity Theory to determine the basic factors and regularities needed by the organisation. The author suggested this analysis would assist in predicting needs and provide efficiencies in computer use.

Activity Theory can be an important tool to provide a common framework or language for a large data set from comparable studies without the need for complex meta-analysis. Robertson (2008) reported that Activity Theory has potential to provide a common language "...to articulate the object of the activity, tools available, rules, community, and division of labour" (p. 824) with respect to the pedagogical use of ICT's. He observed that pedagogical Activity Systems have the potential to resolve possible contradictory assumptions about e-learning among teachers through the development of a set of common terms and assumptions. Robertson (2008) also considered reflection and discussion keys to such resolution. Robertson's (2008) views on the use of Activity Theory to resolve contradictory assumptions were important for this research which relied on the development of a common set of terms to help develop teachers' pedagogical use of ICT.

In his discussion on the use of Activity Theory as a framework for research on learning, Berglund (2002) appeared to be in agreement with writers such as Nardi (1996), Engeström (2001) and Issroff and Scanlon (2002) when he stated at the outset of his

discussions on Activity Theory that it was “not in itself fixed and stable and does not have a given interpretation. The activity theory and its community can in itself be modelled as an activity system that develops over time in the multi-voiced international network of researchers...” (p. 5). He attributed Nardi (1996), Kaptelinin (1996) and Kuutti (1996) as multi-voices in the study of HCI’s through Activity Theory.

The application of Activity Theory in this research followed the Finnish University activity system model (Figure 2) as described by Engeström (2001, p. 135), Romeo and Walker (2002, p. 327), Khine, Ping, Wong and Divaharan (2003), Lloyd and Albion (2005, p. 4) and Waite (2005). Activities in this research included some analyses using Activity Theory framework.

The Activity Theory framework provided different lenses through which to view the developing pedagogical use of ICT in this study. In the current research, the learning structures discussed by Engeström (2001), Nardi (1996) and Kuutti (1992), particularly the type of learning-as-you-go ‘expansive learning’ observations of Engeström (2001), had the potential to affect the secondary teachers’ confidence and outcomes when using computers pedagogically. According to Engeström (1987), data collected based on experience can, and should be used by the researcher for insightful observations about the activity. Berglund (2002) advised that his interpretations from the use of Activity Theory were grounded in the needs of his research and he identified his research focus as being on the “...experience of individuals who are part of the activity” (p. 16) and he preferred to study and describe the experiences of the participants at the risk of not having time and resources to study the activity system itself.

Table 3

*Activity System Elements Adapted From Waite (2005, p. 6), Robertson (2008, p. 822) and Demiraslan and Usluel (2008, p. 2).*

Activity	The development of the regular and authentic integration of ICT's in secondary and intermediate school teachers' pedagogies
Subject	Teacher (teaching experience, teaching approach, the personal, administrative and instructional use of ICT, the place of ICT in daily life, the necessity of knowledge and skills related to ICT, and access to timely and personal technical and pedagogical help).
Object	The goals of gaining skills and knowledge to use ICT in an authentic integrated way in the teaching and learning process in the classroom (knowledge and skills acquisition, and problem solving).
Tools	ICT and the tools other than ICT, curriculum, learning and teaching resources, methods which are used, problems which are encountered, professional development resources and availability, political influence, human and intellectual resources.
Rules	Evaluation criteria, expectations of the teacher, official and tacit rules of the school, academic and ethical expectations of teachers, pedagogical behaviour, expectations of school management.
Transformation Processes	Successful use of ICT's within pedagogies as measured by student learning improvement, teachers' confidence to further develop skills and knowledge to further integrate ICT's in their pedagogies
Community	The immediate community of teacher and students and the wider community of other teaching and school staff, parents, community stakeholders, ICT coordinator, ICT help desk.
Division of labour	The roles and responsibilities of students and teachers, cooperation among teachers and the support of the school administration, technical and academic support staff.
Outcomes	The reflection of the use of ICT in teaching and learning processes to the learning of students and instruction, improved student understanding through the teacher's use of pedagogically integrated ICT's.

**Application of Activity Theory and activity systems.** An example of the use of Activity Theory in this research uses the elements in Table 3 (adapted from Waite (2005), and others) and the Engeström et al., (1999) triadic model in Figure 4, which have been customised for this example. It is important to bear in mind that specific Activity Systems such as mapping teacher's pedagogical changes should be customised in far more detail than shown in this example to accommodate as many aspects of the subject and the subject's environment.

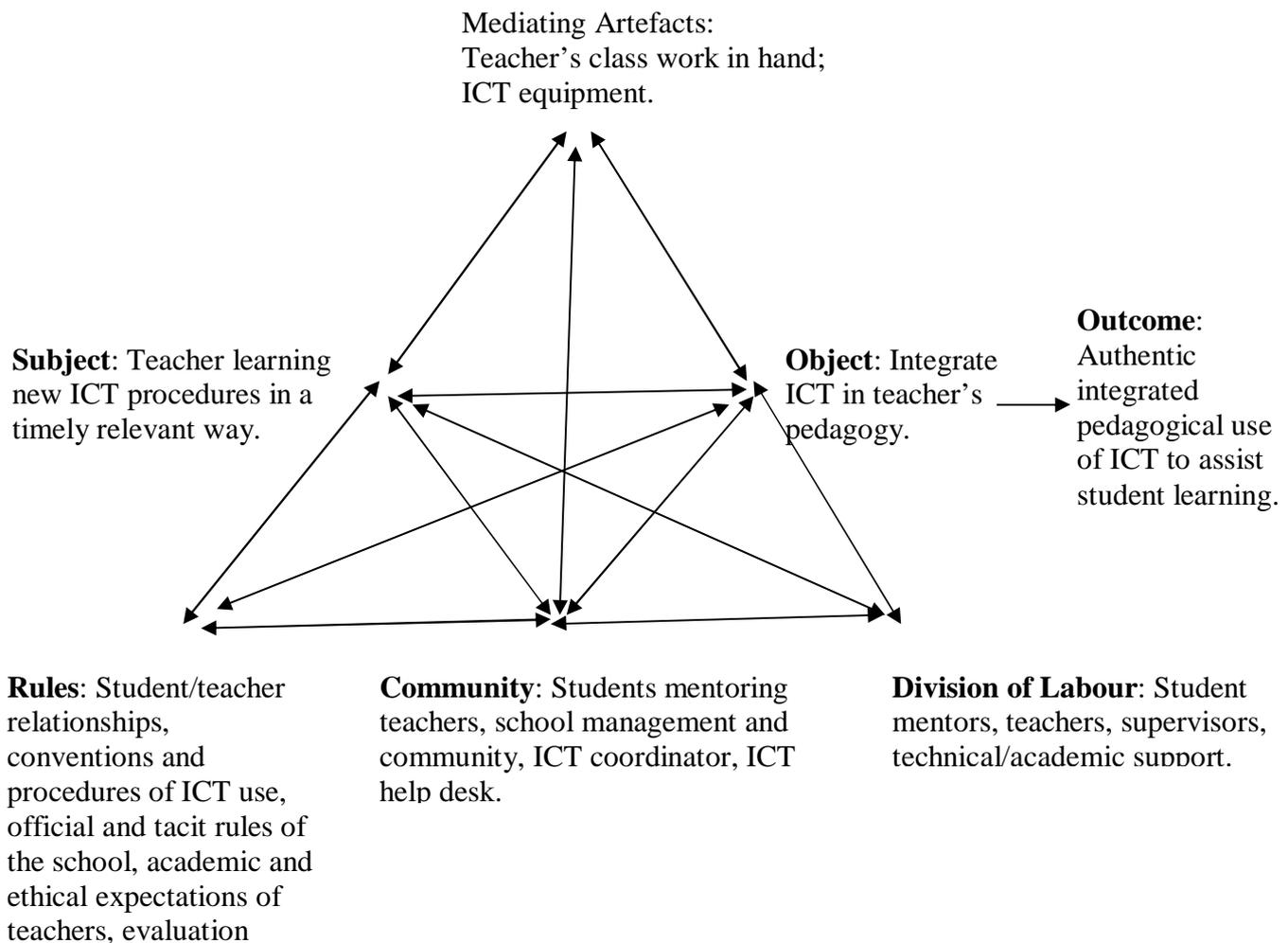


Figure 4. Activity Theory Triadic Model Adapted From Engeström, Miettinen et al., (1999, p. 31)

In other words, each element should contain sufficient relevant data pertaining to the specific Activity System—more than that provided in the following example:

1. The *activity* in this theoretical example follows the professional development through reverse-mentoring of a teacher's development of regular and authentic use of ICT's in her pedagogy;
2. The hypothetical *subject* of the activity is an experienced female secondary teacher who had little experience in using ICT pedagogically but who wanted to improve her teaching through the use of ICT to enhance her students' learning:
  - a. She wanted to develop her pedagogy through the use of ICT's so that she could provide a student-centric pedagogy instead of her didactic, class-centric pedagogy;
  - b. She thought this was possible if she could get the right expert help when she need it;
  - c. Her comfort level in using ICT's in class was close to zero so she decided to use the school's student based ICT reverse-mentored professional development programme to help her become proficient with ICT.
3. The activity's *object* was for the teacher to gain skills and knowledge to use ICT in an authentic way to develop a student-centric pedagogy which should enhance student learning. Simply put, the *object* was to change her pedagogy to integrate ICT.
4. Her ambition was mediated by *artefacts* which influenced her progress towards her goal (*outcomes*) of pedagogically using ICT to assist her students' learning:

- a. The *mediating artefacts* included the availability of *tools* such as available ICT equipment; resources such as professional development, management support, mechanisms for problem resolution, and so on.
5. She was an experienced classroom teacher and accustomed to working with *rules* all her professional life. However, her *activity* took into account numerous *rules* which could impact on this *activity* and these included:
  - a. Evaluation/assessment criteria;
  - b. Expectations of the teacher academically and ethically;
  - c. Expectations of the school management;
  - d. Pedagogical behaviour;
  - e. Student/teacher relationships;
  - f. Conventions and procedures of ICT use;
  - g. Official (and tacit) rules of the school; and so on.
6. Her *activity* was influenced by an important *community* element the triadic model:
  - a. The *community* included human resources such as her immediate community of teachers, students and school management, the school's ICT coordinator and the school's ICT help-desk (if there was one); plus the wider community of her educational world such as community stake-holders.
  - b. An important part of the teacher's *community* in this particular *activity* was the availability of ICT reverse-mentoring students who could help her with ICT issues when she needed that help.
7. This brings us to the *division of labour* element in the Engeström et al., (1999) triadic model which is important for our hypothetical teacher as this establishes who-does-what to achieve the desired end-results.

In this example, the *division of labour* element included the student mentors, teacher colleagues, supervisors, academic/technical support and the school administration.

8. External to the triadic model but included in the activity system elements adapted from Waite (2005) and others is the element of *transformation processes*. This is an important part of our teacher's journey towards the successful pedagogical use of ICT's.
  - a. If student learning outcomes are evidence of the move from class-centric teaching to student-centric teaching, then the teacher's learning can be *transformative*.
  - b. Additionally, if use of resources through the *community* element—the use of the reverse-mentoring students for example—and our teacher develops sufficient confidence to further develop ICT skills and knowledge and continue with her ICT/pedagogy integration, then too can be evidence of the *transformation processes*.
  - c. In short, if the degree of progress of ICT use pedagogically can be measured through the *rules* element, then another of the *transformation processes* can be affirmed.
  - d. Both the triadic and the adapted table of elements schema include the *outcomes* element which is the final element in the *activity*. This element measures the reflection of the use of ICT in the teaching and learning processes of students. It also measures their improved understandings through the teacher's use of ICT in her pedagogy.

These triadic elements—indeed activity systems themselves—do not operate in isolation but influence one another. For instance, in the example activity system

(above) the measurement of the teaching and learning improvements depend (among other things) on the *rules* element. Also, the *community* and *mediating artefacts* elements influence how much time and what resources the teacher can have for her professional development. Issroff and Scanlon (2002) explained that “...contradictions are central to the theory and exist when external influences change elements of activities causing imbalances between them” (p. 78). The authors further explained that when a new tool is introduced—a tool which does not have any rules of practice—a contradiction is likely. They claim that activity systems are almost always in a state of flux as they work through contradictions.

### **Summary: Conceptual Framework**

**Activity Theory.** The elements in the Activity System (Table 3) were adapted from those described by Waite (2005, p. 6), Robertson (2008, p. 822), and Demiraslan and Usluel (2008, p. 2) and these modified elements informed and underpinned the Activity System models (Figure 2 and Figure 4) in this research. The triadic model created from adaptations of the Engeström et al., (1999) design outlined the shape of the Activity Theory model used in this study to evaluate and record how particular participant experiences were shaped by the various components of the Activity System.

## **Chapter Four — Paradigms, Epistemologies and Theoretical Perspectives,**

Qualitative approaches to human behaviour research have been developed through the centuries from 1637 when René Descartes focussed on a model (paradigm) which provided the need for "...objectivity and evidence in the search for truth" (Richie & Lewis, 2003, p. 6). The authors noted that Descartes' key idea was that researchers should avoid any influences which could interfere with the researcher's analytical capacity. In 1781, Immanuel Kant proposed a further set of beliefs which became known as 'interpretivism' and which promoted qualitative researchers to place their own interpretations and understandings on the social world being studied. From the late 1800's qualitative methods of research became more sophisticated and more widely accepted. The 'positivism' paradigm evolved and became dominant until the 1970's when challenges for better qualitative research methods overtook positivism.

Denzin and Lincoln (1994) noted that the challenges and criticisms of the positivist paradigm from poststructuralists and deconstructionists resulted in a crisis for social researchers. For example, one of the challenges was to the positivist concepts of meaning and reality in which there are no fixed meanings to be gathered. This in turn meant that the social researcher could not grasp with any authority, the social world of another. These and other criticisms eventually gave rise to the evolution of additional inquiry paradigms of Post Positivism, Critical Theory and Constructivism. Guba and Lincoln (2004) considered these compete "...for acceptance as the paradigm of choice in informing and guiding inquiry, especially qualitative inquiry..." (p. 17).

Kilbourn (2006) considered the theoretical perspective to be the framework of the proposed study, an important part of which is the point of view (perspective) which 'filters'

the data. Peshkin (1988, p. 20) discussed the need to manage subjectivity and advised the adoption of recognising—not exorcising—all degrees of subjectivity so that it can be managed and prevented from impacting on “...collecting, analysing and writing up ... data”.

Managing subjectivity was important and although the researcher had regular contact with the participant teachers and the school coordinators, the data from the teachers were passively collected thus allowing the participant teachers to chart and manage their own developmental paths towards their pedagogical changes allowing the use of ICT in their classrooms.

Guba and Lincoln (2004) tracked epistemological developments through four paradigms:

1. Positivism’s dualist, objective assumption—“how things really are” and “how things really work”;
2. Post-positivism’s modified dualist/objective assumption which approximates reality;
3. Critical theory’s transactional/subjectivist assumption—knowledge is value dependent;
4. Constructivism’s assumption which sees knowledge as reacted in interaction among researcher(s) and the target research group.

(Guba & Lincoln, 2004, p. 28)

According to Greckhamer and Koro-Ljungberg (2005), theoretical perspective should provide information on the methodology and methods of a particular view of the world through assumptions, concepts and propositions. The authors argued that *constructivist* theory involves data which “...are co-constructed rather than reconstructed in the social

situation of the interview...” (p. 739). Guba and Lincoln (2004) preferred ‘reconstruction’ as part of a constructivist paradigm which they explain as providing a “hermeneutical/dialectic methodology aimed at the reconstruction of previously held constructions” (p. 28).

This study used a constructivist paradigm in a multiple case study design to investigate a reverse-mentored delivery of ICT professional development in two different environments. McMillan and Schumacher (2006) described the five foremost evidence-based qualitative designs as ethnographic studies; phenomenological studies; case studies; grounded theory studies; and critical studies.

The case study design was selected because (among other things) McMillan and Schumacher (2006) argued it provides for “...description, analysis and naturalistic summaries” (p. 382). The authors considered a benefit in case study design to be the ability of the researcher to develop summaries from the data which could be useful to others when applied to similar cases. The multiple case study design also has the potential for cross-study analysis through a comparison of different characteristics to disclose additional factors which influence teachers’ use of ICT. Creswell (1998) pointed out that the case study design was regarded as useful to understand the context within which the participants work. Creswell (2007) argued that case study research is a qualitative methodology through which in-depth data can be collected from “...multiple sources of information (e.g. observations, interviews, audio-visual material and document and reports)...” (p. 73). In the opinion of Creswell (2008), a case can be either an object of study or a procedure of inquiry. In his opinion, a “case study is an in-depth exploration of a bounded system...based on extensive data collection” (p. 476). Creswell (2008) considered multiple case studies not only provide multiple points of view into an issue but also enables the researcher to “...locate the cases

within their larger context, such as geographical, political, social or economic settings” (p. 477).

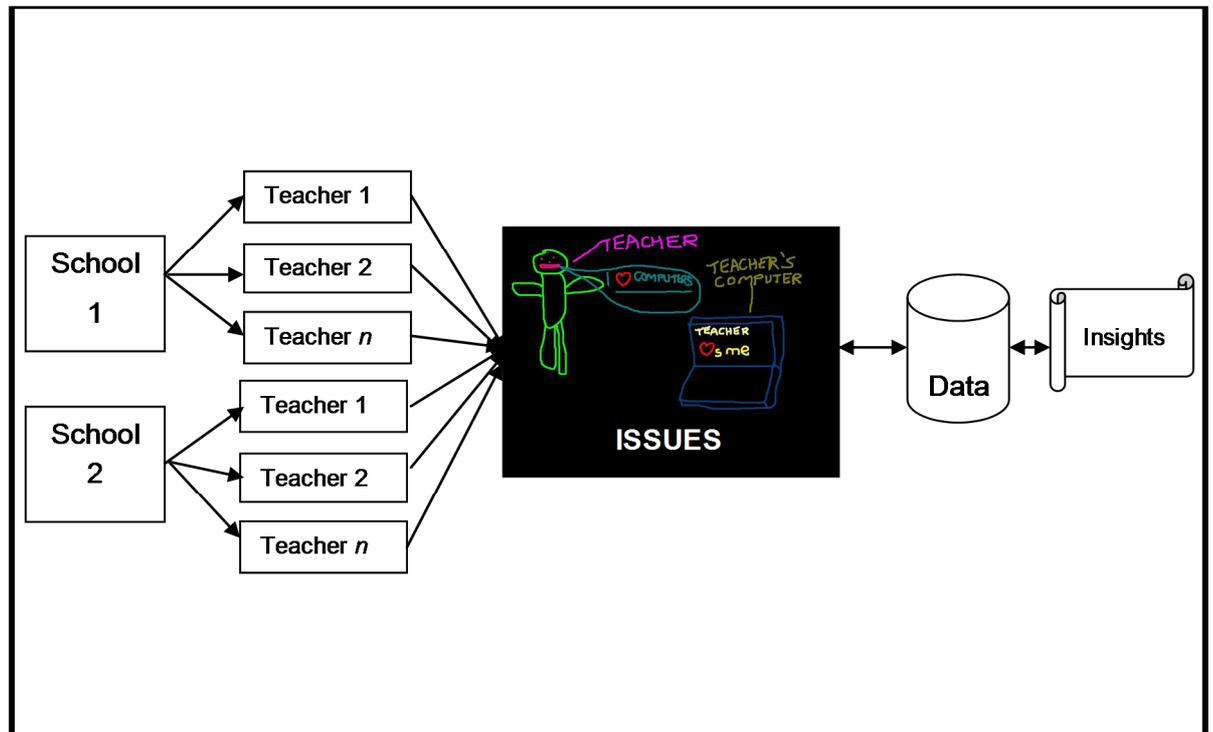


Figure 5. Case Study Structure

The study of multiple individuals in two different schools in this current study (Figure 5) provided data gathered from teachers which were analysed and insights into reported issues identified. This design follows Creswell’s (2008) structure of an in-depth exploration of the activities of individuals in different settings (p. 477).

‘Epistemology’ is concerned with the study of the nature of knowledge. Richie and Lewis (2003) extended that definition to include *ways* of knowing and learning “...about the social world and focuses on questions such as: how can we know about reality and what is the basis of our knowledge?” (p. 13). The authors listed three main issues under debate. The first was the relationship between the researcher and the researched; the second related to

issues about 'truth'; and the third "...concerned the way in which knowledge is acquired" (p. 14).

The relationship of the researcher is a key factor in qualitative case studies. Merriam (1988, p. 19) emphasised the importance of the researcher's role in a qualitative case study "...cannot be overemphasised. The researcher is the primary instrument for data collection and analysis. Data are mediated through this human instrument..." Merriam also pointed out that the researcher could not get 'outside' the phenomena occurring in a natural setting in which qualitative research assumed multiple realities without predetermined hypotheses. In the opinion of Richie and Lewis (2003) the researcher's epistemological position should be "...as objective and neutral as possible in the collection, interpretation and presentation of qualitative data" (p. 20). That objectivity and neutrality can be threatened by the role of 'insider observer'; a person who already has a role at the site selected for the study. McMillan and Schumacher (2006) warn that an 'insider observer' must be "...exceedingly sensitive regarding which voice is represented in the study" (p. 345). The authors went on to say that some critical studies employed the dual role of participant researcher which required the researcher to have constant self-awareness of the origin of the data collected either from researcher or from study participants. This issue was important as part of this study involved the role of participant researcher. Care with attributing data to the correct participants is helped through the observations of the participant researcher, constant audits, and record keeping through logs and/or initialled transcripts. This is in addition to dealing with the so-called 'attribution effect' which is a research phenomenon in which experimental subjects try to tailor their data to support what they think is the point of the research.

In his experiments to determine the attribution of causes of performance, Staw (1975) concluded that some experimental subjects "...may attempt to confirm a researcher's

theoretical hypothesis by providing supporting empirical data” (p. 429) and this, he argued applies to methodologies using survey instruments. He also suggested that self-reported data may represent the consequences rather than the determinants of performance. He pointed out that “...respondents will use knowledge of performance as a cue by which they attribute characteristics to themselves...” (p. 414). A crucial element of what he called the ‘attribution effect’ is that the researcher’s hypothesis is either known or is so obvious that most respondents can guess what it is.

In Staw’s (1975) experiments, the hypothesis was either known or the majority of respondents had “...their own hypotheses linking individual, group, or organizational characteristics to performance” (p. 429). In his research, the respondent teachers were volunteers and were aware of the research hypotheses. The participant observer’s role in this current research was useful in determining and noting incidents of Staw’s (1975) ‘attribution effect’.

McMillan and Schumacher (2006) suggested that participant observation can be beneficial as it sometimes provides corroboration “...between what individuals think they are doing and what the researcher thinks they are doing based on data” (p. 348). Corroboration through naturally occurring evidence (Linda Leach et al., 2001) together with audits which included participant verification and validation of notes/observations helped with keeping the nature of the ‘insider observer’ role transparent.

Richie and Lewis (2003) were of the opinion that different qualitative methodologies can be employed to provide tools with which to approach different social phenomena in naturalistic settings. They also suggest both qualitative *and* quantitative methods can be employed in the same study. Together, the two methods can provide different but

complementary approaches to "...yield different types of intelligence about the study subject rather than simply fuse the outputs from quantitative and qualitative enquiry" (p. 38). The authors identified the relevance of triangulation which involves different methods and sources to check data validity. However, they warned that although this technique may hold relevance, its use remains the subject of a long standing debate.

Qualitative methods may suit social research environments but Richie and Lewis (2003) stressed that a great deal of research is funded by public bodies which use quantitative data. However, the authors say researchers can work in both environments if they produce qualitative evidence which "... has been rigorously collected and analysed, is valid, able to support wider inference, as neutral and unbiased as possible and clearly defensible in terms of how interpretations have been reached" (p. 19).

In this study, both qualitative and quantitative methods were used to yield different types of data. Quantitative data were typically drawn from instruments such as Likert-scale measurements and qualitative data are derived from interviews, observations and so on. Richie and Lewis (2003) considered the use of both to be a legitimate strategy "...provided that the two methods and the data they generate, can be clearly delineated" (p. 38).

This study employed a number of open-ended interviews which allowed co-construction of knowledge for data gathering during which the interviewer and participants shared the conversation. Greckhamer and Koro-Ljungberg (2005) agreed that this is a *constructivist* paradigm. Guba and Lincoln (2004) added that in their view 'constructivism' produced knowledge which is a result of "...those constructions about which there is relative consensus ... among those competent ... to interpret the substance of the construction" (p. 31). The keys of 'consensus', 'competence' and 'interpretation' can be difficult to manage

when using data from informant interviews and this identified a need for an analysis tool for those data.

Romeo and Walker (2002) sought a theoretical perspective which would assist them in the analysis of interview data. Their study related to the implementation of ICT in a large primary school in Victoria, Australia. They selected Activity Theory for the analysis of data they *planned* to obtain "...rather than providing us with any meta-theory with explanative or predictive capabilities" (p. 324). The authors explained that their choice of Activity Theory "...as an analytical device provides us with a holistic and systemic view of human engagement" (p. 324). They organised the interview data into the major elements of Activity Theory which included "subject, instruments, object and outcomes, rules, community and division of labour" (p. 324).

Romeo and Walker (2002) agreed with writers such as Nardi (1996), Kuutti (1996), Issroff and Scanlon (2002) and Berglund (2002) that the use of Activity Theory for the collection of HCI related data provided potential to capture understandings of Human-Computer Interactions (HCI's) both from the participants' personal involvements and from their opinions of the involvement of others in the same study domain. Romeo and Walker (2002) considered Activity Theory to be the best framework available for such data collection.

In this research, Table 3 and the Activity Systems model in Figure 5 describe relationships between the activities and outcomes for each participant teacher. The relationships between activities and outcomes are discussed in Chapter Eight.

The research design described in Chapter Five explains how the study was organised to fit a mixed method approach to capture teachers' concerns at the start of the study and their subsequent comments on their achievements as the study progressed. The discussion will also describe how the schools and participants were selected for the research and explore issues relating to ethics, bias/validity and the limitations of the study.

## Chapter Five — Methodology and Research Design

### Overview

...[as researchers] we do not fit neatly into any one recognised 'school' of qualitative research and instead, we borrow from many different traditions within the social research field generally. (Richie & Lewis, 2003, p. 19)

The design of this research study was intended to cover three main issues. The first was to gather data which may underpin suggested practical initiatives for classroom teachers using ICT; results which could help teachers meet and overcome at least some of the barriers identified earlier in Chapter Two. Those data also provided a useful method of investigating how teachers incorporated ICT in their pedagogies. The second issue was to provide the researcher with a flexible data collection method in a constantly changing subject area such as ICT. The third issue was to test the effectiveness of using students as reverse-mentors for their teachers as a form of adult education. This chapter describes the methodological approach for two mixed method case studies, each of which had local components which were similar.

This study employed both qualitative and quantitative methods of data collection and analysis. The mixed-method approach was intended to provide flexible and complementary strategies in addressing the research questions "...rather than focussing too much on the underlying philosophical debates" (Richie & Lewis, 2003, p. 15). The collection of qualitative data was from naturally occurring evidence from teachers' activities using ICT, observations, documented analyses, and data which were generated or 'constructed' through discussions and interviews. Leach, Neutze et al., (2001) argued for the use of naturally occurring evidence which they claimed empowered learners—particularly adult learners who bring with them a variety of knowledge to the learning process—to use their own way of constructing knowledge rather than formal assessment processes.

Creswell (2008) argued that mixing the data from the quantitative and qualitative collection sources, can provide "...a complex picture of social phenomenon" (p. 552). He also argued for an 'embedded' mixed methods design which simultaneously collects and merges both quantitative and qualitative data and will "...augment or support the primary form of data" (p. 558). He further argued that one of the strengths of using mixed methods "...is that it combines the advantages of both qualitative and quantitative data" (p. 559).

Two mixed method case studies were carried out in two New Zealand schools and there was an opportunity for comparisons between genders as well as within and between the two schools. The data were collected from a number of sources including the structured results of both surveys, semi-structured comments from both surveys, unstructured comments from teachers' event logs and comments from semi-structured interviews. The purpose of the two case studies was to resolve the research objectives which sought to identify the advantages and disadvantages arising from reverse-mentored ICT professional development for teachers.

An important feature of this study was that it did not follow the typical central helpdesk structure of the reverse-mentored models which have been discussed in Chapter Two. The study built on the design established by Peterson's (2004) *Hukarere Kaiawhina* model in which the students continued with their daily class routines until called upon for help. It was expected that each request was 'owned' by a student and resolved within minutes. Any longer periods were either in the student's free time or during a specially arranged time with the teacher concerned. This just-in-time reverse-mentoring supported Fullan's (1993) views on change management. It was also in accord with views discussed earlier on the need for pedagogical change expressed by Cuban (2001), Watson (2001), Ward (2003), Scrimshaw (2004), and Phelps, Graham et al., (2004) who argued that individually

tailored professional development programmes which matched the individual personal characteristics and individual experiences of teachers, were potentially more effective in enhancing teachers' learning than one-size-fits-all professional development programmes.

## **Research Design**

This section outlines the way in which the study was carried out and the manner in which data were gathered in order to address the research questions which are:

1. What do teachers perceive as the advantages and disadvantages arising from a reverse-mentored approach to ICT professional development?
2. What influence does a reverse-mentored approach to ICT professional development have on the type, frequency and use of ICT in teachers' subject areas?

Kilbourn (2006) suggested that the design section can be viewed in two parts. The first is justification for the general approach to the study and the second or central part is a detailed discussion on the data collection. The study justification has been discussed earlier and is summarised as the provision of student assistance to allow teachers to quickly clear pedagogical roadblocks in their use of ICT, rather than have the teachers wait for a scheduled session at some later date. The assistance was designed as part of the daily life of teachers as recommended by Cook (1997) and has the potential to help overcome many of the barriers discussed in Chapter Two.

This study involved teachers and students in two different provincial New Zealand schools. The use of two different schools was intended to increase the potential of the study to address the research questions. The schools had individual cultures and some differences in management styles. Also the different pedagogies of the individual participant teachers

potentially helped identify issues specific to ICT as recommended by Higgins (2003) and Cox, Webb et al., (2003).

The focus of the study was on overcoming barriers to teachers' use of computers in the classroom and the impact of that use on classroom practices. The design was that of constructivist research as discussed earlier and the programme was intended to run continuously over the school year. The purpose of the study was to measure the influence of reverse-mentoring in the development of pedagogical uses of ICT by the participant teachers.

It is important to note that if the students involved were not able to resolve every problem on their own they sought help from other sources such as their own research, their ICT teacher who was available for such help, or their school management. Teachers in the study were aware of this. Once resolved, the request was finalised with closure documentation which was signed off by both the client teacher and student and filed for later analysis. All information created from the data was made available to the relevant participants for comment before publication.

The participating teachers were encouraged to reflect on and build their pedagogical initiatives through fortnightly group meetings. They were encouraged to provide written feedback in reflective journals on the effectiveness of each instance of help from the students. They were also encouraged to discuss their progress and share successes and suggestions in their use of ICT in the classroom through face-to-face meetings or through personal log of their reflections.

## **School Selection**

As Tondeur, Cooper, et al., (2010) have stressed, key personnel to the success and sustainability of a school's ICT integration programme are positive and supportive management and an ICT coordinator who is "... viewed as a leader in the school by teachers, either on the basis of personal attributes, longevity at the school or position in the school" (p. 304). Additionally, the authors argued that positive leadership from both management and the coordinator in promoting change is a "... key factor when it comes to merging ICT and instruction" (p. 304).

Seven schools were approached but while the principals and management in five of those schools were keen to take part in the research, the ICT coordinators were less enthusiastic because of the extra work the research would involve. In two of the schools (Schools A and B), both key groups were enthusiastic in taking part in the research.

The selection process was completed by Term 4 of the 2009 school year. Management, teachers, and parents in schools A and B signed Ethics Committee acknowledgements of their roles before they were involved in the research. There were few male teachers in either of the selected schools, one of which was an all-girls school and the other was a Year 7-8 school. Both types of schools generally had more female than male teachers.

## **The Schools**

The two studies involved three groups of participants—senior management, teachers and students. The oversight and responsibility of the programme was through the management of the participating schools', the schools' ICT coordinators and the researcher.

School A was a State integrated single sex (girls) provincial secondary school with a capped roll of 250 students in Years 7 to 13 ranked at Decile 9 by the New Zealand Ministry of Education. The decile ranking is essentially an indication of the ratio of support the school receives from the Ministry and from parents and community. The assumptions underlying this ranking are the higher the decile, greater the community/parent support and less New Zealand Ministry of Education support. State integrated schools are generally former private schools which have joined the State system but have kept their special character such as religious education, buildings, etc.

School B was a medium sized provincial intermediate State co-educational school ranked at Decile 2 with a roll of 350 students all of whom are in Years 7 and 8. The low decile ranking indicates a low level of support from the community/parents and a higher level of support from the Ministry than that for School A.

Both schools have students in the 'intermediate' year groups (Years 7 and 8) and both were 'smaller' schools compared with urban State schools with rolls of greater than 1,000 students.

### **The Teachers**

The teachers were selected from volunteers in each school. The volunteer teachers said they wanted to improve their use of ICT in the classroom but were lacking timely and personal support from school management to do so. It was intended that teachers in both schools evolve towards a degree of self-sufficiency in their specific subject areas in the use of ICT for teaching and learning in the classroom.

In Term 4 of 2009, 11 teachers in School A signed participant agreements and provided base line data (Appendix A) prior to involvement in the programme. This number grew to 20 early in 2010, all of whom provided the participant agreement documentation before they started in the programme. Also in Term 4 of 2009, School B had 20 teachers involved in the study.

An important development was the addition of a further four School A teachers who joined the programme early in 2010 after the research had started. The latecomers said they joined the programme because they wanted to improve their ICT skills in their classrooms. The activities of the late arrivals were seamlessly integrated into the programme. As with their colleagues in the research, the additional teachers provided reports on each incident of assistance from the student mentors as well as their views on their own progress throughout the ICT reverse-mentored programme. The teacher participants in both schools had a wide range of pedagogical experiences for both genders.

The ICT coordinator in each school was the school liaison with the researcher and also had oversight of the activities of the students mentoring teachers. In both schools, the Principals and the Boards of Trustees had ultimate control over the direction and management of the research. This control and management included acknowledgement and support for the student mentors and their teacher mentees.

## **The Students**

The student sample group in both schools were selected by the school's ICT coordinator from ICT capable students who had the necessary skills with which to assist individual teachers in their use of ICT. The students and staff in both schools provided informed consent for participation in the study. This was a Curtin University Ethics

Committee requirement. The students were under the direction of the ICT coordinator and the researcher did not have direct contact with any of the students involved in the studies.

The numbers of students who volunteered to take part in the mentoring programme in School A increased throughout the school year. Each Year group (7-13) was represented and they formalised their group identity by calling themselves 'StarTechies'. In mid-2010 they were additionally recognised at a school formal assembly with the presentation of special 'StarTechie' badges. In this way, the mentoring students became readily identified as a special group able to help teachers with ICT issues in their work. The students frequently called on each other for help to solve issues presented by teachers in the programme. As a group, they met regularly with the ICT coordinator.

The ICT coordinator in School B elected to have four student mentors. These students were drawn from Years 7 and 8 and named themselves as the school's 'TechSperts'. They were managed and guided by the ICT coordinator and although they did not have badges, they were known in the school as the ICT 'helpers' for teachers. They were volunteers selected on the basis of their above average ability in the use of ICT and their willingness to help teachers use ICT in their lessons.

It must be acknowledged that the primary purpose of a school is to provide learning opportunities for students. It can be argued that the students' reverse-mentoring role supplemented and enhanced their own ICT learning. Being able to explain how to overcome barriers and/or teach ICT skills, the student mentors needed more than a basic understanding of issues resolution. The students in the New Zealand Hukarere Girls' College model (Peterson, 2004) received study-based learning in a manner similar to that of the United States Department of Education Generation Y programmes (*GenY, 2006, 2007*). The

Hukarere students also had additional learning through their own troubleshooting research which was linked to the application of a wide range of Unit and Achievement Standards in the New Zealand Curriculum. For instance, if a teacher needed help in developing a Microsoft PowerPoint presentation, typically the student discussed the problem with peers and sometimes researched the relevant Unit and Achievement Standards dealing with PowerPoint presentations. Often the knowledge gained helped the student with her coursework.

Unlike the Generation Y, MOUSE, and Tech Angel programmes, the students in the Hukarere model did not work from a central helpdesk but attended their scheduled lessons and were available to assist any teacher who needed help. There were times in the Hukarere study when students attending a subject teacher's class were able to provide immediate help for the teacher with ICT issues. Also, the Hukarere mentoring students were asked by teachers at various unscheduled times of the day for help with ICT related problems. The students provided help at the first mutually available opportunity. In other words, any of the selected ICT knowledgeable students were able to work with any of the participant teachers at a mutually agreed time and place. Additional student learning was through the rich experiences achieved through dealing with different adults which provided both parties with enhanced student-teacher relationships as well as valuable workplace and social skills for the students.

### **Data Collection**

As discussed earlier, writers such as Engeström (1987) and Berglund (2002) advocated a research focus on the experiences of the individuals rather than on the systemic structures managing the data. Accordingly, in this research, the focus of participant teachers' experiences became a lens for data collection.

**Data collection alignment with research questions.** Data relating to the first research question “*What do teachers perceive as the advantages and disadvantages arising from a reverse-mentored approach to ICT professional development?*” were shaped by: The ability of individual teachers to develop and report on their own developing pedagogical approaches as recommended by Higgins (2003) and others;

1. The use of naturally occurring evidence from the participant teachers as discussed by Leach, et al., (2001) to provide authentic feedback for individual teachers on their progress with their pedagogical change;
2. In addition to the way in which the data were collected, the multiple case study design of the study also provided an opportunity to collect different and individual points of view from the teacher participants on the advantages or disadvantages of reverse-mentored ICT professional development. (Creswell, 2007, 2008)

In short, the advantages and disadvantages mentioned by individual teachers were able to be identified, discussed and analysed through the way in which the study data were able to be collected.

The answers to the second research question “*What influence does a reverse-mentored approach to ICT professional development have on the type, frequency and use of ICT in teachers’ subject areas?*” were also influenced by the manner in which the data were collected. The influences on the collection were similar to those affecting the first question as the collection nets gave individual teachers’ opportunities to contribute their opinions on their progress throughout the study.

**How the data were collected.** The data were collected in two formal steps; a pre-study baseline evaluation and an end of study evaluation which was the last data gathering instrument used in the study. The pre-study questionnaire (Appendix A) was intended to provide baseline demographic data for each participant as well their current ICT skills, teaching experience, collegial and management support in the use of ICT, attitudes in relation to reverse-mentoring and perceived barriers to ICT use.

The end of the study questionnaire (Appendix A) was designed to collect data relating to each teacher's perceptions on the usefulness or otherwise of the reverse-mentoring project. Additionally, data were collected at two weekly intervals during the project from semi-structured interviews and discussions with each teacher participant. This was in addition to written returns from each teacher after help was provided. The data were organised for analysis in three categories; nominal data for the category responses to produce simple frequency distributions; ordinal data representing the responses from questions using Likert-type measures for cumulative frequency distributions; and data from semi-structured interviews with unstructured probes.

### **Event Logs**

Each request for help from a teacher generated an entry in an event log which included data on the issue raised and its resolution. It also included comments from each teacher at the conclusion of each resolution as to how the request was handled. Each teacher also provided an overall evaluation of the success or otherwise of reverse-mentored project.

### **Ethics**

Guba and Lincoln (2004) discussed the place of ethics in different paradigms. They considered that ethics were an important consideration in the positivism and post-positivism

paradigms but were “...extrinsic to the inquiry process” (p. 33). Guba and Lincoln (2004) also considered that there is a leaning towards deception in those paradigms which was sometimes argued as being necessary to determine “...how things *really* are and work” (p. 33). However, they categorised ethics as being “nearly intrinsic” to Critical Theory and they argued that ethics *are* intrinsic to Constructivism as “...hiding the inquirer’s intent is destructive of the aim of uncovering and improving constructions” (p. 33). They warned that the Constructivist paradigm can produce “...special and often sticky problems of confidentiality and anonymity as well as other personal difficulties” (p. 33).

### **Confidentiality**

In this research, all participants were aware of the object of the research and the teachers were encouraged to voice or note their opinions as to the efficacy of the reverse-mentoring model. Reports from both schools reported a range of opinions in this regard.

Anonymity and confidentiality were recognised as important in this study and every effort was made to achieve both although this may not be 100% achievable. This is because of the small population sizes in the schools and the close working relationships between students, teachers, school management and staff. An absolute guarantee of confidentiality could not be given beyond that which is provided for by law. All study participants were advised of this caveat and were also made aware that privacy laws could extend beyond the New Zealand Privacy Act 1993. See Appendix B for pro-forma letters of information about the research and consent forms for teacher participants and the parents participating students. These were distributed prior to the data collection.

## **Participant consent and feedback**

This study involved students who ranged in ages from 12 years (Year 7) to 18 years (Year 13). The Information Sheet was prepared at a level of language which accommodated the reading ages of the student participants. Informed consent was required from each student, parent/care giver and adult participant. Students who did not wish to participate, or whose parents/care givers did not want them to participate in any of the research activities were assured of anonymity. There were no students in this category. The student participants were also informed through the Information Sheet that non-participation would not affect their studies, or participation in the school routines. There were no financial inducements offered to parents or guardians to persuade them to enter their children in the study. The participants were encouraged to provide feedback on report drafts and permissions for use were negotiated before publication. Copies of the participant forms can be seen in Appendix B.

## **Summary: Ethics**

The methods adopted in this study were accepted and ratified by the Curtin University Ethics Committee (Appendix B) and participant privacy was maintained with all participants given anonymity as discussed above. Each participant had an opportunity to comment on drafts of their contributions before publication and citation.

## **Bias and Validity**

The programmes aimed to support and amplify teacher ICT practices and learning. To that end, an individual's progress was expected to be different from others in the studies. There was no control group through which to judge the effectiveness of the interventions and it is important to acknowledge the factors which could affect internal validity. Tuckman

(1972, p. 133) recommended accounting for three groups of bias factors which may affect internal validity; *experience bias*, *participant bias*, and *instrumentation bias*.

**Experience bias.** The individual levels of experience in this programme did not include repetitive testing and were expected to be different with individual levels of assistance building on those experiences. In this case, there were no ‘treatment’ or ‘testing’ biases. There may have been, however, ‘expectancy’ biases in that the volunteer teachers will do their best to deliver their own expectations of success. This may not have been an influential bias because the individuals are competing against themselves—not a control group.

**Participant bias.** Writers such as Wood (1992) and Doggett (2004) warned that participant bias can create threats to data internal validity. The threats can result from a “...participant bias of those with extremes of interest...” (Wood, 1992 p. 2822); a self-selection bias in which the participants have an interest in the study outcomes; or a bias resulting from an “...attrition of participants due to fatigue, boredom, or time constraints” (Doggett, 2004 p. 4). Low participant numbers can also affect the internal validity the data and the level of generalisation of the findings.

The teachers all started as volunteers and most expected to better their pedagogies through the use of ICT. However, there was no separate control group and the changing numbers of teacher participants may have balanced those participating with extreme interest (Wood, 1992) and those leaving through fatigue, time constraints, etc.

**Participant maturation.** The process of change over the course of the intervention was expected for those completing this study.

**Instrumentation.** The third of Tuckman's biases is the design and use of instruments such as questionnaires. This is important because the questionnaires set the foundation for measuring achievement. This was an issue which required qualification because of the expected and continual changing nature of the study. The participants co-constructed their learning and the initial survey questionnaire should be regarded as a starting point rather than constant measure throughout the programme.

### **Summary: Bias and Validity**

The dynamic and sometimes exponential nature of many participants' learning and adaption of ICT use in classes signalled a need for caution when measuring rates of progress without an external control group. In this study, the varied levels of experience (or lack thereof), learning maturation and determination of individual participants helped provide an overview of progress based on the baseline survey.

### **Limitations of the Study**

**Andragogy.** In this study, the activities relating to reverse-mentoring were based on the assumptions in the andragogical model of adult learning as described earlier. However, that model was intended as a starting point which can be tempered by an array of influences on learning behaviour rather than an inflexible ideology guaranteeing results. In their discussion of the best fit of andragogy to adult learning, Knowles, Holton et al., (2005, p. 204) pointed out that there are too many variables among adults to allow the model to neatly fit all learners. They explained there were "...many individual differences that interact with core adult learning principles..." which in turn shape learning behaviours. Knowles (1984) emphasised that the andragogical model had to be flexible as it was intended to be a "...system of elements that can be adopted or adapted in whole or in part ... an essential

feature of andragogy is flexibility” (p. 418). In other words, the assumptions in the model and the results of this study may not fit all teachers in every circumstance. Only the ICT coordinators and teacher participants were involved with the students. The researcher did not have contact with the student participants and collected all data either directly from the teachers concerned or through the ICT coordinator.

**Activity Theory.** According to Roth (2004), activity theory still has many unsolved issues despite the use of this theory for many decades. He considered the “...nature and role of transformation in activity systems, the relation of collective and individual activity, and the relation of activity theory to other theories of human conduct” (p. 7) to be less than complete. He suggested that a better way of using the theory may be to expand the use of Activity theory beyond the concept words. The author pointed out that the dualistic perspective of Activity Theory did not cater for some aspects of Western input such as contradictions. He also criticised the way in which he saw Activity Theory was used by western educationalists who he claimed have:

...appropriated activity theory in a particular way, grafted a dialectical theory onto a fundamentally dualistic epistemology. Such a move comes with a cost in the sense that important aspects no longer make sense in the new context. Perhaps there is a need to take on board more than some concept words and other tidbits from activity theory...(Roth, 2004, p. 7)

Roth (2004) observed that Western Educationalists using Activity Theory have not yet paid enough attention to the changes individuals’ experience

“...as a consequence of their participation, which itself changes over time. That is, participation in activity entails change in life conditions and identity of the acting subject and its associated object, and this change is coextensive with changing participation and learning. (Roth, 2004, p. 6).

Acknowledging Roth’s (2004) cautions, in this research the mapping of changes and identification of influences in the participant teachers’ use of ICT in their pedagogies provided data through customised elements in the Activity Theory model (Figure 4). Each

element in the model could be customised to suit individual teacher participants including influences from their school environments. For instance, the subject, mediating artefacts, rules, community, and division of labour elements in Figure 4 all help provide multi-lens views of each participant teacher's progress towards integrating pedagogical use of ICT to assist student learning.

**Population size and scope of the study.** The researcher collected data from teachers ( $n=44$ ) in two schools over a school year. The size and scope of the study limited the degree in which the results can be generalised.

### **Summary: Methodology**

This research employed a mixed methods methodology which included the use of naturally occurring evidence from the participant teachers as discussed by Leach, et al., (2001) as well as qualitative and quantitative data collection and as such the methodology did not fit “..neatly into any one recognised ‘school’ of qualitative research...” (Richie & Lewis, 2003, p. 19). This research was designed to accommodate different pedagogical approaches from different teachers in two schools with individual educational cultures as recommended by Higgins (2003) and others. The multiple case study structure design of the study—such as that modelled in Figure 5—was influenced by Cresswell (2007, 2008) who argued such a design afforded an ability to provide multiple points of view. The limitations of the study included the size and scope of the study population as well as criticisms from selected researchers on the general use of Andragogy and Activity Theory.

The details of the quantitative data collected throughout the study are discussed in Chapter Six. The discussion includes statistical analyses of teachers' collective opinions which were often analysed by gender and the teachers' school environments.

## Chapter Six — Quantitative Data Findings

### Introduction

This chapter has been organised in three parts. The first part deals with quantitative data collected through baseline questionnaires from the participant teachers before they engaged in the reverse-mentored programme. The second deals with quantitative data collected through questionnaires at the end of the programme and the third part examines data derived through pairing answers to questions from both questionnaires. Sample questionnaires can be found in Appendix A.

The teachers' answers to each question from each questionnaire have been described in relation to the balance of their opinions and, where appropriate, statistically. The data collection was reasonably straight forward although both questionnaires were affected by changes in staff. In a small number of cases some teachers elected not to answer specific questions which they considered could affect their own standing in the school or that of their colleagues. Also, number of teachers in both schools recorded that one of their least appreciated aspects of the programme was filling in forms to document their progress with their reverse-mentored ICT professional development.

There have been robust discussions in the literature on the relationships between gender and the uptake of ICT, particularly among teachers. Consequently the data sets have been analysed by gender. A further analysis by school was carried out to examine any influence the school environment may have had on the teachers' responses.

The role of the school's ICT coordinator had a strong effect on the study. In both schools, the coordinator was also a busy classroom teacher. Tondeur, Cooper et al., (2010)

considered both the school's ICT coordinator and supportive school's management were critical to the success of a study such as this. The authors argued that for success, the ICT coordinator must have positive interpersonal and organisational skills. The results of this study suggested the Tondeur authors were right, at least in part. For example, both schools had the support of their principals and management. At the outset both ICT coordinators were positive and enthusiastic. As the study progressed, the School A programme grew in popularity and quickly increased numbers of both participant teachers and student mentors. The programme was also recognised by School A management in school assemblies and in school newsletters. The School B management remained supportive throughout the programme but shortly after the start of the programme, the ICT teacher/coordinator was assigned other school-wide responsibilities and was not able to grow the reverse-mentored programme to the same extent as School A.

### **The Sample Group**

The student mentors and teachers in School A were drawn from both the Junior School (Years 7-8) and the Senior School (Years 9-13). School B was a Year 7-8 school which matched the Junior School student age groups in School A. The numbers of student mentors and teacher participants in School A grew as the programme progressed. However, although the numbers of student mentors in School B remained steady, the number of active participant teachers reduced somewhat as some teachers (the technology subject teachers for instance) in School B considered they were sufficiently competent in areas of ICT and did not need ICT reverse-mentored assistance. The remaining School B teachers in the study were active in the programme.

## **Part One: Data from Baseline Questionnaires**

In this part, teachers provided demographic, professional and ICT related data to establish a baseline from which their progress, innovation and self-assessments were measured and documented throughout the programme. The integrity of self-assessment was discussed in Chapter Five. An alpha level of .05 was adopted as standard.

### **Baseline demographic data**

*Teaching subjects by gender.* Male teachers in both target schools were in a minority. Harker and Chapman (2006) claimed that male teachers have been generally in a minority in New Zealand schools and the gap between the genders has been growing since 1994 (p. 49). According to the New Zealand Ministry of Education (2011) teacher headcount report, as at April 2011 76% of classroom teachers in New Zealand State and State Integrated schools were female and 24% were male. Even considering Harker and Chapman's (2006) claims and the New Zealand Ministry of Education's statistic, male teachers were significantly under-represented in the two participating schools. Possibly a good reason for this was both types of school attracted more female than male teachers. School A was an all-girls' Year 7-13 school and School B was a Year 7-8 intermediate school which catered for younger students who were generally between 11 and 13 year of age.

There were no subject areas in which there were only male teachers (Figure 6). The tests for differences between genders and differences between schools were statistically non-significant.

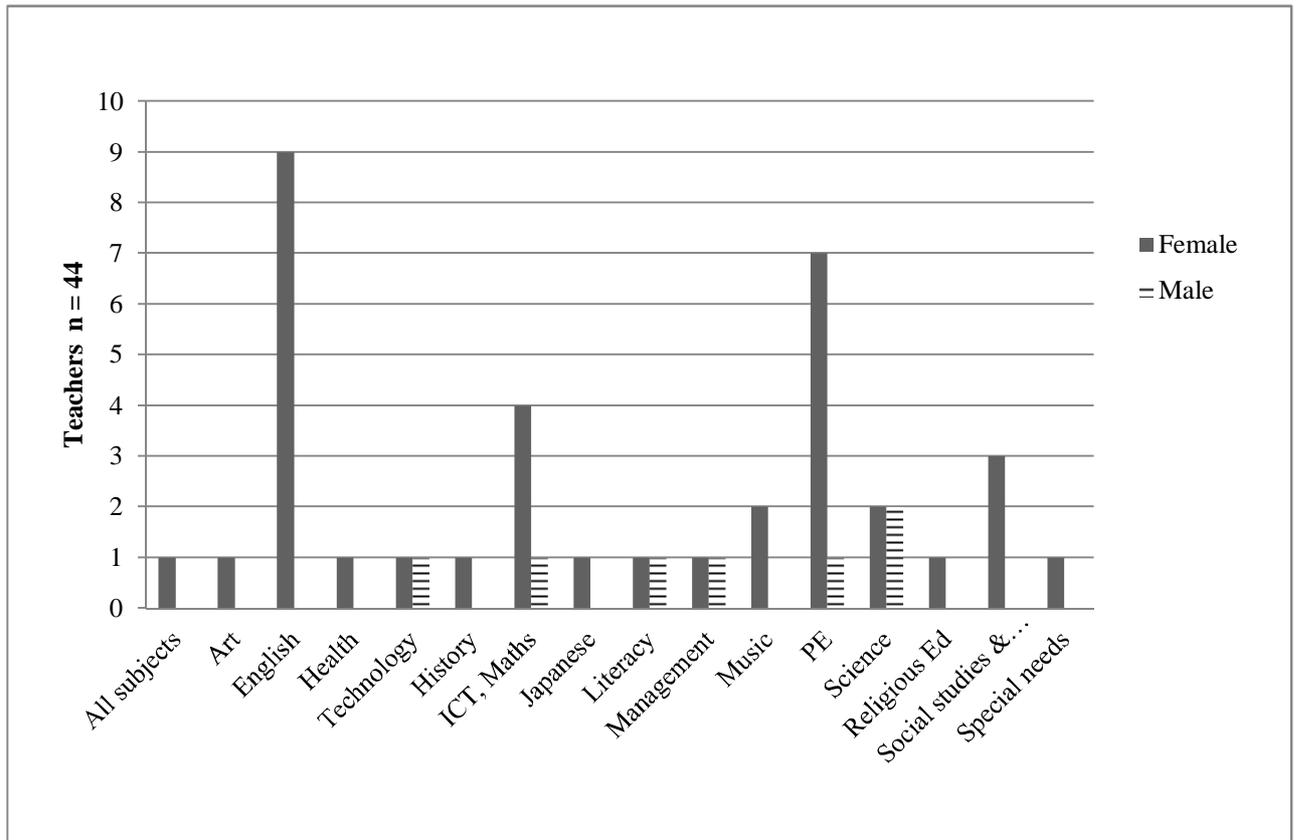


Figure 6. Baseline Demographic Data: Teaching Subjects by Gender

**Teachers' positions in schools.** This baseline question was designed to discover the number of actual classroom teachers in the programme because the reverse-mentored programme was intended to assist classroom teachers to enhance student learning through their use of ICT in their teaching. Thirty one (80%) of the 39 teachers who answered this question reported they were full time classroom teachers. Two (5%) teachers in School A and four (10%) teachers in School B reported they were both managers and teachers. Also two (5%) teachers in School B reported that they were primarily managers but also taught regularly. The tests for differences between genders and differences between schools were statistically non-significant.

Table 4

*Baseline Demographic Question: Teaching Experience*

		Gender				School		
		Female	Male	Total		School A	School B	Total
< 3 years	Count	3	0	3		0	3	3
	% within Gender	8%	0%	7%	% within school	0%	15%	7%
< 5 years	Count	7	1	8		1	7	8
	% within Gender	19%	14%	18%	% within school	4%	35%	18%
5 - 10 years	Count	9	2	11		11	0	11
	% within Gender	24%	29%	25%	% within school	46%	0%	25%
> 15 years	Count	8	0	8		6	2	8
	% within Gender	22%	0%	18%	% within school	25%	10%	18%
> 20 years	Count	9	4	13		5	8	13
	% within Gender	24%	57%	30%	% within school	21%	40%	30%
> 25 years	Count	1	0	1		1	0	1
	% within Gender	3%	0%	2%	% within school	4%	0%	2%
Total		37	7	44		24	20	44

**Teaching experience.** Thirty three (75%) of the 44 participant teachers were experienced practitioners with teaching experience ranging from 5 to 25 years. The result of the chi-square test on the data in Table 4 indicated a significant association between schools and teaching experience,  $X^2(10, N = 44) = 23.953 p = 0.008$ . Twenty three of the experienced teachers (those with five or more years of teaching experience) were from School A and ten were from School B.

***Teachers' full-time use of NZ Ministry of Education laptops for teachers' scheme.***

The TELA scheme (subsidised laptops for teachers) was an initiative by the New Zealand Ministry of Education to supply teachers with subsidised laptops for their professional and personal use. The laptops were two-thirds funded by the Ministry with a three year lease for each laptop. The school or the teacher concerned funded the other third of the lease. The TELA initiative underpinned the Ministry's efforts to engage teachers in the use of technologies. The inclusion of TELA data in this study was considered important as ready access to personal laptops had a potential to influence teachers' confidence in the use of computers (Cowie et al., 2007, p. 45).

Twenty (61%) of the 33 teachers answering this baseline question had full-time use of a TELA laptop for more than a year. Eight (24%) of the teachers had laptops for between 7-12 months and five (15%) teachers had the use of laptops for less than six months. The result of the chi-square test on the association between schools and teachers' use of TELA laptops, was statistically non-significant although the differences approached significance,  $X^2(5, N = 33) = 10.042$   $p = 0.07$ . The results of the tests for differences between genders were statistically non-significant.

***Teachers' access to the Internet outside the school environment.*** Teachers from both schools had similar patterns of connectivity. Thirty two teachers (82%) of the 39 respondents had access to a broadband Internet connection outside of school. Five (13%) teachers used dial-up connections and two (5%) had no connection to the Internet outside the school environment. Internet use was regarded as an important method for access to educational resources and the development of computer skills generally. The results of the tests for differences between genders and differences between schools were statistically non-significant.

### **Baseline questions on professional development**

#### ***Frequency of teachers' formal ICT professional development in last two years.***

Twenty one (52%) of the forty teachers who answered baseline question 1 reported they had not received any formal professional development in ICT in the last two years. Twelve (30%) of the teachers reported they had attended the professional development for one or two days in the past two years. Four (10%) teachers reported they had received between three and four days of professional development in that time and three (8%) teachers reported they had received five or more days of formal ICT professional development in the last two years.

The results of Levene's test for equality of variance indicated a significance difference for the variances of attendance times for formal ICT professional development based on the teachers' schools,  $F(5.980)$ ,  $p = 0.01$ . The results of the tests for differences between genders were statistically non-significant.

***Frequency of teachers' ICT focussed conferences in the last two years.*** Thirty two (80%) of the 40 teachers who answered baseline question 2 reported they had not attended any ICT focussed conferences in the last two years. Seven (17%) reported they had attended conferences for between 1-5 days in that time and one (3%) of the teachers reported attending ICT focused conferences for between six and ten days in the last two years.

The result of the chi-square test indicated a significant association between schools and the time teachers were able to attend ICT professional development programmes,  $X^2(2, N = 40) = 10.000$   $p = 0.007$ . The results of the tests for differences between genders were statistically non-significant.

***Teachers' preferences for learning through working on own with written support materials.*** Thirty (78%) of the thirty eight teachers who answered baseline question 3(a) ranked this method of learning low in their list of learning preferences. Four (11%) of the teachers ranked this method of learning high in their preferences and four (11%) teachers were neutral in their opinion.

The results of the independent samples *t*-test indicated a significant difference between mean scores for female teachers ( $M = 4.47$ ,  $SD = 1.107$ ) and male teachers ( $M = 3.33$ ,  $SD = 1.633$ ),  $t(38) = 2.138$ ,  $p = 0.03$ . The results of the tests for differences between schools were statistically non-significant.

***Teachers' preferences for learning through working one-to-one with mentor.*** Thirty four (86%) of the 40 teachers who answered baseline question 3(b) placed this method of learning in the top two places of their learning preferences and three (7%) of the teachers were neutral in their opinions. Three (7%) teachers ranked this learning option low in the preferences. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Teachers' preferences for learning through informally working with others.*** Thirty three (83%) of the 40 teachers who answered baseline question 3(c) placed this method of learning in the top three places in their list of preferences and seven (17%) of the teachers recorded they did not prefer this method of learning. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Teachers' preferences for learning through working in a small group.*** Twenty nine (73%) of the 40 of the teachers who answered baseline question 3(d) placed this method of

learning in the top three places in their list of learning preferences and 11 (27%) placed this method of learning as their least preferred option. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Teachers' preference for learning through working in a large group.*** Thirty four (85%) of the forty teachers who answered baseline question 3(e) placed this method of learning in the bottom two places in their list of learning preferences. Six (15%) recorded that they preferred this method of learning. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Teachers' preferences for learning with the help of an ICT technically competent student.*** Twenty nine (74%) of the 39 teachers who answered baseline question 3(f) placed this method of learning in the top three places of their preferences for learning. Ten (26%) of the teachers reported they did not regard this as an attractive method of learning. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Teachers' preferences for working with others with the same or similar skill levels.*** Twenty (51%) of the 39 teachers who answered baseline question 4(a) preferred working with others of the same or similar levels of skills. Ten (26%) of the teachers expressed preferences for working with others with a mixture of skills levels in the group. Nine (23%) teachers reported they were not in favour of working in this way. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Teachers' learning preferences for working with others in the same school.*** Twenty two (56%) of the 39 teachers who answered baseline question 4(b) preferred learning through working with staff from their own school. Seventeen (44%) recorded they had no preferences with regard to this method of learning.

The result of the chi-square test indicated a significant association between schools and teachers' preferences in working with others in the same school,  $X^2 (1, N = 39) = 5.770 p = 0.01$ . The results of the tests for differences between genders were statistically non-significant.

***Teachers' learning preferences for working with members of own department or syndicate.*** Thirteen (33%) of the 39 teachers who answered baseline question 4(c) preferred learning through working with members of their own department or syndicate. One (3%) teacher reported a preference for working with members of other departments or syndicates and 25 (64%) indicated they had no preferences either way.

The result of the chi-square test indicated a significant association between schools and teachers' learning preferences,  $X^2 (2, N = 39) = 5.74753 p = 0.05$ . The results of the tests for differences between genders were statistically non-significant.

***Teachers' learning preferences for using adult facilitators or student mentors.*** The data from the 39 teachers who answered baseline question 4(d) have been detailed in Table 5.

Table 5

*Baseline Question 4(d): Teachers' Learning Preferences for Working with Student Mentor or Adult Facilitator*

		Gender			School		
		Female	Male	Total	School A	School B	Total
Student mentor	Count	16	1	17	11	6	17
	% within gender	32%	40%	33%	% within school	58%	32%
Adult facilitator	Count	3	3	6	4	2	6
	% within gender	3%	0%	3%	% within school	21%	11%
No Preference	Count	14	1	15	4	11	15
	% within gender	65%	60%	64%	% within school	21%	58%
Total	Count	33	5	38	19	19	38

The result of the chi-square test indicated a significant association between gender and teachers' preferences,  $X^2(2, N = 38) = 8.468$   $p = 0.01$ . The results also indicated that the association between schools and teachers' preferences were statistically non-significant but the differences were approaching significance,  $X^2(2, N = 38) = 5.404$   $p = 0.06$ .

***Teachers' preferences for ICT professional development through after school sessions.*** Twenty one (57%) of the 37 teachers who answered baseline question 5(a) considered they were either enthusiastic about after school sessions for professional development or they could arrange the time for the sessions. Sixteen (43%) teachers expressed reluctance to take part in this type of programme. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Teachers' preferences for ICT professional development on occasional Saturday mornings.*** No teacher was enthusiastic about a proposal to attend professional development

on a Saturday morning. Nineteen (50%) of the 38 teachers who answered baseline question 5(b) reported they could not attend Saturday morning sessions or that the sessions were beyond reasonable expectation. Twelve (32%) of the teachers replied that they could attend but would rather not and seven (18%) teachers replied that they could arrange to attend Saturday morning sessions. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Teachers' preferences for ICT professional development on several Saturday mornings.*** No teacher was enthusiastic about the prospect of using Saturday mornings for professional development. Eighteen (47%) of the 38 teachers who answered baseline question 5(c) indicated they considered professional development on several Saturday mornings beyond reasonable expectation. Seventeen (45%) teachers recorded they either could not or would rather not attend these sessions. Three (8%) of the teachers considered they could arrange to take part in the programme. The tests for differences between genders and differences between schools were statistically non-significant.

***Teachers' views on ICT professional development on whole or half day during school holidays.*** Two (5%) of the 38 teachers who answered baseline question 5(d) were enthusiastic about attending ICT professional development during the school holidays. Ten (26%) teachers recorded they could arrange to attend such professional development, and eleven (29%) teachers said they could arrange to attend the sessions but would rather not. Six (16%) teachers said they would attend but could not arrange to do so. Nine (24%) teachers considered the school holiday programme was beyond reasonable expectation.

The result of the chi-square test indicated a significant association between schools and teachers' preferences for the use of a whole or half-day in the school holidays for

professional development,  $X^2(4, N = 38) = 15.878$   $p = 0.003$ . The results of the  $t$ -test for independent samples indicated significant differences between mean scores for School A ( $M = 3.89$ ,  $SD = 0.900$ ) and School B ( $M = 2.70$ ,  $SD = 1.261$ ),  $t(36) = 3.311$ ,  $p = 0.002$ .

***Teachers' views on ICT professional development for whole day during school holidays.*** Fourteen (36%) of the 38 teachers who answered baseline question 5(e) were either enthusiastic about using a day during the school holidays for ICT professional development or said they could arrange to attend the sessions. A further seven (19%) said that although they could arrange to attend they would rather not. Five (13%) teachers replied that they would attend but they could not arrange to do so. Twelve (32%) teachers considered the proposal beyond their reasonable expectation.

The result of the chi-square test indicated a significant association between schools and teachers' preferences for using a day of their school holidays for professional development,  $X^2(4, N = 38) = 10.486$   $p = 0.03$ . The results of the  $t$ -test for independent samples indicated significant differences between mean scores for School A ( $M = 3.83$ ,  $SD = 1.200$ ) and School B ( $M = 2.65$ ,  $SD = 1.599$ ),  $t(36) = 2.557$ ,  $p = 0.01$ .

***Frequency of teachers' professional development for use of ICT in education in last two years.*** Twenty seven (68%) of the 40 teachers who responded to baseline question 6 recorded they had not attended any professional development for the use of ICT in education in the last two years. Thirteen (32%) teachers reported they had attended professional development on the use of ICT in education. An important feature of these data is 26 (96%) of the teachers who had not attended any of this type of professional development were female.

The result of the chi-square test indicated a significant association between gender and teachers attending the professional development,  $X^2 (1, N = 40) = 8.315 p = 0.004$ . Additionally the chi-square test result indicated a further significant association between schools and teachers attending the professional development programmes,  $X^2 (1, N = 40) = 9.213 p = 0.002$ .

***Frequency of teachers' participation in professional development online community.*** Thirty three (83%) of the 40 teachers responding to baseline question 8 recorded they did not participate in an online community for professional development. Seven (17%) teachers recorded they participated in an online community either regularly or occasionally. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Teachers' focus on ICT issues in professional development this year.*** Thirty four (87%) of the 39 teachers responding to baseline question 9 reported that ICT issues in professional development were of a secondary or low priority for them this year. Five (13%) teachers recorded that ICT issues were a major focus for them this year. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Teachers' preferences for ICT professional development through study groups.*** Seventeen (42%) of the 40 teachers responding to baseline question 11(a) indicated that study groups for ICT professional development had strong appeal or some appeal. Thirteen (33%) teachers had no views either way. Ten (25%) of the teachers said they either hated the option or found it did not appeal. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Teachers' preferences for ICT professional development through technology***

***coaches.*** Six (15%) of the 40 teachers responding to baseline question 11(b) indicated they considered ICT professional development through technology coaches had strong appeal. Twelve (30%) found the option had some appeal. Eleven (28%) of the teachers had no views either way. Eight (20%) teachers reported the option did not appeal and three (7%) of the teachers reported they would hate the option of using of technology coaches for ICT professional development. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Teachers' preferences for ICT professional development through technology***

***mentors.*** Nine (23%) of the 40 teachers responding to baseline question 11(c) indicated they considered ICT professional development through technology mentors had strong appeal. Twenty (50%) of the teachers considered this option had some appeal and five (12%) teachers had no views either way. Five (12%) teachers recorded the option did not appeal and one (3%) teacher recorded s/he would hate the option.

The results of the *t*-test for independent samples indicated a significant difference between mean scores for female teachers ( $M = 2.09$ ,  $SD = 0.933$ ) and male teachers ( $M = 3.00$ ,  $SD = 1.265$ ),  $t(38) = 2.094$ ,  $p = 0.04$ . The results of the tests for differences between schools were statistically non-significant.

***Teachers' views on ICT professional development from on-the-spot student***

***mentors.*** Nineteen (48%) of the 40 teachers responding to baseline question 11(d) indicated they considered ICT professional development through student mentors had strong appeal. Sixteen (40%) of the teachers considered this option had some appeal. Three (7%) of the

teachers had no views either way. Two (5%) teachers recorded the professional development option either did not appeal or that they would hate it. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Teachers' preferences for ICT professional development through tutorials.*** Five (13%) of the 40 teachers who responded to baseline question 11(e) indicated they considered ICT professional development through tutorials had strong appeal. Fifteen (37%) of the teachers considered the option had some appeal. Eight (20%) of the teachers had no views either way. Eight (20%) considered this option did not appeal and four (10%) reported they would hate having to take this option for professional development. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Teachers' preferences for ICT professional development through workplace visits.*** Seven (18%) of the 40 teachers who answered baseline question 11(f) considered this method of professional development option had strong appeal. Eleven (27%) teachers considered the option had some appeal and six (15%) teachers had no views either way. Ten (25%) teachers reported the option did not appeal to them and six (15%) teachers said they would hate this option for professional development.

The results of the chi-square test indicated a significant association between schools and teachers' preferences,  $X^2(4, N = 40) = 10.777, p = 0.02$ . The results of the  $t$ -test for independent samples indicated a significant difference between mean scores for School A ( $M = 3.55, SD = 1.146$ ) and School B ( $M = 2.30, SD = 1.302$ ),  $t(38) = 3.223, p = 0.003$ . The results of the tests for differences between genders were statistically non-significant.

***Teachers' views on ICT professional development through retreats or intensive practicums.*** Six (15%) of the 40 teachers who answered baseline question 11(g) considered this form of professional development option had strong appeal. Nine (23%) of the teachers considered the option had some appeal and four (10%) teachers had no views either way. Ten (25%) teachers reported the option did not appeal to them and eleven (27%) teachers said they would hate this option for professional development.

The result of the chi-square test indicated a significant association between schools and teachers' preferences,  $X^2(4, N = 40) = 9.832, p = 0.04$ . The results of the *t*-test for independent samples indicated a significant difference between mean scores for School A ( $M = 3.75, SD = 1.372$ ) and School B ( $M = 2.80, SD = 1.436$ ),  $t(38) = 2.139, p = 0.03$ . The results of the tests for differences between genders were statistically non-significant.

***Teachers' preferences for ICT professional development through release time.*** Eleven (28%) of the 40 teachers who answered baseline question 11(h) considered this form of professional development option had strong appeal. Fifteen (37%) of the teachers considered the option had some appeal and eight (20%) teachers had no views either way. Four (10%) teachers reported the option did not appeal to them and two (5%) teachers said they would hate this option for professional development.

The results of the *t*-test for independent samples indicated a significant difference between mean scores for female teachers ( $M = 2.09, SD = 1.026$ ) and male teachers ( $M = 3.33, SD = 1.211$ ),  $t(38) = 2.672, p = 0.01$ . The results of the tests for differences between schools were statistically non-significant.

***Teachers' preferences for ICT professional development through online discussion groups.*** No teacher recorded this option as having strong appeal. Nine (23%) of the 40 teachers who answered baseline question 11(i) considered this form of professional development option had some appeal. Six (15%) of the teachers had no views either way. Fifteen (37%) teachers considered this option had no appeal. Ten (25%) of the teachers said they would hate this option for professional development.

***Teachers' preferences for ICT professional development through after-hours workshops or seminars.*** One (3%) of the 40 teachers who answered baseline question 11(j) considered this form of professional development option had strong appeal. Twelve (30%) of the teachers considered the option had some appeal and 12 (30%) teachers had no views either way. Five (12%) teachers reported the option did not appeal to them and ten (25%) teachers said they would hate this option for professional development.

The results of Levene's test for equality of variance indicated a significance difference in variances based on teachers' schools for this form of professional development,  $F(5.713), p = 0.02$ . The results of the tests for differences between genders were statistically non-significant.

***ICT can help improve curriculum provision in my classroom.*** Thirteen (33%) of the 40 teachers who answered baseline question 12(a) indicated they strongly agreed with the statement that ICT can help improve curriculum provision. Seventeen (42%) of the teachers agreed with the statement and 10 (25%) teachers were not sure of their certainty with regard to this statement. No teacher disagreed with the statement. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Investment in ICT can be justified by teaching and learning outcomes.*** Fourteen (35%) of the 40 teachers who answered baseline question 12(b) indicated they strongly agreed with the statement that ICT can help improve curriculum provision. Twelve (30%) of the teachers agreed with the statement and 12 (30%) teachers were not sure of their certainty with regard to this statement. Two (5%) teachers disagreed with the statement. The results of the tests for differences between genders and differences between schools were statistically non-significant.

### **Baseline levels of teachers' confidence in using ICT**

***Baseline levels of confidence using ICT personally.*** Four (10%) of the 40 teachers who answered baseline question 13(a) considered themselves very confident with using ICT personally. Fifteen (37%) teachers considered themselves confident with using ICT personally and nine (23%) rated themselves as neutral. Nine (23%) teachers rated themselves as not confident and three (7%) teachers considered themselves as anxious with using ICT personally. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***End of programme levels of confidence using ICT personally.*** Ten (32%) of the 31 teachers who answered end of project question 1(a) at the end of the reverse-mentored programme considered themselves very confident with using ICT's personally. Twenty (65%) teachers said they were either confident or neutral and one (3%) of the 31 teachers reported not being confident with using ICT personally. The baseline survey recorded 12 teachers as being either not confident or anxious in this regard.

***Baseline level of confidence using ICT with classes.*** Three (7%) of the 40 teachers who answered baseline question 13(b) considered themselves very confident with using ICT with classes. Thirteen (32%) teachers considered they were confident with using ICT with classes and nine (23%) reported a rating of neutral. Seven (18%) teachers reported they were not confident and eight (20%) teachers considered they were anxious in using ICT with classes. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***End of programme levels of confidence using ICT with their classes.*** The baseline survey recorded 15 (38%) of 40 teachers who regarded themselves as being either not confident or anxious using ICT with their classes. The results from end of project question 1(b) indicated only one of the 31 teachers answering this question as being not confident with using ICT in their classes. No teacher recorded being anxious in the end of project questionnaire. Additionally, the results of an independent samples *t*-test on the data from the end of project question 1(b) described in Chapter Six indicated significant differences in the mean scores for both schools and gender.

### **Baseline levels of teachers' ICT concerns**

***Concerns over access to equipment for student use.*** Ten (25%) of the 39 teachers who answered baseline question 14(a) reported they had significant concerns about access to equipment for students. Fifteen (39%) teachers reported some concern and 14 (36%) teachers reported no concerns. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Concerns over insufficient or poor technical support.*** Eleven (28%) of the 39 teachers who answered baseline question 14(b) reported they had significant concerns about

insufficient or poor technical support. Twelve (31%) teachers reported some concern and 16 (41%) teachers reported no concerns. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Concerns over making links between ICT and teaching and learning.*** Fourteen (36%) of the 39 teachers who answered baseline question 14(c) reported they had significant concerns over making links between ICT and teaching and learning. Seventeen (44%) teachers reported some concern and eight (20%) teachers reported no concerns. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Concerns over a lack of ideas of how to use ICT with classes.*** Twelve (31%) of the 39 teachers who answered baseline question 14(d) reported they had significant concerns over a lack of ideas of how to use ICT with classes. Twenty (51%) teachers reported some concern and seven (18%) teachers reported no concerns. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Concerns over a lack of time to cope with it all.*** Twenty four (62%) of the 39 teachers who answered baseline question 14(e) reported they had significant concerns over having time to cope with it all. Eleven (28%) teachers reported some concern and four (10%) teachers reported no concerns. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Concerns over a need for on-going professional development.*** Fifteen (39%) of the 39 teachers who answered baseline question 14(f) reported they had significant concerns over

the need for on-going professional development. Nineteen (49%) teachers reported some concern and five (12%) teachers reported no concerns. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Concerns over keeping up-to-date with required skills and knowledge on ICT developments.*** Twenty (51%) of the 39 teachers who answered baseline question 14(g) reported they had significant concerns over the need to keep up-to-date with required ICT skills and knowledge. Sixteen (41%) teachers reported some concern and three (8%) teachers reported no concerns. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Concerns over equipment technical reliability or equipment breakdown.*** Twelve (31%) of the 39 teachers who answered baseline question 14(h) reported they had significant concerns over technical reliability or equipment breakdown. Nineteen (49%) teachers reported some concern and eight (20%) teachers reported they had no concerns. The results of the tests for differences between genders and differences between schools were statistically non-significant.

### **Baseline teachers' frequency ICT use**

***Frequency of ICT use in finding or producing resources for lessons.*** Six (15%) of the 40 teachers who answered baseline question 15(a) reported they always used ICT to find or produce lesson resources. Fifteen (38%) teachers reported they often used ICT for this purpose and five (12%) reported they had sometimes used ICT in this way. Fourteen (35%) teachers reported they had rarely or had never used ICT for lesson resources. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Frequency of ICT use in school administration.*** Seventeen (42%) of the 40 teachers who answered baseline question 15(b) reported they always used ICT for school administration. Thirteen (33%) teachers reported they often used ICT for this purpose and eight (20%) reported they had sometimes used ICT for school administration. Two (5%) teachers reported they had rarely used ICT for administration. No teacher reported not using ICT for school administration. The results of the tests for differences between genders and differences between schools were statistically non-significant.

#### **Baseline levels of achievement in ICT competencies**

***Basic computer operations levels of attainment.*** Five (12%) of the 39 teachers who answered baseline question 16(a) reported they had a very high level of attainment in basic computer operations. Seven (18%) teachers reported they had high levels of attainment and 12 (31%) teachers reported they had moderate levels of attainment in basic computer operations. Eight (21%) teachers reported their levels of attainment were low and seven (18%) teachers reported very low levels of attainment. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Current level of attainment with computer files management.*** Six (15%) of the 40 teachers who answered baseline question 16(b) reported they had a very high level of attainment in file management. Seven (17%) teachers reported they had high levels of attainment and 11 (28%) teachers reported they had moderate levels of attainment in file management. Seven (17%) teachers reported their levels of attainment were low and nine (23%) teachers reported very low levels of attainment.

Results of the *t*-test for independent samples indicated a significant difference between mean scores for School A ( $M = 3.60$ ,  $SD = 1.392$ ) and School B ( $M = 2.70$ ,  $SD = 1.281$ ),  $t(38) = 2.176$ ,  $p = 0.03$ . There were no statistically significant differences between genders and teachers' levels of attainment.

***Current level of attainment with word processing.*** Six (15%) of the 40 teachers who answered baseline question 16(c) reported they had a very high level of attainment with word processing. Eleven (27%) teachers reported they had high levels of attainment and 16 (40%) teachers reported they had moderate levels of attainment in word processing. Four (10%) teachers reported their levels of attainment were low and three (8%) teachers reported very low levels of attainment. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Current level of attainment with spreadsheets.*** One (2%) of the 40 teachers who answered baseline question 16(d) reported a very high level of attainment in the use of spreadsheets. Four (10%) teachers reported they had high levels of attainment and ten (25%) teachers reported they had moderate levels of attainment in the use of spreadsheets. Thirteen (33%) teachers reported their levels of attainment were low and 12 (30%) teachers reported very low levels of attainment.

The result of the chi-square test indicated a significant association between schools and teachers' levels of attainment using spreadsheets,  $X^2(4, N = 40) = 10.626$ ,  $p = 0.03$ . Results of the *t*-test for independent samples indicated a significant difference between mean scores for School A ( $M = 3.75$ ,  $SD = 1.333$ ) and School B ( $M = 3.80$ ,  $SD = 0.768$ ),  $t(38) = 2.479$ ,  $p = 0.01$ . A further *t*-test for independent samples indicated a significant difference

between mean scores between the female teachers ( $M = 3.94$ ,  $SD = 0.983$ ) and the male teachers ( $M = 2.83$ ,  $SD = 1.169$ ),  $t(38) = 2.479$ ,  $p = 0.01$ .

***Current level of attainment with databases.*** One (2%) of the 40 teachers who answered baseline question 16(e) reported a very high level of attainment in the use of databases. Two (5%) teachers reported they had high levels of attainment and ten (25%) reported they had moderate levels of attainment in the use of databases. Twelve (30%) teachers reported their levels of attainment were low and 15 (38%) teachers reported very low levels of attainment.

The result of the chi-square test on differences between genders and the teachers' levels of attainment using databases were statistically non-significant but the differences were approaching significance,  $X^2(4, N = 40) = 9.020$   $p = 0.06$ . The result of the  $t$ -test for independent samples indicated a significant difference in mean scores between the female teachers ( $M = 4.12$ ,  $SD = 0.880$ ) and the male teachers ( $M = 3.00$ ,  $SD = 1.414$ ),  $t(38) = 2.610$ ,  $p = 0.01$ . A further  $t$ -test for independent samples indicated a significant difference between mean scores for School A ( $M = 4.35$ ,  $SD = 0.875$ ) and School B ( $M = 3.55$ ,  $SD = 1.050$ ),  $t(38) = 2.617$ ,  $p = 0.01$ .

***Current level of attainment with graphics.*** Two (5%) of the 40 teachers who answered baseline question 16(f) reported a very high level of attainment in the use of graphics. Six (15%) teachers reported they had high levels of attainment and 15 (37%) teachers reported they had moderate levels of attainment in the use of graphics. Eight (20%) teachers reported their levels of attainment were low and nine (23%) teachers reported very low levels of attainment.

The result of the  $t$ -test for independent samples indicated a significant difference between mean scores for School A ( $M = 3.85$ ,  $SD = 0.933$ ) and School B ( $M = 2.95$ ,  $SD = 1.191$ ),  $t(38) = 2.660$ ,  $p = 0.01$ . The results of the tests for differences between genders were statistically non-significant.

***Current level of attainment in use of the Internet.*** Five (12%) of the 40 teachers who answered baseline question 16(g) reported a very high level of attainment in the use of the Internet. Ten (25%) teachers reported they had high levels of attainment and 12 (31%) teachers reported they had moderate levels of attainment in the use of the Internet. Eight (20%) teachers reported their levels of attainment were low and five (12%) teachers reported very low levels of attainment.

The result of the chi-square test indicated a significant association between the teachers' gender and their levels of attainment using the Internet,  $X^2(4, N = 40) = 9.477$ ,  $p = 0.05$ . The result of the  $t$ -test for independent samples indicated a significant difference in mean scores between the female teachers ( $M = 3.12$ ,  $SD = 1.149$ ) and the male teachers ( $M = 2.00$ ,  $SD = 1.265$ ),  $t(38) = 2.167$ ,  $p = 0.03$ .

***Current level of attainment in use of telecommunications.*** Eight (20%) of the 40 teachers who answered baseline question 16(h) reported a very high level of attainment in the use of telecommunications. Ten (25%) teachers reported they had high levels of attainment and 13 (32%) teachers reported they had moderate levels of attainment in the use of telecommunications. Six (15%) teachers reported their levels of attainment were low and three (8%) teachers reported very low levels of attainment. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Current level of attainment in use of multimedia.*** Three (7%) of the 40 teachers who answered baseline question 16(i) reported a very high level of attainment in the use of presentation media and multimedia. Six (15%) teachers reported they had high levels of attainment and 12 (30%) teachers reported they had moderate levels of attainment in the use of presentation media and multimedia. Five (13%) teachers reported their levels of attainment were low and 14 (35%) teachers reported very low levels of attainment. The tests for differences between genders and differences between schools were statistically non-significant.

***Courses completed on the use of computers in education.*** One (2%) of the 39 teachers who had answered baseline question 18 had completed a course on the use of computers in education and 38 (98%) of the teachers reported they had not attended or completed such a course. The tests for differences between genders and differences between schools were statistically non-significant.

***Proportion of units of work in the last year which contained ICT based learning.*** Two (5%) of the 38 teachers who answered baseline question 20 reported all or most of the units they used in the last year contained ICT based learning. Two (5%) teachers reported they used ICT in most of the units they used. Thirteen (34%) teachers reported they had used several units containing ICT based learning in the last year and eight (21%) teachers reported they had used one or two units in this way. Thirteen (35%) teachers reported they had not used ICT in this way. The results of the tests for differences between genders and differences between schools were statistically non-significant.

### **Baseline levels of student use of ICT**

*Average times in last year students used text and picture presentation for communication.* Five (13%) of the 39 teachers who answered baseline question 21(a)(1) reported their students had used text and picture presentation for communication daily or almost daily. Five (13%) teachers reported their students had used this method for communication once or twice a week. Fifteen (38%) teachers reported they had used ICT's in this way once or twice a term and seven (18%) of the teachers reported they had used ICT in this way once or twice a year. Seven (18%) teachers reported they had not used ICT in this way at all. The results of the tests for differences between genders and differences between schools were statistically non-significant.

*Average times in the last year students used multimedia presentation for communication.* Three (7%) of the 39 teachers who answered baseline question 21(a)(2) reported their students had used multimedia presentation for communication daily or almost daily. One (3%) teacher reported they used this method for students' communication once or twice a week. Twelve (31%) teachers reported they had used ICT's in this way once or twice a term and 12 (31%) of the teachers reported they had used ICT in this way once or twice a year. Eleven (28%) teachers reported they had not used ICT in this way at all.

The results of Levene's test for equality of variance indicated a significance difference in variances based on schools and teachers' use of ICT for students' communication using multimedia presentation,  $F(4.414)$ ,  $p = 0.04$ . The results of the tests for differences between genders were statistically non-significant.

*Average times in the last year students used on-line interaction for communication.* Two (5%) of the 39 teachers who answered baseline question 21(a)(3) reported their students

had used on-line interaction communication daily or almost daily. Six (15%) teachers reported they used this method for students' communication once or twice a week. Further six (15%) teachers reported they had used ICT's in this way once or twice a term and eight (21%) of the teachers reported they had used ICT in this way once or twice a year. Seventeen (44%) teachers reported they had not used ICT in this way at all. The tests for differences between genders and differences between schools were statistically non-significant.

*Average frequencies in the last year students used ICT for creativity.* Three (8%) of the 39 teachers who answered baseline question 21(b) reported their students had used ICT for creativity daily or almost daily. Seven (18%) teachers reported their students had used this method for students' creativity once or twice a week. Six (15%) teachers reported their students had used ICT's in this way once or twice a term and seven (18%) of the teachers reported their students had used ICT in this way once or twice a year. Sixteen (41%) teachers reported their students had not used ICT in this way at all. The tests for differences between genders and differences between schools were statistically non-significant.

*Average times in the last year students used ICT for information gathering and processing.* Five (13%) of the 39 teachers who answered baseline question 21(c) reported their students had used ICT for information gathering or processing daily or almost daily. Fifteen (38%) teachers reported their students had used ICT in this way once or twice a week. Ten (26%) teachers reported they had used ICT's for information gathering or processing once or twice a term and five (13%) of the teachers reported they had used ICT in this way once or twice a year. Four (10%) teachers reported they had not used ICT in this way at all. The tests for differences between genders and differences between schools were statistically non-significant.

*Average frequencies in the last year students used ICT for problem solving.* Two (5%) of the 39 teachers who answered baseline question 21(d) reported they had used ICT for student problem solving once or twice a week. Thirteen (33%) teachers reported their students had used ICT in this way once or twice term. Four (10%) teachers reported their students had used ICT's for problem solving once or twice a year and 20 (52%) teachers reported they had not used ICT in this way at all. No teachers reported using ICT in this way on a daily or almost daily basis.

The results of Levene's test for equality of variance indicated a significance difference in variances based on schools and teachers' use of ICT for students' problem solving,  $F(6.233), p = 0.01$ . The results of the tests for differences between genders were statistically non-significant.

*Average frequencies in the last year ICT was used for curriculum practice.* Three (8%) of the 38 teachers who answered baseline question 21(e) reported they had used ICT for curriculum practice daily or almost daily Three (8%) teachers reported their students had used ICT in this way once or twice a week. Seven (18%) teachers reported they had used ICT's for curriculum practice once or twice a term and nine (24%) of the teachers reported they had used ICT in this way once or twice a year. Sixteen (42%) teachers reported they had not used ICT in this way at all.

The result of the chi-square test indicated a significant association between schools and teachers' frequencies using ICT's for curriculum practice,  $X^2(4, N = 38) = 12.559, p = 0.01$ . The result of the  $t$ -test for independent samples indicated a significant difference in mean scores between School A ( $M = 4.26, SD = 0.991$ ) and School B ( $M = 3.42, SD = 1.427$ ),  $t(36) = 2.113, p = 0.04$ . The results of Levene's test for equality of variance indicated

a significance difference in variances based on schools and teachers' use of ICT for curriculum practice,  $F(5.716)$ ,  $p = 0.02$ . The results of the tests for differences between genders were statistically non-significant.

***Average frequencies in the last year students used ICT technical skills.*** Three (8%) of the 39 teachers who answered baseline question 21(f) reported their students had used ICT technical skills daily or almost daily. Six (15%) teachers reported their students had used ICT in this way once or twice a week. Ten (26%) teachers reported their students had used ICT technical skills once or twice a term and seven (18%) of the teachers reported their students had used ICT in this way once or twice a year. Thirteen (33%) teachers reported their students had not used ICT in this way at all. The tests for differences between genders and differences between schools were statistically non-significant.

***Average times in the last year students used ICT for collaborative learning/social interaction.*** One (2%) of the 38 teachers who answered baseline question 21(g) reported their students had used ICT for collaborative learning and social interaction once or twice a week. Eight (21%) teachers reported their students had used ICT in this way once or twice a term. Six (16%) teachers reported their students had used ICT for collaborative learning and social interaction once or twice a year. Twenty three (61%) teachers reported they had not used ICT in this way at all. No teachers reported their students using ICT in this way daily or almost daily.

The results of Levene's test for equality of variance indicated a significance difference in variances based on schools and students' frequency of use of ICT for collaborative learning and social interaction,  $F(11.040)$ ,  $p = 0.02$ . There were no significant results for differences between the genders.

***Average frequencies in the last year for reward for motivating students' ICT work.***

Two (5%) of the 38 teachers who answered baseline question 21(h) reported they had used ICT for reward for motivating students' ICT work daily or almost daily. Two (5%) teachers reported their students had used ICT in this way once or twice a week. Ten (26%) teachers reported they had used ICT's for motivation or reward once or twice a term. Ten (26%) of the teachers reported they had used ICT in this way once or twice a year. Fourteen (38%) teachers reported they had not used ICT in this way at all.

The result of the *t*-test for independent samples indicated a significant difference in mean scores between School A ( $M = 4.20$ ,  $SD = 0.834$ ) and School B ( $M = 3.44$ ,  $SD = 1.338$ ),  $t(36) = 2.112$ ,  $p = 0.04$ . The results of Levene's test for equality of variance indicated a significance difference in variances based on schools and teachers use of ICT for motivation or reward,  $F(4.719)$ ,  $p = 0.03$ . There were no significant results for differences between the genders.

**Baseline levels of teachers' support in their use of ICT in classes**

***Frequency of informal advice to colleagues about using ICT for teaching and learning.*** Three (7%) of the 40 teachers who answered baseline question 22 reported they had informal collegial discussions every day or on most days. Six (15%) of the teachers reported they had discussions every week or most weeks. Twelve (30%) of the teachers reported they had discussions on some weeks. Nineteen (48%) of the teachers reported they had never had collegial discussions through which they offered advice about using ICT for teaching and learning. The results of the tests for differences between genders and differences between schools were statistically non-significant

***Frequency of informal or impromptu technical support for other staff using ICT with their classes.*** Three (7%) of the 40 teachers who answered baseline question 23 reported they provided informal or impromptu technical support to colleagues trying to use ICT with their classes either every day or every week. Two (5%) of the teachers reported they had provided support on most weeks. Ten (25%) of the teachers reported they had provided support on some weeks. Twenty five (63%) of the teachers reported they had never provided collegial support for staff trying to use ICT with their classes.

The result of the chi-square test indicated a significant association between gender and teachers' frequencies of providing collegial technical support,  $X^2(4, N = 40) = 9.725, p = 0.04$ . The results of Levene's test for equality of variance indicated a significance difference in variances based on teachers' gender and their provision of collegial technical support,  $F(11.059), p = 0.002$ . There were no significant results for differences between schools.

***Teachers' technical skills and knowledge in relation to computers.*** Four (10%) of the 40 teachers who answered baseline question 24 reported they rated their technical skills and knowledge with computers as accomplished. Twelve (30%) rated their skills and knowledge as proficient. Thirteen (32%) of the teachers reported emerging skills and 11 (28%) teachers reported they were novices with regard to technical skills and knowledge with computers. The results of the tests for differences between genders and differences between schools were statistically non-significant

***Teachers' technical skills and knowledge in relation to the Internet.*** Two (5%) of the 40 teachers who answered baseline question 25 reported they rated their technical skills and knowledge with the Internet as expert. Four (10%) teachers reported they were

accomplished users of the Internet and 14 (35%) of the teachers reported proficiency. Eighteen (45%) teachers considered they had emerging skills and two (5%) teachers considered themselves as novices with regard to Internet skills and knowledge. The results of the tests for differences between genders and differences between schools were statistically non-significant

***Teachers' levels of teaching experience using computers in the classroom.*** No teacher reported expertness in this field. Five (12%) of the 40 teachers who answered baseline question 26 reported they rated their level of experience as accomplished. Ten (25%) considered they were proficient with using computers in the classroom. Fourteen (35%) of the teachers reported emerging levels of competence and 11 (28%) teachers reported they were novices with regard to teaching experience using computers in the classroom. The results of the tests for differences between genders and differences between schools were statistically non-significant

***Level of support from other staff for using ICT in your teaching.*** Two (5%) of the 40 teachers who answered baseline question 27 reported they rated the level of support they received as excellent. Three (7%) teachers rated the support they received as very good and ten (25%) of the teachers recorded their level of support was good. Eleven (28%) of the teachers rated the support they received as adequate and 14 (35%) teachers rated the support they received as poor. The results of the tests for differences between genders and differences between schools were statistically non-significant

***Level of support you receive from your Principal and Board of Trustees for using ICT in teaching.*** One (3%) of the 38 teachers who answered baseline question 28 reported they rated the level of support they received as excellent. Four (10%) teachers rated the

support as very good. Five (13%) of the teachers recorded their level of support was good and 17 (45%) of the teachers rated the support they received as adequate. Eleven (29%) of the teachers rated the support they received from the Principal and Board of Trustees as poor. The results of the tests for differences between genders and differences between schools were statistically non-significant.

*Levels of support in using ICT received from students in your school.* One (3%) of the 37 teachers who answered baseline question 29 reported they rated the level of support they received as excellent. Six (16%) rated the support as very good and ten (27%) of the teachers recorded their level of support as good. Ten (27%) teachers rated the level of support as adequate and a further ten (27%) teachers rated the support as poor. The results of the tests for differences between genders and differences between schools were statistically non-significant.

*Teachers' current knowledge of recent ICT developments in New Zealand education.* Two (5%) of the 40 teachers who answered baseline question 30 considered their knowledge of recent educational ICT developments to be very good. Three (7%) teachers rated their knowledge as good and 12 (30%) rated their knowledge as adequate. Twenty three (58%) teachers rated their knowledge as poor.

The result of the chi-square test indicated a significant association between schools and teachers' current knowledge of ICT developments in New Zealand education,  $X^2(3, N = 40) = 7.464, p = 0.05$ . The result of the *t*-test for independent samples indicated a significant difference in mean scores between School A ( $M = 1.25, SD = 0.444$ ) and School B ( $M = 1.95, SD = 0.999$ ),  $t(38) = 2.864, p = 0.007$ . The results of Levene's test for equality of variance indicated a significance difference in variances based on schools and teachers' current

knowledge of ICT developments in New Zealand education,  $F(6.757)$ ,  $p = 0.01$ . There were no significant results for differences between the genders.

### **Baseline levels of teachers' use of ICT in pedagogies**

*Percentage of use of ICT's class on a weekly basis.* One (2%) of the 39 teachers who answered baseline question 31 reported 100% use of ICT's in class on a weekly basis. One (2%) teacher reported 90% use of ICT's in class and one (2%) teacher reported 80% use. Five (13%) teachers reported between 70-50% use and eight (21%) teachers reported between 30-40% use of ICT's. Five (13%) teachers reported 20% use of ICT's in class and eight (21%) teachers reported 10% usage. Ten (26%) teachers did not use ICT's in their classes.

The result of the  $t$ -test for independent samples indicated a significant difference in mean scores between School A ( $M = 17.00$ ,  $SD = 20.026$ ) and School B ( $M = 34.21$ ,  $SD = 29.686$ ),  $t(37) = 2.132$ ,  $p = 0.04$ . There were no significant results for differences between the genders.

*Teachers' assessment of current experience with implementing ICT for learning and teaching.* One (2%) of the 39 teachers who answered baseline question 32 considered s/he had no experience with implementing ICT's for learning and teaching. Twelve (31%) teachers considered they were enthusiastic beginners and five (13%) reported they were committed innovators. Twelve (31%) teachers rated themselves as cautious integrators and nine (23%) teachers considered themselves as struggling adopters of ICT in their learning and teaching.

The results of Levene's test for equality of variance indicated a significance difference in variances based on gender and teachers' assessment of their experience with

implementing ICT for learning and teaching,  $F(4.348)$ ,  $p = 0.04$ . There were no significant results for differences between the schools.

***Has the advent of ICT changed your teaching philosophy?*** Thirty (77%) of the 39 teachers who answered baseline question 33 reported the advent of ICT had not changed their teaching philosophy. Nine (23%) of the teachers considered it had changed their teaching philosophy. The tests for differences between genders and differences between schools were statistically non-significant.

***Teachers' levels of success at integrating ICT into the school curriculum.*** One (2%) of the 39 teachers who answered baseline question 34 reported an 'excellent' rating for success at integrating ICT into the school curriculum. Two (5%) teachers considered their rating as 'very good' and seven (18%) teachers rated themselves as 'good'. Fifteen (39%) teachers considered their rating to be 'adequate' and 14 (36%) of the teachers ranked themselves as 'poor' with regard to integrating ICT into the school curriculum.

The results of Levene's test for equality of variance indicated a significance difference in variances based on gender and teachers' success at integrating ICT into the school curriculum,  $F(3.925)$ ,  $p = 0.05$ . There were no significant results for differences between the schools.

***Teachers' Current Levels of confidence with using ICT for learning and teaching.*** One (2%) of the 39 teachers who answered baseline question 35 reported an 'excellent' level of confidence with using ICT for learning and teaching. Five (13%) teachers rated their confidence levels as 'very good' and nine (23%) considered their confidence levels were

‘good’. Twelve (31%) of the teachers considered their confidence levels were ‘adequate and a further 12 (31%) teachers rated their confidence as ‘poor’.

The result of the chi-square test indicated a significant association between schools and teachers’ levels of confidence with using ICT for teaching and learning,  $X^2(4, N = 39) = 9.091, p = 0.05$ . The result of the *t*-test for independent samples indicated a significant difference in mean scores between School A ( $M = 4.10, SD = 1.071$ ) and School B ( $M = 3.37, SD = 1.065$ ),  $t(37) = 2.138, p = 0.03$ .

## **Part Two: Data from End of Project Questionnaires**

This part of the chapter contains an analysis of the quantitative data collected at the end of the project. The data included teachers’ observations and self-assessments of their progress in the development ICT related pedagogies through the reverse-mentored programme. An alpha level of .05 was adopted as standard.

### **End of programme evaluation of teachers’ confidence in using ICT’s**

*Teachers’ levels of confident with using ICT’s personally.* Ten (32%) of the 31 teachers who answered end of project question 1(a) at the completion of the reverse-mentored programme, considered themselves ‘very confident’ with using ICT personally. Sixteen (52%) teachers reported they were ‘confident’ with using ICT’s personally. Four (13%) teachers reported they were ‘neutral’ with regard to confidence with the use of ICT’s and one (3%) of the teachers reported being ‘not confident’. The results of the tests for differences between genders and differences between schools were statistically non-significant.

*Teachers’ levels of confidence with ICT’s with their classes.* Seven (23%) of the 31 teachers who answered end of project question 1(b) at the completion of the reverse-

mentored programme, reported they were ‘very confident’ with using ICT’s in their classes. Fifteen (51%) teachers reported they were ‘confident’ and seven (23%) teachers replied they were ‘neutral’ with regard to their confidence. One (3%) teacher reported being ‘not confident’ with using ICT’s in classes.

The results of an independent samples *t*-test indicated a significant difference in mean scores between School A ( $M = 4.15$ ,  $SD = 0.671$ ) and School B ( $M = 3.50$ ,  $SD = 0.850$ ),  $t(28) = 2.289$ ,  $p = 0.03$ . There was also a significance difference in mean scores between female teachers ( $M = 3.81$ ,  $SD = 0.749$ ) and male teachers ( $M = 4.75$ ,  $SD = 0.500$ ),  $t(28) = 2.414$ ,  $p = 0.02$ .

***Teachers’ levels of confidence in using students to help with ICT’s in the classroom.*** Twenty one (68%) of the 31 teachers who answered end of project question 1(c) at the completion of the reverse-mentored programme, reported they were ‘very confident’ with using students to help with the use of ICT’s in the classroom. Eight (26%) teachers reported ‘confidence’ and one (3%) teacher reported being ‘neutral’ with regard to using students to help in the classroom. One (3%) teacher reported being ‘not-confident’ with using student to help with ICT’s in classes.

The result of the chi-square test indicated a significant association between schools and teachers’ levels of confidence with using students to help with ICT in the classroom,  $X^2(3, N = 31) = 10.652$ ,  $p = 0.01$ . The result of the *t*-test for independent samples indicated a significant difference in mean scores between School A ( $M = 4.86$ ,  $SD = 0.359$ ) and School B ( $M = 4.00$ ,  $SD = 0.943$ ),  $t(29) = 3.695$ ,  $p = 0.001$ . The results of Levene’s test for equality of variance indicated a significance difference in variances based on schools and teachers’

confidence with using students to help with ICT's in classes,  $F(4.337)$ ,  $p = 0.04$ . There were no significant results for differences between the genders.

### **End of programme evaluation of teachers' competence in using ICT's**

***Teachers' levels of competence in basic computer operations.*** Five (17%) of the 30 teachers who answered end of project question 2(a) at the completion of the reverse-mentored programme, reported they had a 'very high' level of competence with basic computer operations. Ten (33%) teachers reported their level of competence as 'high' and 12 (40%) teachers reported 'moderate' levels of competence with basic computer operations. Three (10%) teachers reported 'low' levels of competence.

The result of the  $t$ -test for independent samples indicated a significant difference in mean scores between female teachers ( $M = 3.44$ ,  $SD = 0.847$ ) and male teachers ( $M = 4.67$ ,  $SD = 0.577$ ),  $t(28) = 2.417$ ,  $p = 0.02$ . The results of the tests for differences between schools were statistically non-significant.

***Teachers' levels of competence with file management.*** Eight (27%) of the 30 teachers who answered end of project question 2(b) at the completion of the reverse-mentored programme, reported they had a 'very high' level of competence with file management. Eleven (37%) teachers reported their level of competence as 'high' and ten (33%) reported 'moderate' levels of competence with file management. One (3%) teacher reported 'low' levels of competence.

The result of the chi-square test indicated a significant association between genders and teachers' levels of competence with file management,  $X^2(3, N = 30) = 9.167$ ,  $p = 0.02$ . The result of the  $t$ -test for independent samples indicated a significant difference in mean

scores between female teachers ( $M = 3.74$ ,  $SD = 0.813$ ) and male teachers ( $M = 5.00$ ,  $SD = 0.00$ ),  $t(28) = 2.641$ ,  $p = 0.01$ . The results of Levene's test for equality of variance indicated a significance difference in variances based on teachers' gender and their competence with file management,  $F(7.252)$ ,  $p = 0.01$ . The results of the tests for differences between schools were statistically non-significant.

***Teachers' levels of competence in the use of word processing.*** Twelve (40%) of the 30 teachers who answered end of project question 2(c) at the completion of the reverse-mentored programme, reported they had a 'very high' level of competence in the use of word processing. Fifteen (50%) teachers reported their level of competence as 'high' and three (10%) reported 'moderate' levels of competence with word processing. No teachers reported 'low' levels of competence.

The result of the  $t$ -test for independent samples indicated a significant difference in mean scores between female teachers ( $M = 4.22$ ,  $SD = 0.641$ ) and male teachers ( $M = 5.00$ ,  $SD = 0.000$ ),  $t(28) = 2.071$ ,  $p = 0.04$ . The results of Levene's test for equality of variance indicated a significance difference in variances based on teachers' gender and their competence with word processing,  $F(5.965)$ ,  $p = 0.02$ . The results of the tests for differences between schools were statistically non-significant.

***Teachers' levels of competence in the use of spreadsheets.*** Five (17%) of the 30 teachers who answered end of project question 2(d) at the completion of the reverse-mentored programme, reported they had a 'very high' level of competence in the use of spreadsheets. Five (17%) teachers reported their level of competence as 'high' and 12 (40%) reported 'moderate' levels of competence with spreadsheets. Seven (23%) reported 'low'

levels of competence and one (3%) teacher reported a level of competence which was either 'very low' or 'non-existent'.

The result of the chi-square test indicated a significant association between genders and teachers' levels of competence with spreadsheets,  $X^2(4, N = 30) = 16.667, p = 0.002$ . The result of the  $t$ -test for independent samples indicated a significant difference in mean scores between female teachers ( $M = 3.00, SD = 0.961$ ) and male teachers ( $M = 5.00, SD = 0.000$ ),  $t(28) = 3.550, p = 0.001$ . The results of the tests for differences between schools were statistically non-significant.

***Teachers' levels of competence in the use of databases.*** Two (7%) of the 29 teachers who answered end of project question 2(e) at the completion of the reverse-mentored programme, reported they had a 'very high' level of competence in the use of databases. Five (17%) teachers reported their level of competence as 'high' and seven (24%) reported 'moderate' levels of competence with databases. Fourteen (48%) reported 'low' levels of competence and one (4%) teacher reported a level of competence which was either 'very low' or 'non-existent'.

The result of the chi-square test indicated a significant association between genders and teachers' levels of competence with databases,  $X^2(4, N = 29) = 10.671, p = 0.03$ . The result of the  $t$ -test for independent samples indicated a significant difference in mean scores between female teachers ( $M = 2.58, SD = 0.92$ ) and male teachers ( $M = 4.33, SD = 0.577$ ),  $t(27) = 3.265, p = 0.003$ . The results of the tests for differences between schools were statistically non-significant.

***Teachers' levels of competence in the use of graphics.*** Four (13%) of the 30 teachers who answered end of project question 2(f) at the completion of the reverse-mentored programme, reported they had a 'very high' level of competence in the use of graphics. Nine (30%) teachers reported their level of competence as 'high' and 11 (37%) reported 'moderate' levels of competence with graphics. Four (13%) reported 'low' levels of competence and two (7%) teachers reported a levels of competence which were either 'very low' or 'non-existent'.

The result of the *t*-test for independent samples indicated a significant difference in mean scores between female teachers ( $M = 3.19$ ,  $SD = 1.075$ ) and male teachers ( $M = 4.33$ ,  $SD = 0.577$ ) conditions;  $t(28) = 1.801$ ,  $p = 0.08$ . The results of the tests for differences between schools were statistically non-significant.

***Teachers' levels of competence in the use of the Internet.*** Fourteen (47%) of the 30 teachers who answered end of project question 2(g) at the completion of the reverse-mentored programme reported, they had a 'very high' level of competence in the use of the Internet. Seven (23%) teachers reported their level of competence as 'high' and nine (30%) teachers reported 'moderate' levels of competence with graphics. No teachers reported they had 'low/very low' levels of competence in the use of the Internet.

The result of the chi-square test indicated a significant association between schools and teachers' levels of competence with the use of the Internet,  $X^2(2, N = 30) = 6.833$ ,  $p = 0.03$ . The result of the *t*-test for independent samples indicated a significant difference in mean scores between School A ( $M = 4.38$ ,  $SD = 0.865$ ) and School B ( $M = 3.67$ ,  $SD = 0.707$ ) conditions;  $t(28) = 2.179$ ,  $p = 0.03$ . The results of the tests for differences between genders were statistically non-significant.

***Teachers' levels of competence in the use of telecommunications.*** Fifteen (50%) of the 30 teachers who answered end of project question 2(h) at the completion of the reverse-mentored programme, considered their levels of competence with using telecommunications were 'very high'. Ten (34%) teachers reported their levels of competence in the use of telecommunications were 'high'. Four (13%) reported 'moderate' levels of competence and one (3%) of the teachers reported a 'very low' level of competence with using telecommunications. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Teachers' levels of competence with multimedia and presentation media.*** Five (17%) of the 29 teachers who answered end of project question 2(i) at the completion of the reverse-mentored programme, considered their levels of competence with using multimedia and presentation media were 'very high'. Eight (28%) teachers reported their levels of competence in the use of multimedia and presentation media were 'high'. Eight (28%) teachers reported their levels of competence in the use of multimedia and presentation media were 'moderate'. Seven (24%) reported 'low levels' of competence and one (3%) of the teachers reported a 'very low level' of competence with using multimedia and presentation media.

The result of the *t*-test for independent samples indicated a significant difference in mean scores between female teachers ( $M = 3.19$ ,  $SD = 1.132$ ) and male teachers ( $M = 4.33$ ,  $SD = 0.577$ ) conditions;  $t(4.103) = 2.849$ ,  $p = 0.04$ . The results of the tests for differences between schools were statistically non-significant.

***Teachers' levels of competence in accepting help from technically capable students.***

Seventeen (57%) of the 30 teachers who answered this end of project question 2(j) at the completion of the reverse-mentored programme, considered their levels of competence in accepting help from technically capable students were 'very high'. Ten (33%) teachers reported their levels of competence in accepting help from technically capable students were 'high'. Three (10%) teachers reported their levels of competence in accepting help from technically capable students were 'moderate'. No teacher recorded a 'low' or 'very low' level of competence for this question.

The result of the chi-square test indicated a significant association between schools and teachers' levels of competence in accepting help from technically capable students,  $X^2 (2, N = 30) = 6.833, p = 0.03$ . The result of the  $t$ -test for independent samples indicated a significant difference in mean scores between School A ( $M = 4.62, SD = 0.669$ ) and School B ( $M = 4.11, SD = 0.601$ ) conditions;  $t(16.855) = 2.049, p = 0.05$ . The results of the tests for differences between genders were statistically non-significant.

**End of programme evaluation of teachers' frequency of ICT use.**

***Teachers' frequency of ICT use for school administration.*** Seventeen (53%) of the 32 teachers who answered end of project question 3(a) at the completion of the reverse-mentored programme, considered they always used ICT for school administration. Eight (25%) teachers reported they often used ICT in this way. One (3%) teacher sometimes used ICT for school administration and two (6%) teachers reported they rarely used ICT in this way. Four (13%) teachers replied they had never used ICT for school administration. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Teachers' frequency of ICT use for finding or producing resources for lessons.***

Eight (25%) of the 32 teachers who answered end of project question 3(b) at the completion of the reverse-mentored programme, considered they always used ICT for finding or producing resources for lessons. Fifteen (47%) teachers reported they often used ICT in this way. Six (19%) teachers sometimes used ICT for finding or producing resources for lessons and one (3%) teacher reported rarely using ICT in this way. Two (6%) teachers replied they had never used ICT to find or produce lessons.

The result of the  $t$ -test for independent samples indicated a significant difference in mean scores between School A ( $M = 4.14$ ,  $SD = 0.710$ ) and School B ( $M = 3.10$ ,  $SD = 1.370$ ) conditions;  $t(30) = 2.839$ ,  $p = 0.008$ . The results of Levene's test for equality of variance indicated a significance difference in variances based on teachers' schools and their frequency of use of ICT to find or produce resources for lessons,  $F(7.144)$ ,  $p = 0.01$ . The results of the tests for differences between genders were statistically non-significant.

***End of programme evaluation of teachers' integration of ICT in units of work.***

***The extent teachers have integrated ICT into their units of work.*** Five (16%) of the 31 teachers who answered end of project question 4 at the completion of the reverse-mentored programme, considered they had integrated ICT into all or almost all of their units of work. Six (19%) of the teachers reported they had integrated most units, and 14 (45%) teachers reported they had integrated ICT into several units of work. Three (10%) of the teachers had integrated one or two units and three (10%) teachers reported they had not integrated ICT into any units of work. The results of the tests for differences between genders and differences between schools were statistically non-significant.

**End of programme evaluation of teachers' changes in classroom practices.**

*Extent teachers' classroom practice changed through the reverse-mentored programme.* Two (6%) of the 32 teachers who answered end of project question 5(a) at the completion of the reverse-mentored programme, considered the programme had changed their classroom practices completely. Ten (31%) teachers reported their classroom practices had changed to a large extent and a further ten (31%) teachers reported changes to some extent. Seven (22%) recorded their classroom practices had changed very little and three (10%) teachers reported their classroom practices had not changed at all as a result of the programme.

The results of Levene's test for equality of variance indicated a significance difference in variance based on teachers' gender and the extent the reverse-mentored programme changed their teaching practices,  $F(4.877)$ ,  $p = 0.03$ . The results of the tests for differences between schools were statistically non-significant.

**End of programme evaluation of the programme's impact on understanding of teaching and learning**

*The extent programme has contributed to understanding of teaching and student learning.* Three (9%) of the 31 teachers who answered end of project question 6(a) at the completion of the reverse-mentored programme, considered the programme had provided them with a whole new approach to their teaching and student learning. Seventeen (55%) of the teachers recorded the programme had contributed new ideas for their teaching and student learning. Seven (23%) teachers reported the programme had confirmed their current understanding of teaching and learning and four (13%) of the teachers considered the programme had not influenced their teaching and learning at all. The results of the tests for

differences between genders and differences between schools were statistically non-significant.

#### **End of programme evaluation of the frequency of students' use of ICT**

*Frequency students were guided to use ICT where communication (text and picture presentation) was the main purpose of the activity.* Four (13%) of the 30 teachers who answered end of project question 8(a)(1) at the completion of the reverse-mentored programme, considered they guided their students to use ICT in this way daily or almost daily. A further six (20%) teachers used ICT for this purpose once or twice a week. Sixteen (54%) of the teachers reported having guided their students to use ICT in communication (text and picture presentation) one or twice a term. Four (13%) teachers used ICT in this way once or twice a year. No teacher recorded they had not used ICT in this way at all. The results of the tests for differences between genders and differences between schools were statistically non-significant.

*Frequency students were guided to use ICT where communication (multimedia presentation) was the main purpose of the activity.* Three (10%) of the 30 teachers who answered end of project question 8(a)(2) at the completion of the reverse-mentored programme, considered they had guided their students to use ICT in this way daily or almost daily. A further five (16%) teachers reported they had guided their students to use ICT for this purpose once or twice a week. Eleven (37%) of the teachers reported they had guided their students to use ICT in communication (multimedia presentation) one or twice a term. Six (21%) teachers used ICT in this way once or twice a year. Five (16%) of the teachers reported they had not used ICT in this way at all.

The result of the chi-square test indicated a significant association between schools and students' frequency of use of ICT for multimedia presentations,  $X^2(4, N = 30) = 12.626$   $p = 0.008$ . The results of Levene's test for equality of variance indicated a significance difference in variances based on teachers' schools and the frequency students were guided to use ICT for communication through multimedia,  $F(5.881)$ ,  $p = 0.02$ . The results of the results of the tests for differences between genders were statistically non-significant.

***Frequency students were guided to use ICT where on-line interaction was the main purpose of the activity.*** Six (20%) of the 30 teachers who answered end of project question 8(a)(3) at the completion of the reverse-mentored programme, reported they had guided their students to use ICT in this way daily or almost daily. A further ten (33%) teachers used ICT for this purpose once or twice a week. Two (7%) of the teachers used ICT for on-line interaction once or twice a term. Three (10%) teachers reported they had guided their students to use ICT in this way once or twice a year and nine (30%) teachers reported they had not used ICT in this way at all. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Frequency students were guided to use ICT where creativity was the main purpose of the activity.*** Four (13%) of the 30 teachers who answered end of project question 8(b) at the completion of the reverse-mentored programme, considered they had guided their students to use ICT in this way daily or almost daily. A further seven (23%) teachers used ICT for this purpose once or twice a week. Five (17%) of the teachers used ICT for creativity once or twice a term. Nine (30%) teachers reported they had guided their students to use ICT in this way once or twice a year and five (17%) teachers reported they had not used ICT in this way at all. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Frequency students were guided to use ICT where information gathering or processing was the main purpose of the activity.*** Fourteen (47%) of the 30 teachers who answered end of project question 8(c) at the completion of the reverse-mentored programme, considered they had guided their students to use ICT in this way daily or almost daily. A further eleven (36%) teachers used ICT for this purpose once or twice a week. Two (7%) of the teachers reported they had guided their students to use ICT for information gathering/processing once or twice a term. Three (10%) teachers used ICT in this way once or twice a year. No teachers recorded that they had not used ICT in this way at all. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Frequency students were guided to use ICT where problem solving was the main purpose of the activity.*** Two (7%) of the 30 teachers who answered end of project question 8(d) at the completion of the reverse-mentored programme, reported they had guided their students to use ICT in this way daily or almost daily. A further two (7%) teachers used ICT for this purpose once or twice a week. Nine (30%) of the teachers reported they had guided their students to use ICT for problem solving once or twice a term. Ten (33%) teachers used ICT in this way once or twice a year. Seven (23%) teachers reported they had not used ICT in this way at all. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Frequency students were guided to use ICT where curriculum practice was the main purpose of the activity.*** Three (10%) of the 30 teachers who answered end of project question 8(e) at the completion of the reverse-mentored programme, reported they had guided their students to use ICT in this way daily or almost daily. Five (17%) teachers used ICT for

this purpose once or twice a week. Two (7%) of the teachers reported they had guided their students to use ICT for curriculum practice once or twice a term. Eleven (36%) teachers used ICT in this way once or twice a year. Nine (30%) teachers reported they had not used ICT in this way.

The result of the chi-square test indicated a significant association between schools and students' use of ICT for curriculum practice,  $X^2(4, N = 30) = 10.303$   $p = 0.03$ . The results of Levene's test for equality of variance indicated a significance difference in variances based on teachers' schools and the frequency students were guided to use ICT for curriculum practice,  $F(5.276)$ ,  $p = 0.02$ . The results of the tests for differences between genders were statistically non-significant.

***Frequency students were guided to use ICT where the use of technical skills was the main purpose of the activity.*** Six (20%) of the 30 teachers who answered end of project question 8(f) at the completion of the reverse-mentored programme, reported they had guided their students to use ICT in this way daily or almost daily. A further six (20%) teachers used ICT for this purpose once or twice a week. Six (20%) of the teachers reported they had guided their students to use ICT for using technical skills once or twice a term. Eight (27%) teachers used ICT in this way once or twice a year. Four (13%) teachers reported they had not used ICT in this way at all. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Frequency students were guided to use ICT where collaborative learning and social interaction was the main purpose of the activity.*** Seven (23%) of the 30 teachers who answered end of project question 8(g) at the completion of the reverse-mentored programme, reported they had guided their students to use ICT in this way daily or almost daily. A

further six (20%) teachers used ICT for this purpose once or twice a week. Four (13%) of the teachers reported they had guided their students to use ICT for collaborative learning and social interaction once or twice a term. Five (17%) teachers reported they had guided their students to use ICT in this way once or twice a year. Eight (27%) teachers reported they had not used ICT in this way at all. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Frequency students were guided to use ICT where motivation or reward for engagement was the main purpose of the activity.*** Two (7%) of the 29 teachers who answered end of project question 8(h) at the completion of the reverse-mentored programme, reported they had guided their students to use ICT in this way once or twice a week. A further six (21%) teachers used ICT for this purpose once or twice a term. Three (10%) of the teachers reported they had guided their students to use ICT for students' motivation or reward once or twice a year. Eighteen (62%) of the teachers reported they had not used ICT in this way at all. No teacher reported using ICT as a reward either daily or almost daily.

The result of the chi-square test indicated a significant association between schools and teachers' frequency of use of ICT for students' motivation or reward,  $X^2(3, N = 29) = 11.349, p = 0.004$ . The independent samples *t*-test also indicated a significant difference in mean scores between School A ( $M = 1.30, SD = 0.657$ ) and School B ( $M = 2.67, SD = 1.118$ ) conditions;  $t(27) = 4.147, p = 0.001$ . The result from the test for equality of variances indicated a significant variance between the schools,  $F(4.323), p = 0.04$ . T

The result of the *t*-test for independent samples also indicated a significant difference in mean scores between female teachers ( $M = 1.78, SD = 1.050$ ) and male teachers ( $M = 1.00,$

$SD = .000$ ) conditions;  $t(27) = 3.849$ ,  $p = 0.001$ . The result from the test for equality of variances indicated a significance variance between the genders  $F(7.464)$ ,  $p = 0.01$ .

**End of programme evaluation of teachers' integration of ICT into teaching and learning.**

*Extent of effective integration of ICT into classroom teaching and learning.* Two (6%) of the 32 teachers who answered end of project question 9 at the completion of the reverse-mentored programme, considered they had completely integrated ICT into their classroom teaching and learning. Fourteen (44%) teachers indicated they had integrated ICT to a large extent. A further fourteen (44%) teachers reported they had integrated ICT to some extent and two (6%) reported very little integration. The results of the tests for differences between genders and differences between schools were statistically non-significant.

**End of programme evaluation of extent goals/expectations met by the programme.**

*Extent goals/expectations met for technical skills development.* The goals/expectations were exceeded for one (3%) of the 31 teachers who answered end of project question 11(a) at the completion of the reverse-mentored programme. Nine (29%) teachers reported their goals/expectations had been fully met. Eight (26%) teachers considered their expectations had been largely met and 13 (42%) teachers reported their goals had been partially met. No teacher reported their goals/expectations had not been met. The results of the tests for differences between genders and differences between schools were statistically non-significant.

*Extent goals/expectations met for ideas for using ICT's with classes.* Seven (24%) of the 29 teachers who answered end of project question 11(b) at the completion of the

reverse-mentored programme, considered the programme had fully met their goals/expectations for ideas for using ICT's with classes. Eleven (38%) teachers reported their goals/expectations have been largely met and ten (35%) teachers considered their expectations had been partially met. The expectations/goals of one (3%) of the teachers had not been met. No teacher reported the programme had exceeded their goals for ideas for using ICT's with classes. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Extent goals/expectations met for quality teaching and learning enhancement.*** One (3%) of the 29 teachers who answered end of project question 11(c) at the completion of the reverse-mentored programme, considered the programme had exceeded their expectations with regard to the use of ICT for quality teaching and learning enhancements in general. Four (14%) teachers considered their expectations had been fully met and twelve (42%) teachers considered their expectations had been largely met. Nine (31%) of the teachers reported their goals had been partially met. Three (10%) teachers reported their goals had not been met.

The result of the chi-square test indicated a significant association between gender and the reverse-mentored programme in meeting teacher's expectations/goals,  $X^2(4, N = 29) = 9.532$   $p = 0.04$ . The results of the tests for differences between schools were statistically non-significant.

***Extent goals/expectations met for using ICT's for administration.*** Two (7%) of the 29 teachers who answered end of project 11(d) at the completion of the reverse-mentored programme, considered the programme had exceeded their expectations with regard to the use of ICT for administration. Eleven (38%) teachers reported their expectation/goals had

been fully met. Six (21%) teachers considered their expectations had been largely met and seven (24%) of the teachers reported their goals/expectations had been partially met. Three (10%) reported their goals/expectations had not been met. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Extent goals/expectations met for using ICT's to gain a qualification.*** Two (8%) of the 25 teachers who answered end of project question 11(e) at the completion of the reverse-mentored programme, considered the programme largely met their expectations with regard to the use of ICT to gain a qualification. One (4%) teacher considered his/her expectations had been partially met and 22 (88%) of the teachers reported their goals had not been met.

The results of Levene's test for equality of variance indicated a significant difference in variances based on schools and teachers' reported expectations,  $F(4.605)$ ,  $p = 0.04$ . The results of the tests for differences between genders were statistically non-significant.

**End of programme evaluation of the influence of the programme on ICT use.**

***Extent increase in ICT use attributable to programme.*** Two (7%) of the 29 teachers who answered end of project question 13(a) at the completion of the reverse-mentored programme, considered the increase in use of ICT was completely attributable to the programme. Sixteen (55%) of the teachers considered the programme was largely attributable seven (24%) teachers considered the increased use was partially attributable to the programme. Four (14%) considered any increase in use was not at all attributable to the programme.

The results of the *t*-test for independent samples indicated a significant difference in the mean scores between School A ( $M = 2.76$ ,  $SD = 0.700$ ) and School B ( $M = 2.00$ ,  $SD = 0.926$ ) conditions;  $t(27) = 2.397$ ,  $p = 0.02$ . The results of the tests for differences between genders were statistically non-significant.

**End of programme evaluation of teachers' concerns over using ICT's in schools.**

***Concerns about access to equipment for student use.*** Nine (28%) of the 32 teachers who answered end of project question 14(a) at the completion of the reverse-mentored programme, expressed significant concern about access to equipment for student use. Seventeen (53%) teachers some concern and six (19%) reported they had no concern about access to equipment for student use.

The result of the chi-square test indicated a significant association between schools and teachers' concerns about the availability of equipment,  $X^2(2, N = 32) = 10.598$   $p = 0.005$ . The results of Levene's test for equality of variance indicated a significant difference in variances based on teachers' schools and their reported concerns,  $F(9.365)$ ,  $p = 0.005$ . The results of the tests for differences between genders were statistically non-significant.

***Concerns about insufficient technical support.*** Seventeen (55%) of the 31 teachers who end of project question 14(b) at the completion of the reverse-mentored programme, expressed significant concern about insufficient technical support. Twelve (39%) teachers reported some concern and two (6%) reported they had no concern about the quality of technical support.

The result of the chi-square test indicated a significant association between schools and teachers' concerns about insufficient technical support,  $X^2(2, N = 31) = 9.196$   $p = 0.01$ .

The results of the  $t$ -test for independent samples indicated a significant difference in the mean scores between School A ( $M = 1.29$ ,  $SD = 0.463$ ) and School B ( $M = 2.00$ ,  $SD = 0.667$ ) conditions;  $t(29) = 3.478$ ,  $p = 0.002$ . The results of the tests for differences between genders were statistically non-significant.

***Concerns about making links between ICT and quality teaching and learning.*** Five (16%) of the 32 teachers who answered end of project question 14(c) at the completion of the reverse-mentored programme, expressed significant concerns about making links between ICT and quality teaching and learning. Twenty one (66%) teachers reported some concern and six (18%) reported they had no concern about making the links.

The result of the chi-square test indicated a significant association between schools and teachers' concerns about making links between ICT and quality teaching and learning,  $X^2(2, N = 32) = 13.648$   $p = 0.001$ . The results of the tests for differences between genders were statistically non-significant.

***Concerns about a lack of ideas on how to use ICT's with classes.*** Six (19%) of the 32 teachers who answered end of project question 14(d) at the completion of the reverse-mentored programme, expressed significant concerns about a lack of ideas on how to use ICT's with classes. Twenty two (69%) teachers reported some concern and four (12%) reported they had no concern about a lack of ideas.

The result of the chi-square test indicated a significant association between schools and teachers' concerns about a lack of ideas on how to use ICT's with classes,  $X^2(2, N = 32) = 16.167$   $p = 0.001$ . The results of the tests for differences between genders were statistically non-significant.

***Concerns about a lack of time to cope with it all.*** Four (13%) of the 32 teachers who answered end of project question 14(e) at the completion of the reverse-mentored programme, expressed significant concerns about a lack of time to cope with it all. Seven (22%) teachers reported some concern and twenty one (65%) reported they had no concern about a lack time.

The result of the chi-square test indicated a significant association between schools and teachers' concerns about a lack of time to cope with it all,  $X^2(2, N = 32) = 15.589$   $p = 0.000$ . The results of the  $t$ -test for independent samples indicated a significant difference in the mean scores between School A ( $M = 2.86$ ,  $SD = 0.351$ ) and School B ( $M = 1.80$ ,  $SD = 0.789$ ) conditions;  $t(30) = 5.337$ ,  $p = 0.001$ . The results of the tests for differences between genders were statistically non-significant.

***Concerns about a need for ongoing professional development.*** One (3%) of the 32 teachers who answered end of project question 14(f) at the completion of the reverse-mentored programme, expressed significant concerns about the need for ongoing professional development. Fourteen (44%) teachers reported some concern and seventeen (53%) reported they had no concern about the need for ongoing professional development. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Concerns about keeping up-to-date with skills and knowledge on ICT developments.*** Two (6%) of the 32 teachers who answered end of project question 14(g) at the completion of the reverse-mentored programme, expressed significant concerns about the need to keep up-to-date with required skills and knowledge on ICT developments. Fourteen (44%) teachers

reported some concern and sixteen (50%) reported they had no concern about the need for ongoing skills and knowledge development. The results of the tests for differences between genders and differences between schools were statistically non-significant.

***Concerns about technical reliability/equipment breakdown.*** Seventeen (53%) of the 32 teachers who answered end of project question 14(h) at the completion of the reverse-mentored programme, expressed significant concerns about equipment reliability/equipment breakdown. Nine (28%) teachers reported some concern and six (19%) reported they had no concern about technical reliability or equipment breakdown.

The result of the chi-square test indicated a significant association between schools and teachers' concerns about a lack of time to cope with it all,  $X^2(2, N = 32) = 16.546, p = 0.001$ . The results of the *t*-test for independent samples indicated a significant difference in the mean scores between School A ( $M = 1.32, SD = 0.477$ ) and School B ( $M = 2.40, SD = 0.843$ ) conditions;  $t(30) = 4.648, p = 0.001$ . The results of the tests for differences between genders were statistically non-significant.

**End of programme teachers' evaluation of the significance of the programme.**

***Degree of significance reverse-mentored programme in teacher development.*** Eight (25%) of the 32 teachers who answered the end of project question 15(a) at the completion of the reverse-mentored programme, reported the programme was very significant in their overall development as a teacher. Twelve (38%) teachers reported the programme was somewhat significant and seven (22%) considered the programme was slightly significant in their overall development. Five (15%) reported the programme had no significance in their overall development as a teacher.

The results of the  $t$ -test for independent samples indicated a significant difference in the mean scores between School A ( $M = 3.0$ ,  $SD = 0.976$ ) and School B ( $M = 2.10$ ,  $SD = 0.876$ ) conditions;  $t(30) = 2.492$ ,  $p = 0.018$ . The results of the tests for differences between genders were statistically non-significant.

### **Part Three: Data from Paired Questions**

In this part, selections of the teachers' baseline responses are compared with those given at the end of the project. For example, teachers' self-assessments on their own ICT skills and knowledge were compared through their answers to baseline questions 16(a-i) and the end of project questions 2(a-i). A paired-samples test was used to confirm statistical relationships between each of the paired questions. An alpha level of .05 was adopted as standard.

#### **Teachers' confidence with using ICT's.**

*Paired-samples: Teachers' confidence with using ICT personally.* A comparison of teachers' levels of confidence with using ICT personally was carried out through baseline question 13(a) and end of project question 1(a). The data from baseline question 13(a) indicated 12 teachers considered they were either not confident or anxious with using ICT personally. End of project question 1(a) indicated only one teacher reporting a lack of confidence using ICT's personally.

A paired-samples  $t$ -test was conducted to compare teachers' assessment of their levels of confidence with using ICT personally before the reverse-mentored programme and again at the end of the programme. The test indicated there was a significant difference between the baseline questionnaire score and the end of project questionnaire score,  $t(26) = 3.907$ ,  $p = 0.001$ . The mean scores for responses to the baseline question ( $M = 2.89$ ,  $SD = 1.219$ ) were

higher than the end of project mean scores ( $M = 1.89$ ,  $SD = 0.801$ ). The lower mean score and the standard deviation for the end of project responses indicated a closer grouping of the responses in the end of project data.

***Paired-samples: Teachers' confidence with using ICT with classes.*** A comparison of teachers' levels of confidence with using ICT with classes was carried out through baseline question 13(b) and end of project question 1(b). In answer to baseline question 13(b) 15 teachers reported they were either anxious or not confident with using ICT with classes. Data from the end of project question 1(b) indicated this number dropped to one teacher who reported being unconfident with using ICT's in classes.

A paired-samples *t*-test was conducted to compare teachers' assessment of their levels of confidence with using ICT with classes before the reverse-mentored programme and again at the end of the programme. The test indicated there was a significant difference between the baseline questionnaire score and the end of project questionnaire score,  $t(26) = 4.256$ ,  $p = 0.001$ . The mean scores for responses to the baseline question ( $M = 3.23$ ,  $SD = 1.423$ ) were higher than the end of project mean score ( $M = 2.12$ ,  $SD = 0.816$ ) indicating a smaller distribution of the scores and a closer of grouping of the responses about the means for the end of project responses. There were also a strong correlations between the teachers' answers to the two questions,  $r = 0.389(24)$ ,  $p = 0.04$ .

### **Teachers' frequency of use of ICT's.**

***Paired-samples: Teachers' frequency of use of ICT to find or produce lesson resources.*** A comparison of teachers' frequency of use of ICT in lessons was carried out through baseline question 15(a) and end of project question 3(b). The data from baseline

question 15(a) indicated 14 teachers said they had rarely or never used ICT in this way compared with three teachers in the end of project question 3(b).

A paired-samples *t*-test was conducted to compare teachers' frequency of use of ICT for finding or producing resources for lessons before the reverse-mentored programme and again at the end of the programme. The test indicated although the difference between the baseline questionnaire score and the end of project questionnaire score was statistically non-significant ( $t(27) = 1.679, p = 0.11$ ), the mean scores for responses to the baseline question ( $M = 2.82, SD = 1.362$ ) were higher than the end of project mean scores ( $M = 2.29, SD = 1.084$ ).

***Paired-samples: Teachers' frequency of use of ICT for school administration.*** A comparison of teachers' frequency of use of ICT in school administration was carried out through baseline question 15(b) and end of project question 3(a).

A paired-samples *t*-test was conducted to compare teachers' frequency of use of ICT for finding or producing resources for lessons before the reverse-mentored programme and again at the end of the programme. The test indicated although the difference between the baseline questionnaire score and the end of project questionnaire score was statistically non-significant ( $t(27) = 0.559, p = 0.55$ ), the mean score for responses to the baseline question ( $M = 1.82, SD = 0.983$ ) was lower than the end of project mean score ( $M = 2.04, SD = 1.503$ ).

***Paired-samples: Teachers' competence with basic computer operations.*** A comparison of teachers' competence with basic computer operations was carried out through to baseline question 16(a) and end of project question 2(a). In answer to baseline question 16(a) 15 teachers reported low or very low levels of attainment in basic computer operations

compared with three teachers reporting low levels of attainment in answer to end of project question 2(a).

A paired-samples *t*-test was conducted to compare teachers' assessment of their levels of competence with understanding and using basic computer operations before the reverse-mentored programme and again at the end of the programme. The test indicated there were significant differences between the baseline scores and the end of project scores,  $t(25) = 3.202, p = 0.004$ . The mean scores for responses to the baseline question ( $M = 3.23, SD = 1.394$ ) were higher than the end of project mean scores ( $M = 2.38, SD = 0.941$ ). There was also a strong correlation between the teachers' answers to both questions,  $r = 0.387(24), p = 0.05$ .

***Paired-samples: Teachers' competence with computer file management.*** A comparison of teachers' answers to their competence with computer file management was carried out through baseline question 16(b) and end of project question 2(b). At the start of the reverse-mentored programme, 16 teachers reported their levels of attainment with computer file management were low or very low. By the end of the project only one teacher reported a low level of competence with computer file management.

A paired-samples *t*-test was conducted to compare teachers' assessment of their levels of competence with understanding and using file management before the reverse-mentored programme and again at the end of the programme. The test indicated there was a significant difference between the baseline questionnaire score and the end of project questionnaire score,  $t(25) = 4.321, p = 0.001$ . The mean score for responses to the baseline question ( $M = 3.38, SD = 1.525$ ) was higher than the end of project mean score ( $M = 2.08, SD = 0.845$ ).

### **Teachers' competence in the use of ICT's.**

*Paired-samples: Teachers' competence with word processing.* A comparison of teachers' answers to their competence with word processing was carried out through baseline question 16(c) and end of project question 2(c). At the start of the programme, seven teachers reported low or very low levels of competence with word processing. By the end of the programme (end of project 2(c), no teachers reported low or very low levels of competence.

A paired-samples *t*-test was conducted to compare teachers' assessment of their levels of competence with understanding and using word processing before the reverse-mentored programme and again at the end of the programme. The test indicated there was a significant difference between the baseline questionnaire score and the end of project questionnaire score,  $t(25) = 3.709$ ,  $p = 0.001$ . The mean scores for responses to the baseline question ( $M = 2.77$ ,  $SD = 1.210$ ) were higher than the end of project mean scores ( $M = 1.73$ ,  $SD = 0.667$ ).

*Paired-samples: Teachers' competence with spreadsheets.* A comparison of teachers' answers to their competence with spreadsheets was carried out through baseline question 16(d) and end of project question 2(d). At the start of the reverse-mentored programme, 25 teachers reported low or very low levels of attainment with spreadsheets. By the end of the programme eight teachers reported low or very low levels of competence with spreadsheets.

A paired-samples *t*-test was conducted to compare teachers' assessment of their levels of competence with understanding and using spreadsheets before the reverse-mentored programme and again at the end of the programme. The test indicated there were significant differences between the baseline questionnaire score and the end of project questionnaire

score,  $t(25) = 4.621$ ,  $p = 0.001$ . The mean scores for responses to the baseline question ( $M = 3.88$ ,  $SD = 1.177$ ) were higher than the end of project mean scores ( $M = 2.85$ ,  $SD = 1.120$ ). There was also a strong correlation between the teachers' answers to both questions,  $r = 0.501(24)$ ,  $p = 0.009$ .

***Paired-samples: Teachers' competence with databases.*** A comparison of teachers' answers about their competence with databases was carried out through baseline question 16(e) and end of project question 2(e). Twenty seven teachers reported low or very low levels of competence with databases at the start of the reverse-mentored programme compared with fifteen teachers reporting their levels of competence were low or very low.

A paired-samples  $t$ -test was conducted to compare teachers' assessment of their levels of competence with understanding and using databases before the reverse-mentored programme and again at the end of the programme. The test indicated there was a significant difference between the baseline questionnaire score and the end of project questionnaire score,  $t(24) = 4.529$ ,  $p = 0.001$ . The mean scores for responses to the baseline question ( $M = 4.20$ ,  $SD = 0.913$ ) were higher than the end of project mean scores ( $M = 3.24$ ,  $SD = 0.970$ ).

***Paired-samples: Teachers' competence with graphics.*** A comparison of teachers' competence with graphics was carried out through baseline question 16(f) and end of project question 2(f). At the beginning of the programme, 17 teachers reported their levels of competence with graphics were low or very low. By the end of the programme, there were six teachers in those categories.

A paired-samples  $t$ -test was conducted to compare teachers' assessment of their levels of competence with understanding and using graphics before the reverse-mentored

programme and again at the end of the programme. The test indicated there was a significant difference between the baseline questionnaire score and the end of project questionnaire score,  $t(25) = 3.476$ ,  $p = 0.002$ . The mean scores for responses to the baseline question ( $M = 3.62$ ,  $SD = 1.203$ ) were higher than the end of project mean scores ( $M = 2.69$ ,  $SD = 1.158$ ).

***Paired-samples: Teachers' competence with Internet use.*** A comparison of teachers' answers to competence with Internet use was carried out through baseline question 16(g) and end of project question 2(g). At the start of the programme, 13 teachers reported low or very low levels of competence with Internet use. By the end of the programme, no teachers reported low or very low competence in the use of the Internet.

A paired-samples  $t$ -test was conducted to compare teachers' assessment of their levels of competence using the Internet before the reverse-mentored programme and again at the end of the programme. The test indicated there was a significant difference between the baseline questionnaire score and the end of project questionnaire score,  $t(25) = 3.291$ ,  $p = 0.003$ . The mean scores for responses to the baseline question ( $M = 2.96$ ,  $SD = 1.311$ ) were higher than the end of project mean scores ( $M = 1.96$ ,  $SD = 0.871$ ).

***Paired-samples: Teachers' competence with telecommunications.*** A comparison of teachers' answers to their competence with telecommunications was carried out through baseline question 16(h) and end of project question 2(h). At the start of the programme, nine teachers reported low or very low levels of competence with telecommunications. At the end of the project, no teachers reported low levels of competence and one teacher reported a very low level of competence with telecommunications.

A paired-samples *t*-test was conducted to compare teachers' assessment of their levels of competence with understanding and using telecommunications before the reverse-mentored programme and again at the end of the programme. The test indicated there was a significant difference between the baseline questionnaire score and end of project questionnaire score,  $t(25) = 2.849$ ,  $p = 0.009$ . The mean scores for responses to the baseline question ( $M = 2.73$ ,  $SD = 1.282$ ) were higher than the end of project mean scores ( $M = 1.85$ ,  $SD = 0.967$ ).

***Paired-samples: Teachers' competence with presentation and multimedia.*** A comparison of teachers' answers to the questions of their competence with presentation media and multimedia was carried out through baseline question 16(i) and end of project question 2(i). Nineteen teachers reported their levels of competence with presentation and multimedia were low or very low at the start of the project. By the end of the project eight teachers reported low or very low levels of competence in this area.

A paired-samples *t*-test was conducted to compare teachers' assessment of their levels of competence with understanding and using presentation media and multimedia before the reverse-mentored programme and again at the end of the programme. The test indicated there was a significant difference between the baseline questionnaire score and the end of project questionnaire score,  $t(24) = 3.328$ ,  $p = 0.003$ . The mean scores for responses to the baseline question ( $M = 3.64$ ,  $SD = 1.497$ ) were higher than the end of project mean scores ( $M = 2.27$ ,  $SD = 1.137$ ). There was a strong correlation between the teachers' answers to both questions,  $r = 0.477(24)$ ,  $p = 0.02$ .

### **Teachers' integration of ICT based learning.**

*Paired-samples: Teachers' integration of ICT based learning in units of work.* A comparison of teachers' answers to the proportion of ICT based learning activities was carried out through baseline question 20 and end of project question 4. At the start of the reverse-mentored programme, 13 teachers reported they had not used ICT base learning in any of their units of work. By the end of the programme, three teachers reported they had not used ICT in this way.

A paired-samples *t*-test was conducted to compare teachers' assessment of their integration of ICT in learning activities before the reverse-mentored programme and again at the end of the programme. The test indicated there was a significant difference between the baseline questionnaire score and the end of project questionnaire score,  $t(24) = 3.062$ ,  $p = 0.005$ . The mean scores for responses to the baseline question ( $M = 3.72$ ,  $SD = 1.308$ ) were higher than the end of project mean scores ( $M = 2.76$ ,  $SD = 1.128$ ).

### **Students' frequency of use of ICT's.**

*Paired-samples: Students' frequency of use of communication through text/picture presentation.* A comparison of teachers' answers to baseline question 21(a)(1) and end of project question 8(a)(1) was carried out. At the start of the programme, 14 teachers reported their students used ICT in this way once or twice a year or not at all. By the end of the programme, four teachers reported their students using ICT in this way once or twice a year but no teacher reported their students had not used ICT in this way at all.

A paired-samples *t*-test was conducted to compare student levels of use of text and picture presentation for communication before the reverse-mentored programme and again at the end of the programme. The test indicated although the difference between the baseline

questionnaire score and the end of project questionnaire score was statistically non-significant ( $t(25) = 1.789$ ,  $p = 0.08$ ), the mean scores for responses to the baseline question ( $M = 3.12$ ,  $SD = 1.243$ ) were higher than the end of project mean scores ( $M = 2.69$ ,  $SD = 0.928$ ). There was also a strong correlation between the teachers' answers to both questions,  $r = 0.413(24)$ ,  $p = 0.04$ .

***Paired-samples: Students' frequency of use of communication through multimedia presentation.*** A comparison of teachers' answers to baseline question 21(a)(2) and end of project question 8(a)(2) was carried out. At the start of the reverse-mentored programme, 23 teachers reported their students had not used ICT in this way or they had used it once or twice a year. By the end of the programme, 11 teachers reported their students had not used ICT in this way or they had used it once or twice a year.

A paired-samples  $t$ -test was conducted to compare student levels of use of multimedia presentation for communication before the reverse-mentored programme and again at the end of the programme. The test indicated although the difference between the baseline questionnaire score and the end of project questionnaire score was statistically non-significant ( $t(25) = 1.098$ ,  $p = 0.28$ ), the mean scores for responses to the baseline question ( $M = 3.58$ ,  $SD = 1.238$ ) were higher than the end of project mean scores ( $M = 3.31$ ,  $SD = 1.192$ ). There was also a strong correlation between the teachers' answers to both questions,  $r = 0.471(24)$ ,  $p = 0.02$ .

***Paired-samples: Students' frequency of use of communication through on-line interaction.*** A comparison of teachers' answers to baseline question 21(a)(3) and end of project question 8(a)(3) was carried out. At the start of the programme, 25 teachers reported

their students had used ICT in this way either once or twice a year or not at all. By the end of the programme, that number of teachers dropped to 12.

A paired-samples *t*-test was conducted to compare student levels of use of on-line interaction for communication before the reverse-mentored programme and again at the end of the programme. The test indicated although the difference between baseline questionnaire score and the end of project questionnaire score was statistically non-significant ( $t(25) = 1.591, p = 0.12$ ), the mean scores for responses to the baseline question ( $M = 3.65, SD = 1.413$ ) were higher than the end of project mean scores ( $M = 3.12, SD = 1.608$ ).

***Paired-samples: Students' frequency of use of creativity using ICT.*** A comparison of teachers' answers to baseline question 21(b) and end of project question 8(b) was carried out. At the start of the programme, 23 teachers reported their students had not used ICT in this way or if they did, they did so one or twice a year. By the end of the programme, that number of teachers reduced to 14

A paired-samples *t*-test was conducted to compare student levels of creativity using ICT before the reverse-mentored programme and again at the end of the programme. The test indicated although the difference between baseline questionnaire score and the end of project questionnaire score was statistically non-significant ( $t(25) = 1.591, p = 0.12$ ), the mean scores for responses to the baseline question ( $M = 3.88, SD = 1.306$ ) were higher than the end of project mean scores ( $M = 3.35, SD = 1.294$ ).

***Paired-samples: Students' frequency of use of information gathering/processing.*** A comparison of teachers' answers to baseline question 21(c) and end of project question 8(c) was carried out. At the beginning of the reverse-mentored programme nine teachers reported

their students had either not used ICT in this way at all or had used it once or twice a year. By the end of the programme, all teachers used ICT in this way with three teachers reported using it once or twice a year.

A paired-samples *t*-test was conducted to compare student levels of information gathering/processing before the reverse-mentored programme and again at the end of the programme. The test indicated there was a significant difference between the baseline questionnaire score and the end of project questionnaire score, ( $t(25) = 2.375, p = 0.02$ ), the mean scores for responses to the baseline question ( $M = 2.50, SD = 1.030$ ) were higher than the end of project mean scores ( $M = 1.92, SD = 0.977$ ).

***Paired-samples: Students' frequency of use of ICT for problem solving.*** A comparison of teachers' answers to baseline question 21(d) and end of project question 8(d) was carried out. At the start of the programme no teachers reported their students using ICT in this way daily or almost daily. Twenty four teachers reported their students have never used ICT for problem solving or if used it was only once or twice a year. By the end of the programme, four teachers reported their students had used ICT for problem solving either daily or once or twice a week; ten teachers reported student use once or twice a year and seven teachers reporting they had not used ICT in this way at all.

A paired-samples *t*-test was conducted to compare student levels of use of ICT for problem solving before the reverse-mentored programme and again at the end of the programme. The test indicated there was a significant difference between the baseline questionnaire score and the end of project questionnaire score, ( $t(25) = 2.132, p = 0.04$ ), the mean scores for responses to the baseline question ( $M = 4.08, SD = 1.017$ ) were higher than

the end of project mean scores ( $M = 3.77$ ,  $SD = 1.032$ ). There was also a strong correlation between the teachers' answers before and after the programme,  $r = 0.742(24)$ ,  $p = 0.001$ .

***Paired-samples: Students' frequency of use of ICT for curriculum practice.*** A comparison of teachers' answers to baseline question 21(e) and end of project question 8(e) was carried out. There was little change in the number of teachers who reported either never using ICT for their students' curriculum practice or using ICT in this way once or twice a year. At the beginning and end of the programme 25 teachers recorded they had either never used ICT with their students in this way or had used it once or twice a year compared with 20 teachers reporting the same results at the end of the programme.

A paired-samples  $t$ -test was conducted to compare student levels use of ICT for curriculum practice before the reverse-mentored programme and again at the end of the programme. The test indicated although the difference between the baseline questionnaire score and end of project questionnaire score was statistically non-significant ( $t(25) = 0.938$ ,  $p = 0.38$ ), the mean scores for responses to the baseline question ( $M = 3.80$ ,  $SD = 1.384$ ) were higher than the end of project mean scores ( $M = 3.52$ ,  $SD = 1.358$ ).

***Paired-samples: Students' frequency of use of ICT technical skills.*** A comparison of teachers' answers to baseline question 21(f) and end of project question 8(f) was carried out. At the beginning of the programme, 20 teachers reported their students had either never used ICT technical skills or if they had the frequency was once or twice a year. By the end of the programme this number of teachers had reduced to 12.

A paired-samples  $t$ -test was conducted to compare student frequency of use of ICT technical skills before the reverse-mentored programme and again at the end of the

programme. The test indicated although the difference between the baseline questionnaire score and the end of project questionnaire score was statistically non-significant ( $t(25) = 1.889, p = 0.07$ ), the mean scores for responses to the baseline question ( $M = 3.62, SD = 1.416$ ) were higher than the end of project mean scores ( $M = 2.96, SD = 1.399$ ).

***Paired-samples: Students' frequency of use ICT for collaborative learning and social interaction.*** A comparison of teachers' answers to baseline question 21(g) and end of project question 8(g) was carried out. At the beginning of the reverse-mentored programme, 29 teachers reported their students had either not used ICT for collaborative learning and social interaction or if the students had used ICT in this way the frequency was once or twice a year. By the end of the programme the number of teachers in this category was reported as 13.

A paired-samples  $t$ -test was conducted to compare student frequency of use of ICT for collaborative learning and social interaction before the reverse-mentored programme and again at the end of the programme. The test indicated there was a significant difference between the baseline questionnaire score and the end of project questionnaire score, ( $t(25) = 4.768, p = 0.001$ ), the mean scores for responses to the baseline question ( $M = 4.40, SD = 0.913$ ) were higher than the end of project mean scores ( $M = 3.20, SD = 1.528$ ). There was also a strong correlation between the teachers' answers to both questions,  $r = 0.568(24), p = 0.003$ .

***Paired-samples: Students' frequency of use of ICT for motivation or reward.*** A comparison of teachers' answers to baseline question 21(h) and end of project question 8(h) was carried out. Twenty four teachers reported that at the start of the programme, their students had either not had ICT for motivation or reward or if they did have ICT for this

purpose, it was once or twice a year. At the end of the programme, there were 21 teachers in this category.

A paired-samples *t*-test was conducted to compare student frequency of use of ICT for motivation or reward before the reverse-mentored programme and again at the end of the programme. The test indicated there was a significant difference between the baseline questionnaire score and the end of project questionnaire score, ( $t(25) = 2.236, p = 0.03$ ), the mean scores for responses to the baseline question ( $M = 3.69, SD = 1.192$ ) were higher than the end of project mean scores ( $M = 4.19, SD = 1.059$ ). There was also a strong correlation between the teachers' answers to both questions,  $r = 0.492(24), p = 0.01$ .

### **Summary: Quantitative Data Findings**

Chapter Six contains numerical data and statistical analyses of teachers' responses to questions in the two questionnaires—one data set completed at the beginning of the reverse-mentored programme and the other at the end. A comparison of the two sets indicates—statistically and otherwise—the reverse-mentoring programme had a positive effect on the participant teachers' development in the use of ICT both personally and pedagogically.

Statistically significant results for differences in the data between schools and genders have been reported with each survey question. However, in cases in which the data from specific questions has been tagged as 'statistically non-significant', numeric data showing teacher preferences has been provided to give an estimate of the strength of teachers' views. For example the results from baseline question 3(b) (teachers' preferences for learning through working one-to-one with a mentor) were statistically non-significant but 34 (85%) of the 40 teachers preferred this method of learning. A consistent (and reinforcing) result to the answer of baseline question 3(e) relating to a preference for working in a large group, was

that 34 (85%) of the 40 teachers did not like this method of learning but again the results were statistically non-significant for differences between either genders or schools.

Part One of this chapter addressed the state of readiness of teachers to integrate ICT's in their pedagogies before they took part in the reverse-mentored programme. The quantitative data from this baseline survey indicated a number of areas in which the participant teachers expressed their concerns and preferences including areas such as professional development for the use of ICT's in the classroom. There were statistical indications that their concerns and preferences were influenced at least in part by the teacher's gender and/or the teacher's school. Another potential influence was the effect of teaching experience on the teachers' responses. In the baseline demographic question on teaching experience, School A had 23 teachers with 5 to 25 years of teaching experience compared with ten at School B. The difference between the schools was reported as being statistically significant.

The analysis of the data in Part Two, related to the teachers' views on the effect of the reverse-mentoring on their pedagogies after the completion of the programme. In general, teachers reported that their levels of confidence using ICT personally and in classes rose after the reverse-mentored project. For example, in answer to baseline question 13(b), sixteen teachers reported being confident in using ICT's with classes and 15 teachers reported either a lack of confidence or anxious in using ICT's in that way. At the end of the project the numbers changed considerably. The end of project question 1(b) indicated only one teacher was lacking in confidence and 30 reported being confident or very confident in using ICT's in classes. A paired samples *t*-test (reported in Part Three) using data from those two questions (before and after the programme) indicated a significant difference between the

baseline score and the end of project score and there were also strong correlations between the teachers' answers to the two questions.

Teachers' concerns have also been reported in this chapter. There were concerns reported about the availability and classroom use of ICT equipment. Responses to the end of project questions 14(a) and 14(b) indicated concerns regarding access to and technical support of ICT equipment for student use. For example for end of project question 14(a) 26 (91%) of teachers had concerns or significant concerns over access to equipment for student use. Statistically these concerns indicated significant differences between schools. Responses to the end of project question 14(b) indicated that 29 (94%) teachers had concerns or significant concerns about the quality of technical support they receive. Statistically these concerns also indicated significant differences between schools. Further teachers' concerns identified by the research are detailed in this chapter.

Part Three compared selected paired questions from both questionnaires and an analysis of those comparisons provided insight on the developmental pathways the teacher respondents took in the development of ICT skills and knowledge. Among the data collected were teachers' competencies before and after the reverse-mentored programme. Before and after comparisons were made through the use of paired-samples *t*-tests. For example teachers' competence with computer file management—16 teachers reported low or very low levels of attainment before the project and only one teacher reported this level of attainment after the programme. Teachers' competence with spreadsheets—25 teachers reported low or very low levels of attainment before the project and eight teachers reported this level of attainment after the programme. Part Three details 24 such paired-samples tests using *t*-tests analyses.

The qualitative data collected from the study discussed in Chapter Seven provides a number of further lenses through which teachers' comments describing their experiences before, during and after the reverse-mentored programme can be examined.

## Chapter Seven — Qualitative Data Findings

### Introduction

This chapter describes teachers' comments from two sources: teachers' written comments in the survey instruments (baseline and end of project questionnaires) and informal comments from teachers during and at the end of the project. The teachers' comments from the questionnaires have been labelled with the number and a description of the question itself. Not all teachers provided comments in the questionnaires. A number of teachers remarked they preferred to tick boxes rather than provide written comments. Sample questionnaires can be found in Appendix A.

Teachers' informal comments given verbally during and at the end of the project were written in note form at the time they were made and are as near as possible to the actual comments made. These were in addition to teachers' own recorded impressions on student help immediately after that help was given and discussions in post-programme meetings. Unlike those quantitative data in Chapter Six, this chapter is a record of teachers' opinions, hopes, and expectations as they strived to cope with the rapid advance of technology in their classrooms as such teachers' opinions rather than numbers, dominates this chapter.

Common threads in the qualitative data included teachers' need for their student helpers to receive credit for their work in assisting them (the teachers) to cope with using ICT in the classroom. Some teachers found the need to keep records of their progress a nuisance but most were willing to discuss, rather than write about, their experiences in the programme.

## The Extent of Teachers' Focus on ICT Professional Development at the Start of the Programme

### Teachers' views on professional development for using ICT in the classroom.

Baseline question 9 was designed to elicit teachers' views on their abilities to use ICT in the classroom. Twelve teachers recorded they considered ICT professional development was a major focus for them, 22 teachers considered it a secondary focus and 15 teachers ranked this type of professional development as a low priority (Figure 7 and Figure 8)

<p><i>Baseline question 9: Ranking of ICT issues in professional development this year. Teacher responses from School A</i></p>	<p>With this mentoring idea, ICT issues will be a higher priority for me as the year moves on and teachers get on-board and participate. Major focus.</p>
	<p>I need to keep up with students to engage them for the best learning. Major focus.</p>
	<p>I need to extend my knowledge and skill level using InterWrite technology. A performance objective for me this year. Major focus.</p>
	<p>ICT is important to my teaching. Major focus.</p>
	<p>I have reasonable skills already. Secondary focus</p>
	<p>Uncertain due to other expectations but would greatly appreciate ICT professional development if I can receive it. Secondary focus.</p>
	<p>We have had ICT PD at various times as a departmental goal but largely related to reporting English related tasks that we have addressed in the whole school professional development. No specific department time allocated. Secondary focus.</p>
	<p>Eleven teachers recorded ICT professional development as a secondary focus but did not comment further.</p>
	<p>Eleven teachers recorded ICT professional development as a low priority but did not comment further.</p>

Figure 7. Baseline question 9: Focus on ICT professional development this year. School A.

<p><i>Baseline question 9: Ranking of ICT issues in professional development this year. Teacher responses from School B.</i></p>	<p>Would love to involve ICT in the classroom but I do not have the knowledge or experience to do this. Major focus.</p>
	<p>It's a huge focus for me second only to management of behaviour. Major focus.</p>
	<p>I need to increase my ICT skills. Major focus.</p>
	<p>Get to know Apple system in my class, Apple laptop a possibility. Major focus.</p>
	<p>Depends on availability of any professional development and how that pans out. Secondary focus.</p>
	<p>I'm a new teacher so my primary focus is on classroom management. Secondary focus.</p>
	<p>Four School B teachers recorded that ICT professional development was a major focus but did not commented further.</p>
	<p>Six School B teachers recorded ICT professional development as a secondary focus but did not comment further.</p>
<p>Four School B teachers recorded that ICT professional development was a low priority but did not commented further.</p>	

Figure 8. Baseline question 9: Focus on ICT professional development this year School B.

**Teachers' primary goals by gender for ICT professional development.** Seven teachers who answered baseline question 10(a) recorded they had major ICT professional development goals but did not specify what they were. Nine teachers reported they had secondary (but important) goals for ICT professional development but did not specify what they were. One teacher recorded she was confident in the use of ICT and had no ICT professional development priorities. The remaining teachers listed what they wanted as major ICT professional development goals (Figure 9 to Figure 12)

<p><i>Baseline question 10(a): Teachers' ICT professional development major goals. School A List #1.</i></p>	I want to get some way [for] integration of ICT in the classroom. (Female teacher).
	I need to up-skill using STAR link. (Female teacher).
	No priorities - confident with ICT and often teach other staff. (Female teacher).
	I want to put all NCEA tasks etc., on computer. (Female teacher).
	I want to be more savvy with Word. (Female teacher).
	I want to up-skill in ICT. (Female teacher).
	I want to confidently work with digital cameras with computers etc. (Female teacher).
	I want to become technically proficient at ripping and inserting DVD clips. (Female teacher).
	I want subject skills with ICT. (Female teacher).
	I want to become more literate at using computers. (Female teacher).
	Four female teachers recorded ICT professional development was a major goal but did not supply any further comment.

*Figure 9. Baseline question 10(a): Priorities for ICT professional development by gender*

School A List #1.

<p><i>Baseline question 10(a): Teachers' ICT professional development major goals. School A List #2.</i></p>	<p>I want to develop my interactive white board skills. (Male teacher).</p>
	<p>I want to learn about Scratch. (Male teacher).</p>
	<p>I want to use more valuable technology in the classroom. (Male teacher).</p>
	<p>I want to upgrade my ICT skills in my subject. (Male teacher).</p>
	<p>I want to learn new ICT skills. (Female teacher).</p>
	<p>I want to learn about computers. (Female teacher).</p>
	<p>I want to learn about how to use computers to assist me in my role. (Female teacher).</p>
	<p>I want to have ICT knowledge and skills. (Female teacher).</p>
	<p>I want to be more up-to-date with MYClasses. (Female teacher).</p>
	<p>I need occasional help with changing to new versions of Windows etc. (Female teacher).</p>
<p>Two male teachers recorded ICT professional development was a major goal but did not supply any further comment.</p>	

*Figure 10.* Baseline question 10(a): Priorities for ICT professional development by gender

School A List #2

<p><i>Baseline question 10(a): Teachers' ICT professional development major goals. School B (List #1).</i></p>	I want to create a PowerPoint. (Female teacher).
	I want student confidence when learning with ICT as a tool. (Female teacher).
	I want to get to know Apple laptops. (Female teacher).
	I want to have a broad knowledge of programmes available to run with curriculum areas. (Female teacher).
	I want to have a range of programmes that will enhance teaching and learning. (Female teacher).
	I want to learn how to use Excel. (Female teacher).
	I want to incorporate a Q&A area on my website. (Female teacher).
	I want to integrate ICT into lessons - not just research assignments. (Female teacher).
	I want to integrate [ICT] into all of my teaching. (Female teacher).
	One female teacher recorded ICT professional development was a major goal but did not supply any further comment.

*Figure 11.* Baseline question 10(a): ICT professional development priorities School B #1

<p><i>Baseline question 10(a): Teachers' ICT professional development major goals. School B ( List #2).</i></p>	I want to use ICT in all lessons. (Male teacher).
	I want to use Interactive White Board in class. (Male teacher).
	I want a support programme for staff. (Male teacher).
	I want to work on developing SchoolZone [website] page. (Female teacher).
	I want to be up to speed with technology to suit student needs. (Female teacher).
	I want to use computers in class. (Female teacher).
	I want to be highly proficient in all aspects of Corel Draw X3. (Female teacher).
	I want to explore different features of InterWrite technology. (Female teacher).
	I want to be able to understand and implement Excel. (Female teacher).
	I want to become more ICT literate. (Female teacher).

*Figure 12.* Baseline question 10(a): ICT professional development priorities School B #2

**Teachers' secondary goals by gender for ICT professional development.** Nine teachers who answered baseline question 10(b) recorded they had secondary but important ICT professional development goals but did not specify what they were. The remaining teachers' list of goals included a need to learn skills, learn programme/applications, gain computer knowledge and get confidence in the use of computers (Figure 13 13 and Figure 14).

<p><i>Baseline question 10(b): Teachers' ICT professional development secondary goals. School A.</i></p>	I want to learn more about graphics. (Male teacher).
	I want to learn new ICT skills. (Female teacher).
	I want to utilise/access better web sites for teaching programmes (Female teacher).
	I want to use ICT in my subject teaching. (Female teacher).
	I want to use ICT in my lessons. (Female teacher).
	I want to understand the value of Wikis etc. (Female teacher).
	I want to learn about using computers with my subject and work. (Female teacher).
	I want to learn to use ICT in science. (Female teacher).
	I want to know more about blogging, Twitter, etc. (Female teacher).
	I want to incorporate more ICT in lessons. (Female teacher).
	I need more ICT skills. (Female teacher).
	I want to do NZ curriculum units of work on computer. (Female teacher).
	I want to develop mark-books etc., separate from classroom manager. (Female teacher).
	I want to be come an expert in P2P. (Female teacher).
	I want to use Excel better. (Female teacher).
One male teacher recorded ICT professional development goal as a secondary goal but did not comment further.	
Eight female teachers recorded ICT professional development as secondary goals but did not comment further.	

*Figure 13.* Baseline question 10(b): Teachers' ICT professional development secondary priorities. School A

	I want to use ICT in all lessons. (Male teacher).
	I want to increase my knowledge of Publisher. (Male teacher).
	I want to see educational benefits for students who are technical support. (Male teacher).
	I want to use and learn programmes. (Male teacher).
	I want to develop my own confidence when using ICT tools. (Female teacher).
	I want to know how to use the current Word programme. (Female teacher).
	I want the use of my computer all day and all programmes. (Female teacher).
	I want to be able to use computers to prepare lessons. (Female teacher).
<p><i>Baseline question 10(b): Teachers' professional development secondary goals. School B.</i></p>	I want to use ICT in most lessons. (Female teacher).
	I want to work on photo stories. (Female teacher).
	I want to work on a SchoolZone page. (Female teacher).
	I want to have students up-skill to help mentor staff in ICT skills (Female teacher).
	I want to have students teach me their strengths in ICT. (Female teacher).
	I want to give students a better chance to become more competent using iPads without taking time from other areas. (Female teacher).
	I want to get to know the computer systems in my class. (Female teacher).
	I want to find more InterWrite programmes. (Female teacher).
	I want to be able to understand a computer language. (Female teacher).

*Figure 14.* Baseline Question 10(b): Teachers' ICT professional development secondary priorities. School B

**Teachers' minor goals by gender for ICT professional development.** The teachers answered baseline question 10(c) included in their minor ICT professional development goals aspirations for competence in general computer troubleshooting, the use of ICT with special needs students, expertise in specialist applications, and how to meet their students' learning through being more technically knowledgeable (Figure 15).

<p><i>Baseline question 10(c): Teachers' minor ICT professional development goals.</i></p>	<p>I would like to use computer programmes with special needs students. (School B female teacher).</p>
	<p>I want to get to design music compositions and lessons. (School B male teacher).</p>
	<p>I want to fix minor computer problems i.e. computers going to sleep. (School B female teacher).</p>
	<p>I want to learn more about video editing software. (School A male teacher).</p>
	<p>I want to become an expert in the use of computers/ multimedia in public gatherings to have impact. (School A female teacher).</p>
	<p>I want to be able to troubleshoot better on my own. (School A female teacher).</p>
	<p>I want to be more knowledgeable and technical savvy in classes to meet how kids like learning. (School A female teacher).</p>

*Figure 15.* Baseline question 10(c): Teachers' ICT professional development minor goals for Schools A & B.

## Changes to Classroom Practice as a Result of the Programme

At the end of the reverse-mentored programme, teachers were asked about positive changes to their classroom practices as a result of the reverse-mentored programme (Figure 16). A number of the teachers' comments indicated the programme not only helped their ICT professional development but it also helped build positive student/teacher relationships.

<p><i>End of project question 5(b): Positive changes to classroom practices.</i></p>	<p>I can actually gain access to resources from the Internet. School B.</p>
	<p>Electronic roll is much easier. School B.</p>
	<p>Leadership for students. Shows that all people can be teachers/learners. School B.</p>
	<p>Less paper. Students extremely comfortable with the tools. School B.</p>
	<p>Mentoring system was useful when available. School B.</p>
	<p>Students really enjoyed sharing knowledge. School B.</p>
	<p>Easy [for me] to learn with help from [students]. School A.</p>
	<p>I can use technology in my lessons now I have some help from the [students]. School A.</p>
	<p>[The reverse mentoring] programme gives me confidence to try things out. School A.</p>
	<p>It's great to have student help when I need it. School A.</p>
<p>It is good to get the help I need to use computers in my lessons. School A.</p>	
<p>Schemes of work and tasks now on computer. School A.</p>	
<p>I'm now using "My Classes". School A.</p>	

*Figure 16.* End of project question 5(b): Positive changes in classroom practices as a result of the reverse-mentored programme.

End of project question 5(b) also asked teachers for their views on any negative changes to classroom practices. Eleven teachers reported they had no negative comments. One teacher considered the lack of computers made teaching with ICT difficult and another teacher commented that the student mentors were not always available when needed (Figure 17).

<i>End of project question 5(b): Negative changes to classroom practices.</i>	Lack of computers make whole or even half class skills lessons difficult. School B.
	Nothing negative (four teachers). School B.
	Student could not fix the problem. School B.
	They are limited by my limits. School B.
	It can mean students aren't used to interacting [with teachers]. School A.
	No negative comments (seven teachers). School A.
	[Student mentors] not always available. School A.

*Figure 17.* End of project question 5(b): Negative changes in classroom practices as a result of the reverse-mentored programme. Schools A and B.

### **The Extent the Programme has Contributed to Understanding of Teaching and Learning Generally**

End of project question 6(b) asked for information on the extent the programme contributed to teachers' understanding of teaching and learning. Teachers in both schools answered this question positively with some of their comments suggesting the beginning of pedagogical changes to use ICT in their teaching (Figure 18).

<p><i>End of project question 6(b): Extent programme has contributed to understanding of teaching and learning generally.</i></p>	<p>Better to be hands on (e.g. students get you to do the work) rather than them pushing the right keys and you not knowing what they are doing. School B.</p>
	<p>Gave me more of an idea/confidence to have students develop and confirm their learning when in the role. School B.</p>
	<p>Students are more likely to try unique angles to problem solve. School B.</p>
	<p>Reinforced my belief that students can be teachers too. School B.</p>
	<p>I'm not a nerd yet but I am 100% more confident. School A.</p>
	<p>We are all learners and this point is reinforced by the programme. School A.</p>
	<p>The programme gives me confidence to try things out. School A.</p>
	<p>I can develop a new way of teaching. School A.</p>
	<p>I can teach to individual needs. School A.</p>
	<p>Helped me to see if "MyClasses" worked for students on their machines. School A.</p>
<p>I can teach to individual students instead of the whole class doing the same thing. School A.</p>	

*Figure 18.* End of project question 6(b): Extent the programme has contributed to understanding of teaching and learning generally. Schools A and B.

## Benefits for Using Students to Help with Teachers' Use of ICT

End of project question 10 asked for teachers' comments on the benefits of using students to help teachers' use of ICT. The School A teachers' responses in Figure 19 vary but were positive with one epigrammatic comment "Benefits? I have success" which summarised a number of the responses.

<p><i>End of project question 10: Observed benefits for using students to help with the use of ICT. School A.</i></p>	They present things in an easy style so easy to understand.
	They [the students] are always there when I need them (1 teacher).
	The [students] were always there when I needed them (1 teacher).
	Communication between students/staff build good relationships.
	Explained points and processes clearly and simply.
	Good to see something work on the students machines first.
	The [students] are helpful and pleasant.
	A fresh pair of eyes or a new way of looking at a problem.
	Students always approachable and willing.
	Builds confidence in students; allows them to be teacher.
	I can get help when I need it.
	I don't have to worry about getting stuck.
	Increasing confidence and inter-relationships with peers/adults.
	Benefits? I have success.
	The students were fantastic and very patient.
	Avenue for IT keen girls to take on responsibility.
	Gave them a sense of achievement.
The [student mentors] often suggested different ways of doing things.	

Figure 19. End of project question 10: Observed benefits of student help with ICT. School A.

The School B teachers' responses to end of project question 10 regarding the benefits of using students to help teachers' use of ICT were also generally positive (Figure 20). The teachers' comments included an increase in self-confidence, positive student/teacher relationships, and opportunities for individualised learning.

<i>End of project question 10: Observed benefits for using students to help with the use of ICT. School B.</i>	Confidence of the [student] helpers.
	Utilising reading skills in a practical way is a life skill.
	Engagement of students.
	I haven't used any [students] in our area for troubleshooting.
	One benefit is more confidence in myself.
	Reinforcing the reading skills we are teaching.
	The students were self motivated.
	Time efficiency.
	Students were enthusiastic to learn.
	Individualising learning for them and myself.
Presenting work so that they feel proud of their achievements.	

*Figure 20.* End of project question 10: Observed benefits for using students to help teachers in the use of ICT. School B.

### **Aspects of the Programme Most Appreciated**

End of project question 12(a) was designed to establish aspects of the programme which the participant teachers most appreciated. The teachers' responses in Figures 21 to 23

are all dominated by expressions of increasing confidence developed through assistance from the student reverse-mentors. The just-in-time and just-for-me help provided by the students was appreciated by the majority of the teacher respondents. Three teachers recorded the question was not applicable for them but did not explain further.

<p><i>End of project question 12: Aspects of the programme most appreciated . School A (List #1).</i></p>	Availability of help when I need it. Very positive.
	Being able to call on a member of the class to provide technical assistance.
	Confidence to know it would work.
	Excellent help, most appreciated and [students] explained how-to with each problem.
	Great having student support when I need it. Very helpful with specific suggestions, practical and very professional.
	Great rapport with my students. They are positive, knowledgeable and easy to work with. I'm keen to do more.
	Help on hand.
	I haven't used the mentors greatly, mainly setting up equipment for outside presenters, and trouble shooting.
	It's great to have someone reliable and competent.

*Figure 21.* End of project question 12(a): Aspects of the reverse-mentored programme most appreciated. School A (List #1).

<p><i>End of project question 12: Aspects of the programme most appreciated . School A (List #2)</i></p>	Not applicable for me.
	Pupils available to help when I need them.
	Students quietly helped with issues, used initiative in a friendly manner.
	Students are there to help when I get stuck. Extremely helpful and precise in explanation and teaching me how easy it was.
	Students were helpful, especially with diagnoses. Very clear instructions. Left me positive.
	Appreciated the assistance to make things happen, usually at the last minute when presentations are not working.
	The [students] were there to help when I needed them.
	The helpfulness and readiness of the [students].
	They are always there and willing to help.

*Figure 22.* End of project question 12(a): Aspects of the reverse-mentored programme most appreciated. School A (List #2).

<p><i>End of project question 12: Aspects of the programme most appreciated. School B.</i></p>	<p>Not applicable for me (2 teachers).</p>
	<p>Students show how to use Excel/Word etc. They are super helpful.</p>
	<p>Easier access/knowledge of teaching tools.</p>
	<p>Having the student mentors there.</p>
	<p>Seeing professional growth.</p>
	<p>Sharing of ideas.</p>
	<p>I was supported once and the student was upskilled regarding printer access on all my computers.</p>
	<p>Most appreciated is the fact that I know I can have support when I needed the help.</p>
	<p>Most appreciated is help on hand.</p>

*Figure 23.* End of project question 12(a): Aspects of the reverse-mentored programme most appreciated. School B.

### **Aspects of the Programme Least Appreciated**

End of project question 12(b) gave teachers the opportunity to comment on aspects of the programme which they least appreciated (Figure 24). Six teachers from School A recorded they had no negative comments on the programme. An important comment (from each school) was the dislike of the paperwork needed for the project. The paperwork included both survey instruments and in some cases, the progress reports for the ICT

coordinator. These comments helped explain the sometimes erratically written completion of the questionnaires.

<p style="text-align: center;"><i>End of project question 12: Aspects of the programme least appreciated. Schools A and B.</i></p>	<p>Filling in forms for the project analysis. School A.</p>
	<p>All the paperwork to show how [student] had helped me. School B.</p>
	<p>Students making time to work with me and not turning up. School B.</p>
	<p>Not having [student mentors] there. School B.</p>
	<p>Nothing to comment on (6 teachers responses). School A.</p>
	<p>[Student mentors] not always available. School A.</p>
	<p>Getting time to ask/seek out students. School A.</p>

*Figure 24.* End of project question 12(b): Aspects of the reverse-mentored programme least appreciated. Schools A and B.

### **Factors Involved in the Increased Use of ICT with Classes**

The end of project question 13(b) called for the identification of factors other than the reverse-mentored programme which involved an increase in use of ICT with classes. Two teachers found the question did not apply to them and three teachers misread the intention of question and related the increase to the support they received from the reverse-mentored programme rather than factors outside the programme (Figure 25).

<p><i>End of project question 13: Factors involved in increased use of ICT. Schools A and B</i></p>	<p>Not applicable (2 teachers). School B.</p>
	<p>My own interest to learn and develop understanding and skills. School B.</p>
	<p>Use of absentee programme. Changes to report writing programme. School B.</p>
	<p>I can now try things out without having to worry about not knowing how to use the ICT. School A.</p>
	<p>[The teacher support] from the mentors. School A.</p>
	<p>Fitting integrating ICT into programme when there are many other tools that can be used with [ICT]. School A.</p>
<p>Great [student mentor] support for teachers. School A.</p>	

*Figure 25.* End of project question 13(b): Other factors involved increased use of ICT. Schools A and B.

### **Significance of the Programme on Overall Teacher Development**

The comments in response to the end of project question 15(b) (which dealt with the significance of the programme on overall teacher development) were generally positive. However, one teacher considered the programme a failure as s/he considered the students were not up to being ICT reverse-mentors for teachers (Figure 26).

<p style="text-align: center;"><i>End of project question 15(b): Comments on the significance of the reverse mentoring programme on overall teacher development. Schools A and B.</i></p>	<p>The base level of ability of students we have taken in nearly all cases, including specialist ICT classes, is minimal and shows the failure of the programme. School B.</p>
	<p>[The ICT coordinator] has been instrumental in getting this to happen - in sharing her knowledge and giving me the confidence to let the students help me. School B.</p>
	<p>The support I needed in Reading Assistance required [the systems administrator] to come over so the mentor idea is not applicable where I am. School B.</p>
	<p>Good to be part of the programme although I started late. Thank you. School A.</p>
	<p>As Principal, many of the questions are not applicable. School A.</p>
	<p>Great. I'm glad I had the help of these [student mentors]. Thanks. School A.</p>
	<p>I can't believe how much I have learned. School A.</p> <p>It is a great idea. The fault is mine for not taking full advantage of the opportunity. The [student mentors] were always very obliging when I did ask something. School A.</p>

*Figure 26.* End of project question 15(b): Comments on the significance of the reverse-mentored programme on teachers' overall development. Schools A and B.

### **Teachers' Comments on Student Mentor Help with ICT**

Figures 27 to 31 detailed teachers' comments and their views of the reverse-mentored programme. The comments are idiosyncratic and generally reflect the success of the programme through a positive relationship between teachers and their student mentors.

<p><i>School A teachers' comments on student mentor help. List #1.</i></p>	<p>DataShow images were wrong way around. [Student] quickly helped and corrected images. Used initiative in a friendly manner.</p>
	<p>Image on video was too small but [student] was very helpful and had a pleasant manner and showed me how to fix it. Thanks.</p>
	<p>Bad connection to laptop but [student] was most helpful and showed me how to fix the damaged pin. Thank you.</p>
	<p>[Student] showed me how to remove a text-box from a document. Very helpful and time-saving.</p>
	<p>Couldn't log in. [Student] was a great help. Thank you.</p>
	<p>My document exploded and then I saved. Sigh! [Student] put Humpty Dumpty together again!</p>
	<p>No sound on my laptop and saving and emailing photos. [Student] was very supportive and made helpful suggestions as I went through the processes.</p>
	<p>I wanted text on PowerPoint to fly into screen one sentence at a time. All text was in one box. [Student] suggested separate text-boxes and it worked. Thanks.</p>
	<p>[Student] helped me with how to use an aspect of M/s Word in the new format. Very knowledgeable.</p>
	<p>[Student] helped me with using memory sticks for backup. I want to take her home too, she's so knowledgeable.</p>
<p>When I couldn't resize photos on Microsoft Word [student] showed me how to move and resize. Excellent help! She even showed me how to do it in the future.</p>	

Figure 27. School A Teachers' comments on student mentor help. List #1.

<p><i>School A teachers' comments on student mentor help. List #2.</i></p>	<p>She showed me how to scan, cut, paste, and crop images. I want her with me always! :-)</p>
	<p>I'm loving help from this girl. She showed me how to resize fonts.</p>
	<p>She fixed the remote access which was not working. Excellent work.</p>
	<p>I needed to know how to start the MyClasses programme. She was positive, knowledgeable and easy to work with. She was willing to help and keen to do more. Thanks.</p>
	<p>Using ClipArt. She was a big help. Can I take her home? :-)</p>
	<p>Banners - she helped me make some. I love this girl's help!</p>
	<p>Text boxes - she helped me create some. She's unflappable.</p>
	<p>She helped me make changes in a scanned document. She's invaluable.</p>
	<p>More work with scanned documents. More chocolate needed!</p>
	<p>Laptop screen not displaying images. She was very helpful especially when under pressure.</p>
	<p>Display pictures on a projector from a Mac computer. Very helpful with specific suggestions, patient and very professional.</p>
	<p>The H drive wasn't the correct drive. Problem solved. Thanks.</p>
	<p>Using projector with a remote. [Student] was very helpful and showed me how to do it.</p>

Figure 28. School A Teachers' comments on student mentor help. List #2.

*School A teachers'  
comments on student  
mentor help. List #3.*

I needed to know how to transfer photos from camera to computer and email them. [Student] was very helpful, very precise in her teaching and explained how easy it was. I was very grateful and [student] displayed courtesy in showing me a simple task.

My printer wasn't working and [student] loaded the printer into the menu and reset it. :-) Great!

School printers kept online after school hours. Great that [student] was able to keep the printers working for teachers and students.

I had trouble using graphs in Excel but [student] knew exactly what to do and then showed me how to do it.

I couldn't attach a certain file to email but [student] was fantastic! She was patient and very helpful as she suggested different ways of doing things if the first way didn't work.

I had to connect up a laptop and speakers to a projector. [Student] was great. She sets things up quickly and without fuss and then she shows me.

Presentations. [Students] provided excellent help.

I needed to figure out how to use speakers and the projector. {Student] was very helpful and now I know.

Printer problems in the main computer room. [Student] was a genius!! She is fantastic - definitely knows what she is doing.

I had to make a table for all the parts of speech. [Student] was very clear in her instructions - left me to complete - positive about my "homework".

I needed help with tables. [Student's] help was wonderful.

*Figure 29. School A Teachers' comments on student mentor help. List #3.*

<p><i>School A teachers' comments on student mentor help. List #4.</i></p>	<p>She helped me with changing scanned documents. She's invaluable.</p>
	<p>She helped me in my 13 Bio class with my presentations.</p>
	<p>She was life saving (or lesson saving) helping me with my computer.</p>
	<p>She helped me to understand how to align [text] boxes.</p>
	<p>She helped me insert scanned documents. I'm so pleased with all that help. I would like to feed her chocolates :-)</p>
	<p>She helped with scanning, email, and folder management. She even had an instruction sheet for me!</p>
	<p>She helped me understand moving pictures and text wrapping. And I learned it!</p>
	<p>She helped me with formatting pictures and emails She's so good let's bottle her.</p>
	<p>I'm glad she's in my class because she helps with formatting my presentations.</p>
	<p>She helped me with fixing an illegible font in Word. She explained what she had done so I could fix it myself next time - hopefully!</p>
	<p>She is a Star! She has shown me how to use Prezi.com only after an hour of orientation herself - brilliant! I'm in awe! I want to know more!!</p>
	<p>She helped me get documents from the common drive to my own. I'm sure this girl knows everything.</p>

Figure 30. School A Teachers' comments on student mentor help. List #4.

<p style="text-align: center;"><i>School B teachers' comments on student mentor help.</i></p>	<p>He had to learn how to fix the fault that stopped emails from opening. He did and then he showed me. Thanks.</p>
	<p>Printers weren't working. He got them working again after changing the settings for me.</p>
	<p>He showed me how to get formulae in excel to change automatically. He was super helpful.</p>
	<p>He showed me how to make fields in forms change automatically. He was super helpful.</p>
	<p>He was very clear and easy to follow in helping me with my newsletter.</p>
	<p>The screen moved and I couldn't get it back. He showed me how to drag it back again. He was very helpful.</p>
	<p>I wanted to cut some pieces of music out of a number of songs. She helped me by showing me what to do.</p>
	<p>He showed me how to copy and paste slides and keeping the backgrounds. Very helpful.</p>
	<p>He helped me with making hyperlinks.</p>
	<p>She was really good - actually got me to do it which is how I learn. I wanted educational maths activities on NZ Maths.</p>
	<p>I needed to integrate ICT into classroom activities. She showed me how to integrate two classes into the programme.</p>
	<p>I wanted to take the vocals out of a song. She and I worked it out together.</p>

*Figure 31.* School B Teachers' comments on student mentor help.

### Summary: Qualitative Data Findings

In this chapter, the teachers' responses to the two survey instruments are discussed and included with their semi-structured comments to complement the quantitative data in Chapter Six. The teachers' comments speak for themselves but it is worth exploring some examples to highlight the teachers' views of the reverse-mentoring programme. The examples also reinforce the views on adult learning from writers such as Merriam (2001) and Knowles et al., (2005) who considered that adult learners are often self-directed and motivated learners who like to be in control of their learning which they prefer to be at a time of their choosing and relevant to their needs. These adult learner traits are frequently represented in the teachers' comments.

Teachers' answers to baseline questions 9 and 10 (teachers' ICT professional development goals) indicated that many already knew they needed help with ICT professional development. The responses identified individual teacher's needs and some were specific about the nature of that help. For example "*I want to be more savvy with Word*" and "*I want to learn about Scratch*". Others were looking more to the future of teaching with ICT's and their needs were more general "*I want to use more valuable ICT in the classroom*", "*I want to get some way [for] integration of ICT in the classroom*" and "*Would love to involve ICT in the classroom but I do not have the knowledge or the experience to do this*". The number of responses asking for help indicated the majority of the teacher participants were ready for ICT professional development in any form. At the end of the reverse-mentoring programme, teachers' comments indicated a strong appreciation of the student help they received to use ICT's in their classrooms. For example in response to end of project question 5(b) which asked about positive changes to classroom practices, teachers responses included "*Easy for [me] to learn with help from [the students]*", "*It's great to have*

*student help when I want it*” and another teacher reported “*Students really enjoyed sharing knowledge*”.

As the project progressed, comments such as those from the end of project question 6(b) which asked about the extent the programme has contributed to understanding of teaching and learning generally, indicated a positive trend in the student/teacher relationships and in the teachers’ acquisition of knowledge and skills: “*I can develop a new way of teaching*”, “*I can teacher to individual students instead of the whole class doing the same thing*” and “*The programme gave me confidence to try things out*”. The end of project question 10 which asked for comments on the benefits of using students to help with the use of ICT, elicited positive responses: “*I can get help when I need it*”, “*I don’t have to worry about getting stuck*”, “*The students were fantastic and very patient*”, and one which identified a common thread in many of the teachers’ comments “*Benefits? I have success*”. Teachers’ responses to the end of project question 12 which asked for teachers’ views on aspects of the programme they most appreciated included comments such as: “*Available help when I need it. Very positive*”, “*Great having student support when I need it...*”, “*Excellent help, most appreciated...*”, and “*Students quietly helped with issues, used initiate in a friendly manner*”.

The overall picture drawn from both quantitative and qualitative data is that of a varied group of classroom teachers who needed professional development to work with ICT’s in their classrooms. The picture focussed on the need for individual, timely and relevant help which was satisfactorily provided by their students. The reverse-mentoring project outcomes overcame many of the barriers to teachers’ uptake of ICT identified in the literature by writers such as Ertmer, Addison et al., (1999) Cuban (1999a), Cuban, Kirkpatrick et al., (2001) and Auxter (2002). These barriers included the appropriate nature of the professional development, gender issues, a lack of time and a lack of relevance. The teachers’ comments

in this chapter indicated the reverse-mentoring programme countered those barriers through being timely, relevant to the teacher's need at the time, appropriate, and gender free.

Nearly all the participants were busy classroom teachers and they preferred to discuss their progress rather than keep records. This preference appeared to account for the seeming erratic nature of their written responses as not all teachers completed all the qualitative sections of the surveys but nearly all took part in discussions on their progress. Their overall view of the programme was that of an appreciation of the student help.

Chapter Eight identifies important connections between points discussed in the preceding chapters. Also, conclusions which can be drawn from the data in Chapters Six and Seven are identified and explored.

## Chapter Eight — The Research Questions and Conclusions

### Introduction

The two research questions provide a framework for a summary of the teachers' journeys towards achieving competence in the use of ICT in their pedagogies. The other six chapters have provided supporting data to describe and quantify the teachers' hopes at the start of their reverse-mentored programme and their reflections on their learning during and at the end of the programme.

### The First Research Question

*What do teachers perceive as the advantages and disadvantages arising from a reverse-mentored approach to ICT professional development?*

To answer the first research question it was useful to establish at the start of the programme what the teachers considered their ICT skills were and what it was they thought they would like achieve through this reverse-mentored form of ICT professional development. At the start of the programme, 80% of the teachers noted a major concern which was a lack of ideas about how to use ICT's in their teaching (baseline questions 14(c) and (d)). In their discussions, they attributed their reluctance to use the ICT's to a lack of knowledge on how to do that. The literature was right in suggesting the mere availability of ICT's did not guarantee their use because teachers had to know *how* to use their ICT's before they started using them. Additionally, data from baseline questions 1 and 2 recorded in Chapter Seven indicated that a majority of teachers had not taken part in *any* formal ICT professional development or attended *any* ICT-focussed conferences in the past two years. Authors such as Larner and Timberlake (1995), Zehr (1997), Ertmer et al., (1999), Preston et al., (2000), Cuban (2001) Cuban et al., (2001), Pelgrum (2001), Snoek and Ertmer (2001) and

Yuen and Ma (2002) argued that without suitable professional development, teachers would not use the technologies in their teaching. Moreover, because teachers were adult learners any professional development had to be appropriate to their needs as adult learners (Knowles et al., 2005). For example, the failure of the £230 million British ICT professional development programme (reported in Chapter Two) was blamed on lack of ‘appropriate’ professional development programmes (Kirkwood, Van Der Kuyl et al., 2000; Conlon 2004; Scrimshaw 2004).

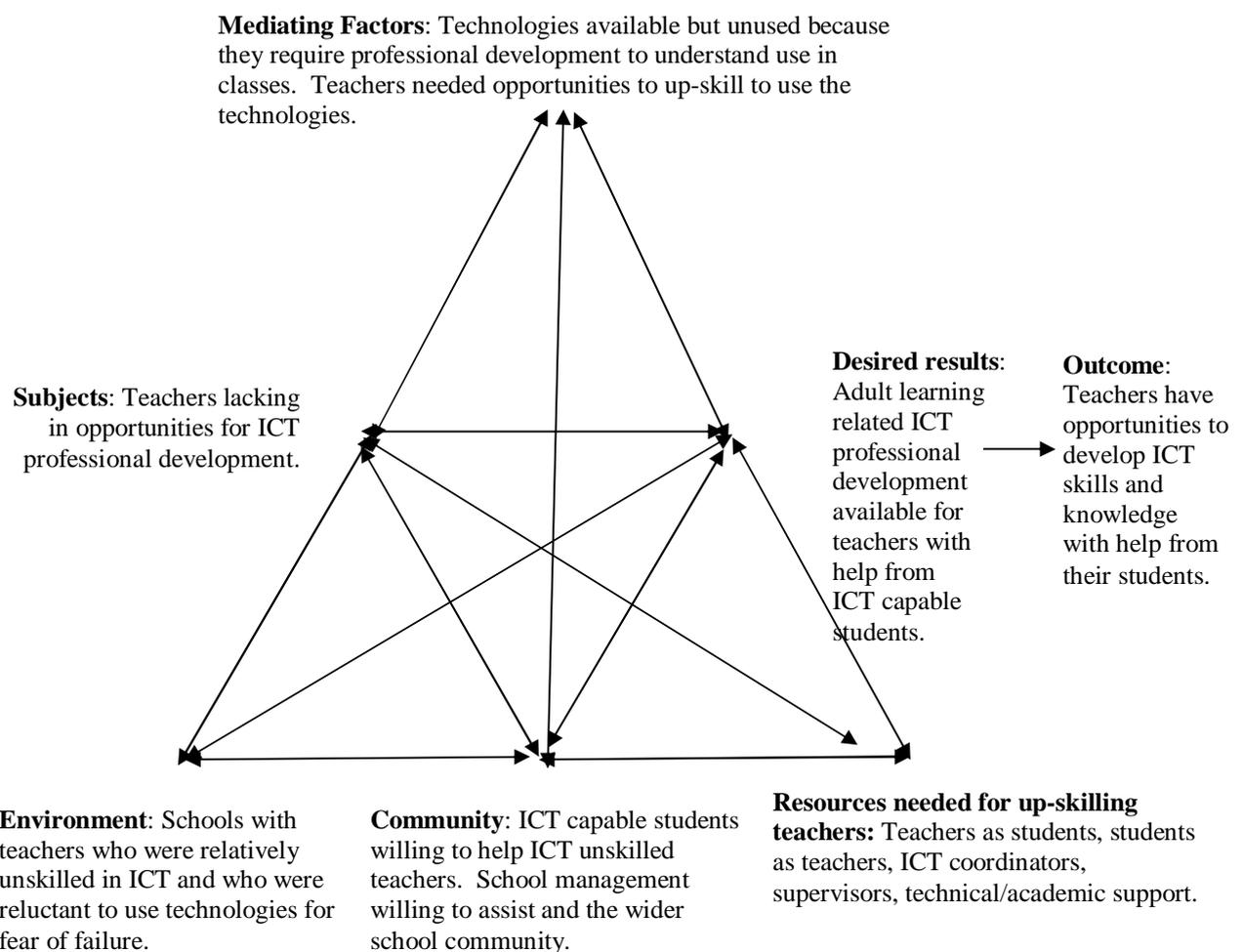


Figure 32. Pre-Programme Model of Teacher's Need for ICT Skills and Knowledge

The pre-programme Activity Theory model (Figure 32) was drawn from data collected from baseline questions 3, 4, 9 and 10, which indicated a number of teachers wanted to use ICT's but recognised they did not have the skills to do so. It was a model of expectations of being able to use a professional development model which provided each teacher with individual help rather than trying to learn in groups. The teachers (*subjects*) indicated they wanted professional development in ICT and preferred that to be on a one-to-one basis. The *mediating factors* were technologies being available in classrooms but because teachers were unskilled they could not use those technologies. These were important incentives for teachers to up-skill their ICT abilities. The teachers also made it clear what they did not want. They did not want to join large groups, or work on their own with written support materials to learn how to use ICT's both personally and in their classes (Chapter Six baseline questions 3 and 4). They were strong in their opinions on their preference for help on a one-to-one basis (such as that offered in this study), or if that was not available their next preference was learning through small-group workshops with colleagues from their own departments or syndicates.

The *environment* element in the model referred to schools with teachers who were largely unskilled in ICT. The *desired results* in this activity model were relatively uncomplicated—teachers wanted professional development (preferably as adult learners) to become proficient in the use of ICT in their pedagogies. The *outcome* of this activity was the provision of professional development for each teacher. However, there were other elements in the model which included both *community* and *resources* which were needed to meet the *outcome*. An important feature of those *resources* was the presence of ICT capable students in the school *community* who could help their teachers to up-skill their ICT abilities and positive help from school management. At the outset, the reverse-mentoring model found

favour with most teachers, whereas others took a little more time to conclude the reversal of the teacher/student roles was worth the effort for the knowledge gained.

Answers to baseline questions 9 and 10 at the start of the programme (detailed in Chapter Seven), made it clear that teachers wanted to develop ICT skills in their teaching. Their comments included expressions of a need for knowledge and skills to teach using technologies: “[I] would love to involve ICT in the classroom but I do not have the knowledge or experience to do this”, “I want to up-skill in ICT”, “I want to integrate ICT into all of my teaching” and “I want to have ICT knowledge and skills”. Some teachers recognised the potential of professional development through the reverse-mentoring programme to help with their ICT development “With this mentoring idea, ICT issues will be a higher priority for me ...”, and “[I] would greatly appreciate ICT professional development if I can receive it”.

At the end of the programme, a majority of teachers were satisfied with the way in which their students helped them with ICT issues (Chapter Seven end of project questions 5 and 6). Some teachers attributed their success to their students’ help in the reverse-mentoring programme “The [reverse-mentoring] programme gives me confidence to try things out”, “It is good to get the help I need to use computers in my lessons”, “I can use technology in my lessons now I have some help from the [student mentors]” and “It’s great to have student help when I need it”. Other comments indicated teachers’ forward looking views on their developing ICT enhanced pedagogies “I can develop a new way of teaching”, “I can teach to individual needs” and “I can teach to individual students instead of the whole class doing the same thing”.

**Mediating Artefacts:** Available help with ICT on an ‘as required’ basis created teachers confidence with student help; sufficient technologies available in the classroom.

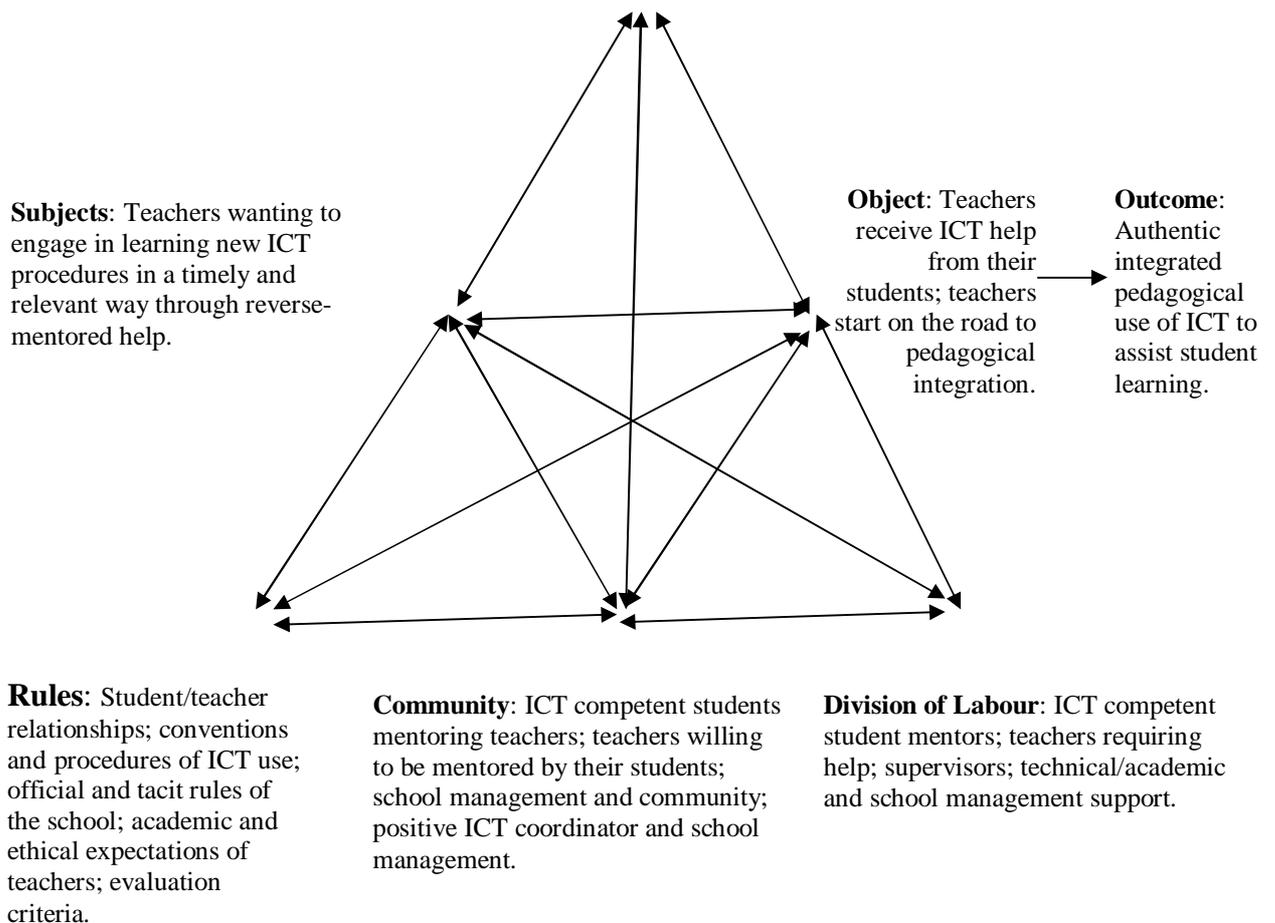


Figure 33. Post-Programme Activity Theory Reverse-Mentoring Model

In the Activity Theory model (Figure 33), the *subject* (teachers) worked with their *community* (student mentors and ICT coordinators), to use *mediating artefacts* (technologies in the classroom) to attain the *objective* (teachers receiving sufficient ICT professional development to start the integration of ICT in their pedagogies). The *outcome* is the integration of ICT in pedagogies to support student learning. The element called *community* is a description of who can be involved in the programme if required. Once the *subject* teachers accepted the merit of using ICT competent students (*community and division of labour*) a strong positive bond was formed between mentor and mentee (Chapter Six figures 27-31).

In the post-programme model there was an important element called *rules*. These are the one-hundred-and-one written and unwritten procedures, conventions, etc., in schools for teachers. Most importantly, the *rules* element refers to traditional teacher/student relationships. Those relationships were, for some teachers, hard to reconcile as traditionally teachers teach and students learn. Reverse-mentoring turned this tradition on its head and it took some teachers a little time to embrace the new way for them to learn. In the end, nearly all teachers found benefits in using their students to help them develop confidence and competence in using technologies. Their interaction with their student mentors was in a timely (just-in-time) and a personal way (just-for-me) which satisfied a number of adult learning criteria as discussed in Chapter Two (Baumgartner et al., 2003; Knowles et al., 2003; Phelps et al., 2004).

There were few negative comments from teachers regarding changes to their classroom practices (Chapter Seven end of project question 5(b)). One teacher reported that a lack of computers made whole—or even half—class skills lessons difficult, another found that student mentors were not always available when needed and one further teacher found

the student called on to help could not fix the problem. According to Smerdon et al., (2000) and Pelgrum (2001) the lack of resources such as those described by those teachers were indeed substantial barriers to their learning.

Teachers' views on the effectiveness of the programme to help them with growing their abilities to use the technology were addressed in the end of project questions 9 and 10 (Chapter Seven). The many responses indicated teachers' overall satisfaction with the help their students provided. A selection of the responses detailed in Chapter Seven included "They [the students] are always there when I need them", "The [students] are helpful and pleasant", "and I can get help when I need it ", "I don't have to worry about getting stuck and The students were fantastic and very patient".

Chapter Seven also provided a number of schedules of teachers' opinions on what they saw as advantages in using the reverse-mentored approach to ICT professional development. Figures 27-31 contain comments from teachers recorded during and at the end of the programme. These comments indicate strong approval by teachers for using students to help them with ICT issues.

### **The Second Research Question**

*What influence does a reverse-mentored approach to ICT professional development have on the type, frequency and use of ICT in teachers' subject areas?*

To understand the impact of the programme on teachers' use of ICT, comparisons were made of teachers' reported comments through interviews before, during and after the study.

In answer to question 3(f) at the start of the programme, 10 teachers reported that they did not regard using student mentors to help them with ICT issues as an attractive method of learning. However, by the end of the study, the results from question 2(j) produced a different picture in that most teachers accepted and valued student help with ICT.

The following sample of teachers' comments on their students' help was taken from Figures 27-31 (Chapter Seven): "She is a star. She has shown me how to use Prezi.com only after an hour of orientation herself—brilliant! I'm in awe! I want to know more!!"; "He showed me how to get formulae in Excel to change automatically. He was super helpful"; "He had to learn how to fix the fault which stopped emails from opening. He did and then showed me. Thanks"; "I needed to integrate ICT into classroom activities. She showed me how to integrate two classes into the programme"; "I couldn't attach a certain file to email but [student] was fantastic! She was patient and helpful as she suggested different ways of doing this if the first way didn't work" and "I had trouble using graphs in Excel but [student] knew exactly what to do and then showed me how to do it". The teachers' comments helped clarify the effect of the reverse-mentored approach to professional development in relation to the second research question and they also gave an indication of the areas in which the students were able to help and how that help was given.

At the start of the programme (questions 13(a) and 13(b)) 12 teachers recorded they were either not confident or anxious with using ICT's personally and 15 teachers said they were not confident or anxious with using ICT's with classes. At the end of the programme (questions 1(a) and 1(b)) only one teacher reported that s/he was not confident with using ICT's personally or with classes. These results indicate a general positive growth in teachers' confidence in the use of ICT both personally and with their classes.

Before the programme started and again at the end, teachers were asked about their levels of competence in a list of computer related activities (Chapter Seven). By the end of the programme, there were substantial *decreases* in the number of teachers who had registered low or very low levels of competence before they started using their students for help:

- *Competence with basic computer operations*; at the start of the programme 15 teachers reported low or very low levels of competence compared with three teachers reporting low levels of competence in this area at the end of the programme (Chapter Six);
- *Competence with computer files management*; at the start of the programme 16 teachers reported low or very low levels of competence compared with one teacher reporting low levels of competence in this area at the end of the programme. At the start of the programme, a *t*-test for independent samples indicated significance differences in mean scores between the schools. However, at the end of the reverse-mentored programme, a *t*-test for independent samples, a Levene's test for equality of variance and a chi-square test indicated significant differences/associations based on teachers' *gender* rather than their *school* (Chapter Six);
- *Competence with word processing*; at the start of the programme seven teachers reported low or very low levels of competence compared with no teacher reporting low levels of competence in this area at the end of the programme. At the start of the programme, there were no statistically significance differences between schools or genders. However, at the end of the programme, a *t*-test for independent samples and a Levene's test for equality of variance indicated significant differences based on teachers'

*genders* (Chapter Six);

- *Competence with spreadsheets*; at the start of the programme 25 teachers reported low or very low levels of competence compared with eight teachers reporting low levels of competence in this area at the end of the programme. At the start of the programme, a chi-square test indicated a significant association between schools and teachers' levels of attainment using spreadsheets and two *t*-tests for independent samples indicated significance differences in mean scores between the *schools* and between *genders*. At the end of the reverse-mentored programme, a chi-square test indicated a significant association between *genders* and teachers' levels of attainment using spreadsheets and a *t*-test for independent samples indicated significance differences in mean scores between *genders* only (Chapter Six);
  
- *Competence with databases*; at the start of the programme 27 teachers reported low or very low levels of competence compared with 15 teachers reporting low levels of competence in this area at the end of the programme. At the start of the programme, a chi-square test indicated a significant association between genders and teachers' levels of attainment using spreadsheets and *t*-tests for independent samples indicated significance differences in mean scores between genders. At the end of the reverse-mentored programme, a chi-square test again indicated a significant association between genders and teachers' levels of attainment using spreadsheets and a *t*-test for independent samples again indicated significance differences in mean scores between genders (Chapter Six);

- *Competence with graphics*; at the start of the programme 17 teachers reported low or very low levels of competence compared with six teachers reporting low levels of competence in this area at the end of the programme. At the start of the programme a *t*-test for independent samples indicated significance differences in mean scores between *schools*. By the end of the programme, the results of the *t*-test for independent samples changed somewhat indicating significance differences in mean scores between *genders* (Chapter Six);
  
- *Competence with the Internet*; at the start of the programme 14 teachers reported low or very low levels of competence compared with no teacher reporting low levels of competence in this area at the end of the programme. At the start of the programme, a chi-square test indicated a significant association between *genders* and teachers' levels of attainment using the Internet. A *t*-test for independent samples indicated significance differences in mean scores between *genders*. However, at the end of the programme, the emphasis switched to schools. The chi-square test indicated a significant association between *schools* and teachers' levels of attainment using the Internet and *t*-tests for independent samples indicated significance differences in mean scores between *schools* (Chapter Six);
  
- *Competence with telecommunications*; at the start of the programme nine teachers reported low or very low levels of competence compared with only one teacher reporting low levels of competence in this area at the end of the programme;
  
- *Competence with multimedia*; at the start of the programme 19 teachers reported low or very low levels of competence compared with eight teachers reporting low levels of competence in this area at the end of the programme (Chapter Six);

The before-and-after comparisons of competencies produced some interesting changes in statistical associations. A number changes appeared during the programme from significant associations based on schools changing to those based on gender. One competence (Internet use) reversed this trend as it changed from gender to school. A study of the teachers' demographics and the results in Chapters Five and Six indicated a noticeable swing by female teachers to increased use of their student mentors to gain proficiencies in the use of ICT in the areas of competencies.

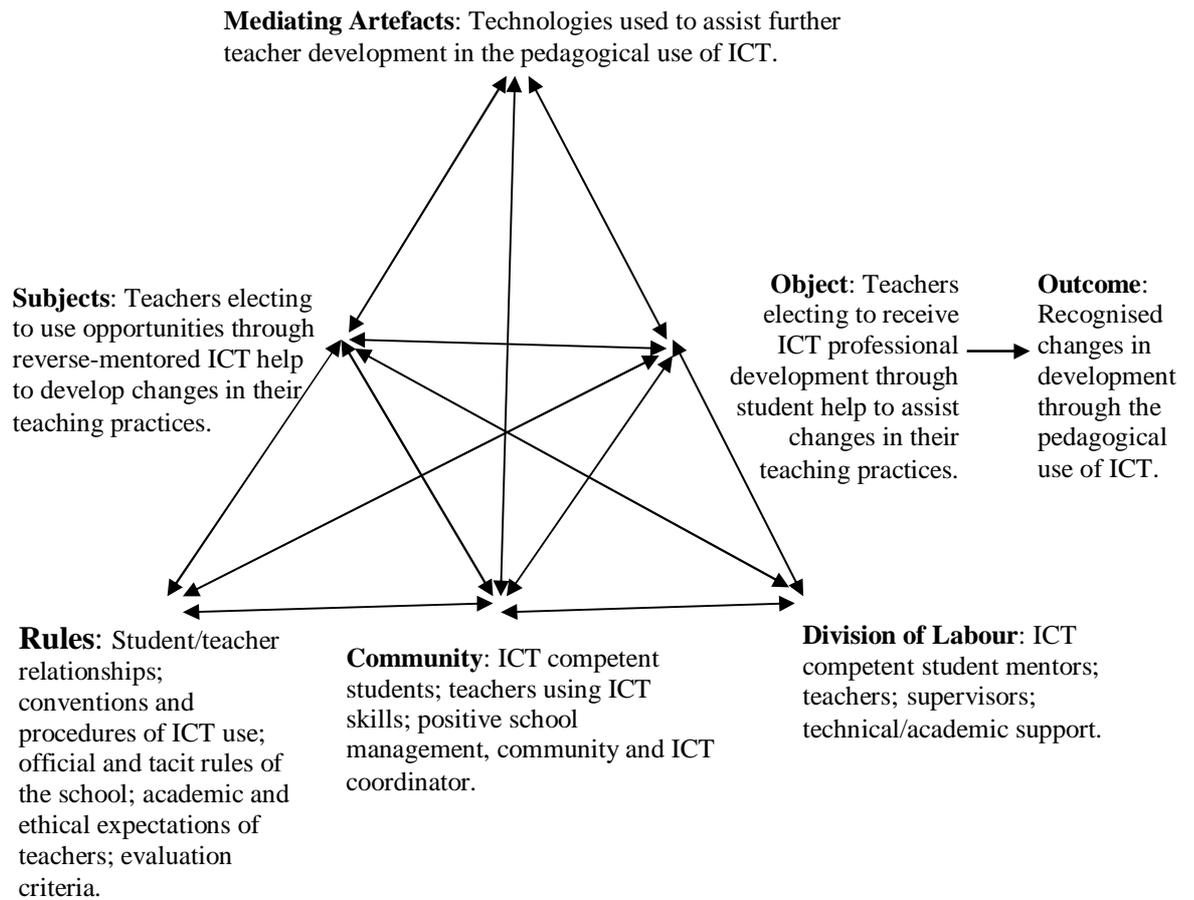
The end of project questions 12 and 13 asked for teachers' levels of appreciation of the programme and also for their opinions as to the significance of the programme on overall teacher development. The aspects of the programme teachers most appreciated involved the readiness of their students to help with ICT issues. Their comments—more fully reported in Chapter Seven—were dominated by increasing levels of confidence with the use of ICT because help was to hand when they needed it.

Teachers' comments included: "Availability of help when I need it. Very positive"; "Being able to call on a member of the class when I need it"; "It's great having someone reliable and competent"; "Great having student support when I need it. Very helpful with specific suggestions, practical and very professional"; "Excellent help, most appreciated and [students] explained how-to with each problem"; "Students are to help when I get stuck. Extremely helpful and precise in explanation and teaching me how easy it was" and "Great having student help when I need it. Very helpful with specific suggestions, practical and very professional".

Teachers were asked for examples of aspects of the programme they least appreciated. Responses were few with a number of teachers specifically reporting they found no such aspects of the programme. However, there were two complaints about having to fill out forms and other paperwork for the research programme and four complaints on the difficulty of actually getting mentoring students when they were needed because of demand.

The end of project question 13 (Chapter Seven) was designed to identify factors other than the reverse-mentored programme which played a part in the increase of ICT in the school. However, this question was largely misinterpreted. Instead of referring to influences outside the programme, a number of the teachers reported they attributed their increased use of technologies to help from their student mentors.

The end of project question 15 (Chapter Six) asked for comment on the significance of the programme to overall teacher development. This question gave one School B teacher the opportunity to express misgivings and cited the programme as a failure because the "...base level of ability of students we have taken in nearly all cases, including specialist ICT classes, is minimal and shows the failure of the programme". Other teachers answering that question had different views on the significance of the programme: "Good to be part of the programme although I started late"; "Great. I'm glad I had the help of these [student mentors]. Thanks" and "I can't believe how much I have learned".



*Figure 34.* Post-Programme Activity Theory—Teacher Satisfaction

The Activity Theory model in Figure 34 related to data from end of project question 15 (Chapter Seven) about the significance of the programme on teacher development. All but one of the teachers considered the reverse-mentored programme had significantly helped them develop their use of ICT in their classrooms. The teacher who expressed misgivings about the effectiveness of the implied the reverse-mentoring students were not equipped to help teachers with ICT. Interviews did not produce any further information except that the student mentors in question were the same students who received praise for their help from other teachers. As one of the *subjects* in the model, the teacher concerned considered s/he was already been proficient in ICT and did not need any help from students who s/he considered not expert enough to help which is a reasonable comment with regard to that teacher's lack of need for assistance. Interviews did not ascertain the type of help or the frequency the help was requested for that teacher. Whatever the case, the teacher concerned did not accept either student help or the overall reverse-mentored programme was effective.

Probably the teachers' successes through their students' help engendered an awareness of the need for reliable equipment. Once they starting using the technologies, concerns arose about the availability and reliability of equipment. At the start of the programme, the teachers' were surveyed on these concerns through baseline question 14(a) and 25 teachers reported they had concerns about their classroom equipment. In later interviews, those teachers commented that they were looking at the *status quo*—how their classroom was currently equipped—which was often insufficient if the computers and other ICT's were to be used in a teaching setting. At the end of the programme (question 14(a)) those concerns were still there with 26 teachers expressing concern or significant concern about access to reliable equipment for student use. Two teachers explained that since their experience in the use of ICT equipment, they were more aware of the need for those teaching

facilities to be on hand and be reliable for their students' use and this, they said was not always the case.

Both Zehr (1997) and Pelgrum (2001) argued that a lack of equipment was a major barrier to teachers' use of ICT. Ertmer et al., (1999), Cuban (2001) and others had argued that even if there were sufficient ICT's the teachers would not necessarily use them. However, in this study the comments of Ertmer (1999) and Cuban (2001) did not apply as the teachers *wanted* to use ICT's and the participant teachers' opinions on access to equipment ranged from a severe shortage to insufficient for whole class work. Pelgrum's (2001) argument supported the need for sufficient equipment included the availability of reliable ICT resources for classroom use. Once the teachers were able to use the technologies, they expected good technical support to keep the equipment running.

Twenty three teachers in this study responding to baseline question 14(b) reported that they had concerns or significant concerns about insufficient or poor technical support for the equipment their classroom equipment. The number of concerned teachers grew by the end of the programme to 29 as teachers recorded their concerns or significant concerns over the levels of support (question 14(b)). Statistically these teacher concerns were associated by school which implies the lack of support may have been related to one school.

A question on teachers' concerns over the technical reliability of the equipment (baseline question 14(h)) resulted in 31 teachers reporting concerns in this area. The teachers' numbers were still high at the end of the programme when 26 teachers continued to report concerns of technical reliabilities (question 14(h)). These results may also have been a by-product of the growing awareness of teachers now using the technologies of the need for reliable equipment and on-going support.

When interviewed at the start of the programme, some teachers who had technical support concerns mentioned their embarrassment and class disruption when the ICT's used in a lesson failed. They blamed this factor on the lack of programmes to help them upgrade their skills and knowledge to incorporate ICT in their teaching. They also mentioned that because they perceived their ICT skills and knowledge were so low, they were worried about the amount of time it would take to get sufficient skills to use the technologies productively in the classroom.

Teachers' uptake of ICT technologies can be both complex and idiosyncratic. Complex because of the wide range of computer based activities which can be potentially addressed and idiosyncratic because adult learners tend to learn through individual needs and understandings.

The concerns of the teachers' about the lack of both reliable equipment and ideas on how to use ICT's in their teaching were not new. Researchers including Granger et al., (2002) and the New Zealand Ministry of Education (2005) urged the provision of more reliable equipment in the classrooms and adequate training for the teachers in how to use it. In their New Zealand study, Murray and Campbell (2000) found that not only was there evidence of insufficient usable equipment but also teachers were not getting training in the use of ICT.

At the outset, the participant teachers were concerned about their lack of technical skills. However, their answers to the end of project question 11(a) which asked the extent goals/expectations met for technical skills development, emphatically reversed their former low opinion of their abilities in this area. The goals/expectations were exceeded for one (3%)

of the 31 teachers who answered this question at the completion of the reverse-mentored programme. Nine (29%) teachers reported their goals/expectations had been fully met. Eight (26%) teachers considered their expectations had been largely met and 13 (42%) teachers reported their goals had been partially met. No teacher reported their goals/expectations had not been met.

## Conclusions

Teaching is a complex profession made so by the wide range of subjects to be taught and the equally wide diversity of individuals carrying out that teaching. These factors make effective teacher learning with ICT's difficult because of a number of barriers (Table 2) and the need for individualised learning (Table 1). At the start of the programme, the literature was right in that the participant teachers were reluctant to use ICT's even if the technologies were available because they did not know how to do that. Cuban (2001) and Pelgrum (2001) were among many writers who insisted that teachers' lack of knowledge and skills in using the technologies was a major barrier to their use. Preston, Cox et al., (2000) and Snoeyink and Ertmer (2001) included the need for *appropriate* professional development to first *use* the technology so that they could develop pedagogically effective ways to enhance student learning. The literature was also clear that teachers were adult learners and any professional development had to be appropriate to the needs of an adult learner (Knowles et al., 2005).

It is useful at this point to return to the first research question: *What do teachers perceive as the advantages and disadvantages arising from a reverse-mentored approach to ICT professional development?* The participant teachers made it clear at the outset that they needed ICT professional development and if they had a choice, they preferred it to be on a one-to-one basis. The Activity Theory model of the reported pre-programme teacher needs for ICT skills and knowledge (*Figure 32*) was a model of teachers' expectations of

professional development on an individual basis. The reverse-mentored programme provided one-to-one help and it overcame many barriers associated with adult learning. The post-programme Activity Theory model (*Figure 33*) was based on data drawn from the end of project questions 5 and 6 in Chapter Seven in which most teachers attributed their success to their students' help in the reverse-mentoring programme.

Advantages which teachers frequently reported included the immediacy of assistance to resolve ICT issues, confidence in the students' abilities to provide assistance for their issues and the confidence of being able to move on with their targeted ICT project. A sample of their comments has been drawn from those recorded in Figures 27-31 (Chapter Seven) "I don't have to worry about getting stuck", "The students were fantastic and very patient" and "They [the students] are always there to when I need them". On the negative side, one teacher reported that a lack of computers made lessons difficult and another found the student mentors were not always available when needed. Writers such as Smerdon et al, (2000) have frequently pointed out that the lack of resources was always going to be substantial barriers to the teachers' learning.

The availability of resources (including student mentors) was discussed in relation to the second research question: *What do teachers perceive as the advantages and disadvantages arising from a reverse-mentored approach to ICT professional development?* As a result of the reverse-mentored programme, teachers' levels of ICT competence rose in the majority of areas of ICT use. Most teachers saw the immediacy of their students' help a major factor in their progress towards ICT competencies. In response to the end of project questions 12 and 13, comments such as "Great having student help when I need it. Very helpful with specific suggestions, practical and very professional" were common.

Statistically, female teachers were prominent in expressing satisfaction with the programme. They significantly increased their use of their student mentors to help with ICT issues. This produced a noticeable swing from statistically significant associations based on schools to those based on gender.

However, there were two complaints about having to fill out forms and other paperwork associated directly with the research itself. Additionally, four teachers reported difficulty in getting help when they needed it because of the demand on the time of students.

A major factor in this study was the teachers' acceptance of help from their students. An important outcome of the programme was the positive teacher/student learning relationship which developed through mutual respect. The programme reverses, albeit temporarily, the accepted pedagogical direction of learning but the qualitative data in Chapter Seven indicated that this was not an issue for the majority of the study teachers. Also the produced some interesting changes in statistical associations.

Chapter Nine presents recommendations for future research in this important area of teachers' professional development.

## Chapter Nine — Recommendations

In many countries, teachers are being encouraged to move towards learner-centred pedagogies. The literature reviewed in Chapter Two is clear that the integration of ICT with pedagogies is necessary in schools to support that learner-centred teaching. It is also clear that many New Zealand teachers—particularly at secondary and intermediate levels—are ill-equipped to use technologies in this way. Moreover, in order to integrate ICT with their pedagogies, teachers have to change their teaching paradigms. Researchers also claim that this lack of pedagogical adaption has a real potential to negatively impact on student achievement. The New Zealand Ministry of Education (2007a) went so far as to say the integration of teaching and learning with ICT was critical to support learner centred pedagogies.

The literature is rich in researchers' opinions on barriers to teachers' uptake of ICT. Simply providing teachers with traditional one-to-many professional development sessions on the use of ICT was not an answer. Teachers preferred to be treated as adult learners and have their support delivered on a one-to-one basis, at the time it was needed, and tailored to meet their ICT issue of the moment. Additionally, writers such as Pelgrum (2001) pointed out, the lack of reliable computers available for use was just as much a barrier just as the lack of skills to use that equipment. The two issues are inextricably linked with the first priority being the availability of suitable equipment followed by the ability to use that equipment. Granger et al., (2002) presented views similar to that of Pelgrum (2001) with their suggestions that teachers cannot integrate ICT with various curricula, or teach, or learn computer skills without having computers that actually work! The New Zealand Ministry of Education (2005b) also reported that the lack of access to reliable equipment presented a potential barrier to ICT use in the classroom by both primary and secondary teachers.

In this study, the majority of teachers had access to suitable ICT's but they lacked the ability to use them. Furthermore, they knew they needed help and were anxious to develop the skills and knowledge to use the technologies in their classrooms. They also knew what they did not want. They did not want to be given professional development in groups or in advance of their need for the knowledge provided—they preferred one-to-one sessions at the time of, and relating to, the task in hand. Unfortunately one-to-one sessions using adult mentors are expensive and suitable adult mentors are hard to find. On the other hand, schools usually have numbers of ICT literate students who are generally always on hand to help when they are asked.

There are few examples in the literature of this reverse-mentored approach to teachers' professional development and learning. One of the reasons for this may be that the concept of reverse-mentoring runs contrary to the unwritten rule which has governed teachers for hundreds of years—'teachers teach and students learn'.

When the reverse-mentored programme was proposed, many of the participant teachers were sufficiently motivated to immediately take advantage of the help their students had to offer. Others joined the programme shortly after the start when they saw clear benefits in the help their students provided.

The participant teachers were clear in their satisfaction of the help they received from the programme. Their positive comments in Chapter Seven reinforced the statistical and other data in Chapter Six. Statistically, some trends were interesting. Not only was there an almost universal increase in levels of abilities, satisfaction, etc., but as the programme progressed, there was also were statistical changes from significant differences between

schools to differences between genders. These changes are discussed further in the following recommendations.

The data from this research has prompted four recommendations:

### **Recommendation One—Effectiveness of Reverse Mentoring in Other Schools**

The first recommendation is for further study into the effectiveness of reverse-mentoring involving a wider range of schools. These data have provided strong evidence that reverse-mentoring *did* work for the majority of the participant teachers in this study but although the participant population was varied, it was small.

### **Recommendation Two—Further Research into Gender Barriers**

The second recommendation is for more research into solutions to the barriers related to the gender divide which the literature claimed female teachers are disadvantaged in the uptake of ICT.

This recommendation is important for two reasons. The first is the importance of female teachers in the New Zealand education system. According to the New Zealand Ministry of Education, females make up 76% of the teaching population in New Zealand classrooms and according to Harker and Chapman (2006), this imbalance with male teachers is growing. The data from this study indicated that the gender divide was indeed present for the female teachers at the start of the reverse-mentoring programme and researchers such as Yuen and Ma (2002), Baumgartner et al., (2003), Ward (2003) and Knowles et al., (2005) were right—at least in part—when they claimed that female teachers generally had to see a *reason* to use technologies before they set out to learn *how* to use them. It remains unclear as

to which came first—a recognition of the usefulness of the technologies or the availability of help from their students to develop skills to use those technologies.

At the start of the programme female teachers were *not* using available technologies and most were ambivalent about using their students as reverse-mentors. Also they had little or no ICT professional development prior to this study and they did not really know what to expect from the programme. But these circumstances changed as the study progressed, the enthusiasm of the female teachers to use help from their students increased as they found they were able to develop and use ICT's in their teaching. The female teachers' comments in Chapter Seven covered a wide range of successes which they related directly to the help provided by their students. Chapters Five and Seven describe the before-and-after comparisons of competencies which indicated a number of statistically significant changes. Statistically, associations with *schools* changed to associations with *gender*. There was also a noticeable move by female teachers to increase their use of student mentors to develop competencies in the use of ICT. It is clear from the data analyses in Chapter Six and the teachers' comments in Chapter Seven that the reverse-mentoring programme helped female teachers to overcome many of the widely reported ICT gender barriers. It may be useful to further investigate, identify and qualify the effects the reverse-mentoring programme may have had on barriers to the uptake of ICT's by female teachers.

The second reason for further research into solutions to the gender barriers relates to the extent the programme supported female teachers with regard to the adult learning precepts of self-direction, transformation and prior experience as well as the encouragement to use their new found knowledge and skills in the workplace. As discussed in Chapter Two, Ertmer (2005) argued that the success of programmes which encouraged the use of technologies is critically dependent on an alignment of those programmes to the teacher's

current pedagogical beliefs. The author further argued that such an alignment potentially increased the teacher's confidence for using technologies. It is likely the reverse-mentoring programme provided an approach for change which was compatible with the teachers' current pedagogical beliefs as well as with the elements of adult learning described in Tables One and Two. In Chapters Five and Six the female teachers acknowledged that their individual positive progress in using ICT's in their classes was a result of help from their students. However, further research with a larger and more varied teacher group could establish with more certainty the degree to which the reverse-mentoring programme provided turning points to overcome the ICT gender barriers which were present at the start of this study.

### **Recommendation Three—Further Research into Sustainability of Reverse-Mentoring**

The third recommendation is for more research into the sustainability of a programme which is predicated on the ability of students to help their teachers. A reverse-mentored programme *must* manage changes to meet the dynamic nature of its participants and their day-to-day needs. A question which is likely to arise is 'in what form would transformational processes continue—if indeed they can continue—when the subject teacher's needs surpass the ability of their students to help them?' In other words, can a reverse-mentored relationship evolve into other forms of teacher/student relationships once the original goals are met? The answer may be the development of a teacher/student partnership.

As a partnership, the special reverse-mentor teacher/student relationship could continue in an altered but sustainable form. A partnership could involve the sharing of ideas and the search for solutions and would need to be on a more equal footing than the reverse-mentoring programme. A very minor form of such a partnership can be found in Figure 31. In this case neither party knew what to do to resolve an issue. The teacher reported that the

student "... had to learn how to fix the fault which stopped emails from opening. He did. Then he showed me." In this instance there was trust on both sides to find a solution. In a more advanced form of this cooperation, either party (teacher or student) could request help from the other and this could involve a greater and more equal contribution from the other party (teacher or student) in providing a solution. The trust factor and the willingness of one party to help the other may be a natural follow-on from the reverse-mentor programme especially when the skills of both parties become more balanced. Also the world of ICT is in constant and rapid change which necessitates the need for help and consultation on a regular basis by both experts and students alike. The reverse-mentoring programme sponsored pedagogical changes and further research into future, more advanced programmes—such as a teacher/student partnership—which have a potential to change the traditional teacher/student relationships, may be of value.

#### **Recommendation Four—Further Research on Potential of Using Reverse Mentoring in Other Subject Areas**

The fourth recommendation is for further investigation of the use of reverse-mentoring as a form of professional development in areas other than ICT in which student input could be of value to teachers. This recommendation is based on the positive feedback from teachers (Chapter Seven) on the value and nature of a reverse-mentored professional development programme and the pedagogical changes which ensued. The test here is to identify an area of teacher need coupled with student ability to help with that need and acceptance of the reverse-mentoring process. When the ICT programme started in this study, there was only one element already in place—that of teachers' need for some sort of professional development to use technologies. However, as the programme developed, the teacher/student trust developed and teachers' skills acquisition followed. At the end of the programme, the teachers were bountiful in their praise for their student helpers and were

generally well satisfied with their progress with using ICT pedagogically (Chapters Six and Seven).

Schools which have already developed and run an ICT reverse-mentoring programme for teachers in different subject areas could make the progression to other areas of teacher professional development as the element of mutual trust has probably been established by the ICT programme. The area of assistance may be more difficult to envisage. Perhaps students who are native speakers of a language other than English could help their teachers with skills in that language. Further research may identify other areas in which students could help in this way.

### List of Tables

Table 1 <i>Comparisons Between Pedagogy and Andragogy (Knowles et al., 2005, pp. 61-68)</i> .....	68
Table 2 <i>Potential Solutions to Barriers through Reverse-Mentoring</i> .....	94
Table 3 <i>Activity System Elements Adapted From Waite (2005, p. 6), Robertson (2008, p. 822) and Demiraslan and Usluel (2008, p. 2)</i> .....	110
Table 4 <i>Baseline Demographic Question: Teaching Experience</i> .....	146
Table 5 <i>Baseline Question 4(d): Teachers' Learning Preferences for Working with Student Mentor or Adult Facilitator</i> .....	151

## List of Figures

<i>Figure 1.</i> Basic Activity Theory Framework (Issroff and Scanlon 2002, p. 78) .....	101
<i>Figure 2.</i> Engeström's (1987) Revised Activity Theory Framework (Issroff and Scanlon 2002, p. 78) .....	102
<i>Figure 3.</i> Activity System of Primary Care Physician (Helsinki University, 2009, p. 2).....	104
<i>Figure 4.</i> Activity Theory Triadic Model Adapted From Engeström, Miettinen et al., (1999, p. 31).....	111
<i>Figure 5.</i> Case Study Structure .....	119
<i>Figure 6.</i> Baseline Demographic Data: Teaching Subjects by Gender .....	145
<i>Figure 7.</i> Baseline question 9: Focus on ICT professional development this year. School A.....	221
<i>Figure 8.</i> Baseline question 9: Focus on ICT professional development this year School B. ....	221
<i>Figure 9.</i> Baseline question 10(a): Priorities for ICT professional development by gender School A List #1...	222
<i>Figure 10.</i> Baseline question 10(a): Priorities for ICT professional development by gender School A List #2.	223
<i>Figure 11.</i> Baseline question 10(a): ICT professional development priorities School B #1 .....	224
<i>Figure 12.</i> Baseline question 10(a): ICT professional development priorities School B #2 .....	225
<i>Figure 13.</i> Baseline question 10(b): Teachers' ICT professional development secondary priorities. School A	226
<i>Figure 14.</i> Baseline Question 10(b): Teachers' ICT professional development secondary priorities. School B	227
<i>Figure 15.</i> Baseline question 10(c): Teachers' ICT professional development minor goals for Schools A & B. .....	228
<i>Figure 16.</i> End of project question 5(b): Positive changes in classroom practices as a result of the reverse- mentored programme.....	229
<i>Figure 17.</i> End of project question 5(b): Negative changes in classroom practices as a result of the reverse- mentored programme. Schools A and B. ....	230
<i>Figure 18.</i> End of project question 6(b): Extent the programme has contributed to understanding of teaching and learning generally. Schools A and B. ....	231
<i>Figure 19.</i> End of project question 10: Observed benefits with student help with ICT. School A.....	232
<i>Figure 20.</i> End of project question 10: Observed benefits for using students to help teachers in the use of ICT. School B. ....	233
<i>Figure 21.</i> End of project question 12(a): Aspects of the reverse-mentored programme most appreciated. School A (List #1).....	234
<i>Figure 22.</i> End of project question 12(a): Aspects of the reverse-mentored programme most appreciated. School A (List #2).....	235
<i>Figure 23.</i> End of project question 12(a): Aspects of the reverse-mentored programme most appreciated. School B. ....	236
<i>Figure 24.</i> End of project question 12(b): Aspects of the reverse-mentored programme least appreciated. Schools A and B.....	237
<i>Figure 25.</i> End of project question 13(b): Other factors involved increased use of ICT. Schools A and B. ....	238
<i>Figure 26.</i> End of project question 15(b): Comments on the significance of the reverse-mentored programme on teachers' overall development. Schools A and B. ....	239
<i>Figure 27.</i> School A Teachers' comments on student mentor help. List #1.....	240
<i>Figure 28.</i> School A Teachers' comments on student mentor help. List #2.....	241
<i>Figure 29.</i> School A Teachers' comments on student mentor help. List #3.....	242
<i>Figure 30.</i> School A Teachers' comments on student mentor help. List #4.....	243

<i>Figure 31.</i> School B Teachers' comments on student mentor help. ....	244
<i>Figure 32.</i> Pre-Programme Model of Teacher's Need for ICT Skills and Knowledge.....	249
<i>Figure 33.</i> Post-Programme Activity Theory Reverse-Mentoring Model .....	252
<i>Figure 34.</i> Post-Programme Activity Theory—Teacher Satisfaction.....	261

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## Appendix A

### Baseline Data Survey

### Information and Communication Technology Professional Development (ICT PD) through Reverse-mentoring Research 2009-2010

This questionnaire is designed to assist independent research into improving teachers' use of ICT in their classrooms.

Individual responses will be kept confidential to the researcher and his supervisors.

The results of statistical and other analyses of the data, including anonymous exemplary quotations, may be published in non-attributable and aggregated form in presentations, reports and papers by the researcher as part of his research.

<b>Your Name:</b> (Needed for comparison with End of Project survey done at the End of the project)	
<b>School:</b>	
<b>Gender:</b>	<input type="checkbox"/> Female <input type="checkbox"/> Male
<b>School Sector:</b>	<input type="checkbox"/> Primary <input type="checkbox"/> Secondary <input type="checkbox"/> Both
Position in School	<input type="checkbox"/> Teacher <input type="checkbox"/> Manager <input type="checkbox"/> Both
Do you have a laptop under the TELA scheme?	<input type="checkbox"/> Yes <input type="checkbox"/> No
If yes, how long have you had a laptop under the scheme?	<input type="checkbox"/> 0-6 mths <input type="checkbox"/> 7-12 mths <input type="checkbox"/> 13-18 mths <input type="checkbox"/> 19-24 mths <input type="checkbox"/> 25-30 mths <input type="checkbox"/> ≥31 mths
Access to the Internet outside the school environment	<input type="checkbox"/> I have a broad band access <input type="checkbox"/> I have a dial up access <input type="checkbox"/> I do not have access

**1. How many days (or day equivalents) of formal ICT Professional Development have you had in the last 2 years prior to this survey?** *e.g.: night classes, in-service courses, after school sessions, holiday time classes/courses.*

**Please circle the appropriate number: None, 1, 2, 3, 4, 5+**

**2. How many ICT-focused conferences have you attended in the last 2 years?**

More than 10 days                       6 to 10 days                       1 to 5 days                        
None

**3. How do you prefer to learn new ICT skills?** Please rank the following options in order of preference 1 being the MOST preferred option and 5 being the LEAST preferred.

a	On my own, with written support material	
b	One to one with a mentor	
c	Informally working with others	
d	In a small group	

e	In a large group <i>i.e. lab situation</i>	
f	With an ICT knowledgeable student who can help me as and when I need it.	

**4. What are your preferences when working with others?** Please tick one box for each of questions a-d.

<b>a</b>	<input type="checkbox"/> others at the same/similar level of ICT skill / experience	or	<input type="checkbox"/> a mixture of levels of skill or experience in ICT	or	<input type="checkbox"/> either / no preference
<b>b</b>	<input type="checkbox"/> staff from my own school	or	<input type="checkbox"/> staff from other schools	or	<input type="checkbox"/> either / no preference
<b>c</b>	<input type="checkbox"/> members of my own department or syndicate	or	<input type="checkbox"/> members of other depts. or syndicates	or	<input type="checkbox"/> either / no preference
<b>d</b>	<input type="checkbox"/> student mentors assisting you personally with developing ICT skills as and when you require	or	<input type="checkbox"/> an adult facilitator who can occasionally assist you with questions when that facilitator is available	or	<input type="checkbox"/> either / no preference

**5. Have you attended some ICT PD sessions in your own time throughout the year?**

Please rate each of these options with a 1,2,3,4 or 5 rating as described below:

1 = Enthusiastic    2 = Can arrange it    3 = Can but would rather not    4 = Would but can't arrange it    5 = This is beyond reasonable expectation.

Rating

a	After school sessions	
b	Occasional Saturday mornings, <i>i.e. perhaps one or two a year spread over the year</i>	
c	Several Saturday mornings, <i>i.e. perhaps three or four a year</i>	
d	School holiday programme— <i>whole or half day, during the July &amp;/or Sept breaks</i>	
e	School holiday programme - whole day, <i>i.e. during the July &amp;/or September breaks</i>	

**6. Have you attended in the last two years any type of professional development course on the use of ICT in education?**  Yes  No

**7. If yes, briefly state the nature of each course :**

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**8. How often do you participate in a professional online community?** E.g. Teachers@Work, Talk2Learn, NZIST list, Learning@School, etc.

- <sup>s.</sup>  Regularly  Occasionally  Not at all

**9. To what extent are you able to focus on ICT issues in your PD this year :**

*Please tick the box alongside ONE of the following descriptors*

- ICT is the major focus of my PD this year
- ICT is a secondary focus for my PD this year
- ICT is a low priority for my PD this year

Comment	
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### 10. Professional Development Goals

*Please list up to 3 specific goals or objectives that you would like to achieve as a result of your participation in this research programme. Please indicate how important these goals are to you by a number 1 – 3 in the box alongside each objective to indicate priority.*

*1= A major goal.                      2= An important but secondary goal.                      3= A minor goal.*

GOALS (be as specific as possible)

Priority

- a \_\_\_\_\_
- b \_\_\_\_\_
- c \_\_\_\_\_

### 11. Preferred PD Activities

This is to get some idea of your current preferences.

*Write in each box a number 1-5 representing the extent of appeal of the activity.*

*1= Has strong appeal                      2 = Has some appeal                      3= No view either way*  
*4=Does not appeal                      5=I would hate it*

*Rating*

a	<b>Study Groups:</b> Teachers join a study group of three or more members with common interests and goals as well as a commitment to working with the group at regular intervals.	
b	<b>Technology Coaches:</b> Every teacher could become a technology coach - good at something and prepared to help and support others when they can.	
c	<b>Technology Mentors:</b> Teachers who are highly skilled in certain areas are paired for a short scheduled times with less skilled teachers in order to pass on	

	some of their expertise as and when both parties have time.	
d	<b>Student on the spot support (reverse-mentoring):</b> Students who are skilled in certain areas and who are available to help teachers in ICT areas at any time when the teachers need that help.	
e	<b>Tutorials:</b> Short bursts of on-site learning—for example an early morning session on inserting graphics into text or organising bookmarks in a browser for those unsure of the methods.	
f	<b>Workplace Visits:</b> Visits to ICT intensive workplaces would be organised so that teachers can see the impact of ICT and better understand the implications for learners and classrooms.	
g	<b>Retreats or Intensive Practicums:</b> Teacher negotiate several days out of classroom at one time for intensive PD or training.	
h	<b>Release Time:</b> Release time is negotiated to discuss and translate new ideas and strategies into practical classroom unit plans.	
i	<b>Online Discussion Groups or Listserv Membership and/or Online Discussion Groups:</b> This is an online informal discussion group using email or websites where teachers in the cluster can talk over problems and successes, ask questions and offer solutions.	
j	<b>After Hours Workshops/Seminars:</b> These may offer a varied programme of activities scheduled outside school hours.	
k	<b>Other (specify)</b>	

**12. Please indicate with a tick in the appropriate box the extent to which you agree or disagree with each of the following statements**

(a) ICT can help improve curriculum provision in my classroom

Strongly Agree     Agree     Not sure/Neutral     Disagree     Strongly Disagree

(b) **Overall, the investment by schools in ICT can be justified by the teaching and learning outcomes.**

Strongly Agree     Agree     Not sure/Neutral     Disagree     Strongly Disagree

**13. How confident are you about using ICTs? Please tick the appropriate box.**

(a) How confident are you about using ICTs personally:

Very Confident     Confident     Neutral     Not Confident     Anxious

(b) **How confident are you about using ICTs with classes:**

Very Confident       Confident       Neutral       Not Confident       Anxious

**14. What are your greatest current concerns about using ICTs with classes?** Please rate each of the following as it applies to you, on a 1-3 scale

*1 = Significant concern                      2 = Some concern      3 = No concern.*

*Rating*

a	Access to equipment for my students' use	
b	Insufficient or poor technical support	
c	Making the links between ICTs and quality teaching and learning	
d	Lack of ideas on how to use ICTs with classes	
e	Lack of time to cope with it all	
f	Need for on-going professional development	
g	Keeping up-to-date with required skills and knowledge on ICT developments	
h	Technical reliability/equipment breakdown	
i	Others: Please specify	

**15. Please indicate the frequency with which you use ICT for:**

*Enter a rating 1,2,3,4 or 5 in the box on the right.*

*1 = Always      2 = Often      3 = Sometimes      4 = Rarely      5 = Never*

*Frequency*

a	Finding or producing resources for lessons (lesson ideas from internet; making task sheets etc.)	
b	School administration (Marks; attendance; pupil records etc.)	

**16. Please indicate your current level of achievement in each of the following ICT competencies.**

*Enter a rating 1,2,3,4 or 5 which best reflects your **current** level of knowledge/skill attainment. Be honest, but be kind to yourself! We will be asking the same questions again at the end of the programme.*

*1= Very high                      2= High                      3= Moderate                      4= Low                      5= Very low/None*

	<i>ICT Competencies</i>	<i>Level</i>
a	Basic Computer Operation (5= running programmes, 1 = trouble shooting, etc.)	
b	File Management (manipulation of documents, folders, etc.)	
c	Word Processing (5 = basic typing; 1 = advanced formatting & layout)	
d	Spreadsheets (5 = basic calculations in existing sheets; 1 = advanced formulae and layout)	
e	Database (5 = use pre-made databases such as library catalogue database; 1 = create your own databases & reports)	
f	Graphics (5 = placing clip art in docs; 1 = manipulation of photos and editing images—programs such as KidPix, Photoshop, etc.)	
g	Internet (5 = basic searching & browsing; 1 = designing your own website etc.)	
h	Telecommunications (5 = basic email, 1 = own MySpace, Bebo site, blog etc.)	
i	Presentation / Multimedia (5 = slideshows with some pre-recorded sound or movie etc.; 1 = making movies and animations or interactive ‘shows’ from scratch)	

**17. In what setting did you first become reasonably comfortable at using the Internet?**

Please tick the appropriate box

- At home     
 At school     
 During In-service training  
 During pre-service training     
 Other [specify]

**18. Have you ever completed a formal course or tertiary qualification on the use of computers in education?**

- Yes       No

**19. If yes, briefly state the nature of each course**

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**20. What proportion of your units of work in the last year contained ICT based learning activities?**

Please tick the appropriate box

- All or almost all units     
 Most units     
 Several units     
 One or two units     
 No units

**21. Please indicate the average frequency (using the 1-5 scale below) with which some or all students have done any of the following during your lessons over the last year.**

1 = Daily/almost daily      2 = Once or twice a week      3 = Once or twice a term  
 4 = Once or twice in the year      5 = Not at all

	Purpose	Activity	Frequency
a	<b>Communication</b>	<i>Text and picture presentation</i> : eg. making posters, journals, written stories text/image slideshows etc.	
		<i>Multimedia presentations</i> : eg. making slideshow presenting results of project using PowerPoint or Hyperstudio with sound/movies; etc. showing movies they have produced	
		<i>Online interaction</i> : e.g. emailing or chatting with experts/other students on a current topic or a problem. Belonging to e-club or contributing to online communities, blogs, Bebo etc.	
b	<b>Creativity</b>	e.g. creative writing, designing and making websites, editing and composing music, video etc. creativity is the focus	
c	<b>Information gathering/processing</b>	e.g. accessing or searching for information on the internet, accessing school library electronic catalogue. data logging using external devices connected to computers	
d	<b>Problem solving</b>	e.g. calculating/analysing data, working through concept simulations on computer, designing or developing their own spreadsheets or database to solve a problem; interactive fiction, data logging using external devices connected to computers	
e	<b>Curriculum practice</b>	e.g. learning from tutoring software, reinforcing pre-taught knowledge or practicing skills; drill and practice	
f	<b>Technical skills</b>	e.g. cut and paste, file management, importing digital photographs, key board skills, how to use Inspiration	
g	<b>Collaborative learning and social interaction</b>	e.g. working in groups to solve a problem using spreadsheets etc., collaborating on DTP projects etc.	
h	<b>Motivation/Reward /Engagement</b>	e.g. working on a CD Rom or game <i>as a reward</i>	

**22. How often do you have informal discussions with colleagues where you offer advice about using ICT for learning and teaching? [circle the most appropriate answer]**

Never                      Some weeks                      Most weeks                      Every week  
 Most days                      Every day

**23. How often do you provide informal or impromptu technical support for other staff who are trying to use ICT with their class? [circle the most appropriate answer]**

*Never      Some weeks    Most weeks    Every week    Most days    Every day*

**24. How would you rate your technical skills and knowledge in relation to computers?**

Novice                       Emerging                       Proficient                       Accomplished                       Expert

**25. How would you rate your technical skills and knowledge in relation to the Internet?**

Novice                       Emerging                       Proficient                       Accomplished                       Expert

**26. How would you rate your level of teaching experience at using computers in the classroom?**

Novice                       Emerging                       Proficient                       Accomplished                       Expert

**27. How would you describe the level of support you receive from other staff for using ICT within your teaching?**

Poor                       Adequate                       Good                       Very good                       Excellent

**28. How would you describe the level of support you receive from the Principal and Board of Trustees for using ICT within your teaching?**

Poor                       Adequate                       Good                       Very good                       Excellent

**29. How would you describe the level of support in using ICT's you receive from students in your school?**

Poor                       Adequate                       Good                       Very good                       Excellent

**30. How would you rate your current knowledge of recent ICT developments in New Zealand education?**

Poor                       Adequate                       Good                       Very good                       Excellent

**31. On a weekly basis, what percentage of use of ICT do you use in your class?** [Circle the appropriate percentage]

0%    10%    20%    30%    40%    50%    60%    70%    80%    90%    100%

**32 Which of the following terms best describes your current experience at implementing ICT for learning and teaching?**

Enthusiastic beginner

Committed innovator

Cautious integrator

Struggling adopter

Accomplished Achiever

**33. Has the advent of ICT changed your teaching philosophy?**  Yes  No

If yes, briefly explain the type of changes that have taken place

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**34. How would you rate your success at integrating ICT into the school curriculum?**

Excellent

Very good

Good

Adequate

Poor

**35. How would you rate your current level of confidence at using ICT for learning and teaching?**

Excellent

Very good

Good

Adequate

Poor

**Thank you for completing this survey. I appreciate the attention you have given it.**

If you have any queries or comments regarding the survey, please contact:

Michael Peterson

Email: [michael@hedgeley.co.nz](mailto:michael@hedgeley.co.nz)

Tel (06) 836-6993; Mob. 02102924858

*Acknowledgement: This questionnaire was adapted from the format created by Core Education for the New Zealand Ministry Education for use in the ICT PD clusters throughout New Zealand. My thanks to Dr Vince Ham and his colleagues for allowing me to use and adapt their basic questionnaire for this research project.*

## Information and Communication Technology Professional Development (ICT PD) through Reverse-mentoring Research 2010- 2011

### End of Project Evaluation

This questionnaire is designed to assist independent research into improving teachers' use of ICT in their classrooms.

Individual responses will be kept confidential to the researcher and his supervisors.

The results of statistical and other analyses of the data, including anonymous exemplary quotations, may be published in non-attributable and aggregated form in presentations, reports and papers by the researcher as part of his research.

Your Name: (Needed for comparison with the baseline survey done at the beginning of the project)	
School: (Needed for comparison with baseline survey.)	
Gender:	<input type="checkbox"/> Female <input type="checkbox"/> Male
School Sector you <i>mostly</i> teach in	<input type="checkbox"/> Intermediate <input type="checkbox"/> Secondary <input type="checkbox"/> Both
Length/Duration of your involvement in ICT Reverse-mentoring Professional Development Programme:	<input type="checkbox"/> 0-6 mths <input type="checkbox"/> 7-12 mths <input type="checkbox"/> 13-18 mths <input type="checkbox"/> 19-24 mths <input type="checkbox"/> 25-30 mths <input type="checkbox"/> 31-36 mths
Do you have a laptop under the TELA scheme?	<input type="checkbox"/> Yes <input type="checkbox"/> No
If yes, how long have you had a laptop under the scheme?	<input type="checkbox"/> 0-6 mths <input type="checkbox"/> 7-12 mths <input type="checkbox"/> 13-18 mths <input type="checkbox"/> 19-24 mths <input type="checkbox"/> 25-30 mths <input type="checkbox"/> ≥31 mths

### **THE ICT REVERSE-MENTORING PROFESSIONAL DEVELOPMENT PROGRAMME**

**1. Please indicate your level (1-5 scale) of confidence in relation to personal and classroom use of ICT's after taking part in the ICT Reverse-mentoring PD Programme. Enter a rating 1,2,3,4 or 5. (See example)**

1= Anxious      2= Not confident      3= Neutral      4= Confident      5= Very confident

		Confidence about using ICT's	After PD
Example	How confident are you about using ICT's with your classes		4
a	How confident are you about using ICT's <b>personally</b> ?		
b	How confident are you about using ICT's <b>with your classes</b> ?		
c	How confident are you about <b>using students to help</b> you with using ICT's in the classroom?		

**2. Please indicate your level (1-5 scale) of competence with each of the following ICT's after taking part in the ICT Reverse-mentoring PD programme. Enter a rating 1,2,3,4 or 5**

1= very low/none    2= low    3= moderate    4= high    5= very high

ICT	After PD
Basic Computer Operation (running programmes, trouble shooting, etc.)	
File Management (manipulation of documents, folders, etc.)	
Word Processing (manipulation of text—programs such as Word)	
Spreadsheets (create charts/graphs, use for record keeping purposes—programs such as Excel.)	
Database (use pre-made databases such as library catalogue database or create own databases)	
Graphics (manipulation of pictures and images—programs such as KidPix, Photoshop, etc.)	
Internet (searching and/or website design)	
Telecommunications (email, chat, etc.)	
Presentation / Multimedia (incorporating sound, movies, etc.)	
Accepting help from technically capable students when faced with barriers to learning how to use ICT's	

**3. Please indicate the frequency with which you used ICT after the ICT Reverse-mentoring PD programme for the two purposes below. Enter a rating 1,2,3,4 or 5.**

1 = never    2 = rarely    3 = sometimes    4 = often    5= always

Purpose	After PD
School administration e.g. reports, marks and grades, attendance etc.	
Finding or producing resources for lessons	

**4. To what extent has ICT been integrated into your units of work?** (Please answer with reference after the ICT Reverse-mentored programme. Please enter a rating 1, 2, 3, 4, or 5).

1. no units    2. one or two units    3. several units    4. most units    5. all or almost all units

Extent of ICT Integration		After PD
	What proportion of your units of work contains ICT based learning activities?	

**5. a) To what extent have your classroom practices changed as a result of your participation in the ICT Reverse-mentoring PD programme?** (Please tick *ONE* box only).

not at all     very little     to some extent     to a large extent     completely changed

b) Describe these changes (positive and/or negative) to your classroom practices.

**Positive:**

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**Negative:**

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**6. a) To what extent has the ICT Reverse-mentoring PD programme contributed to your understanding of teaching and learning generally?** (Please tick *ONE* box only).

- Not at all  
 Confirmed current ideas/understandings about teaching and learning  
 Contributed some new ideas about teaching and learning  
 Provided a whole new approach to teaching and learning

b) Describe how the ICT Reverse-mentoring PD programme has contributed to your understanding of teaching and learning in general.

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**7. Describe up to 5 different ICT based activities that you have organised for your students to engage in during the last year?**

Identify the subject or learning area (e.g.: Health, Science, integrated curriculum), the type of ICT/software you used (e.g. Internet, word- processor, digital camera, etc.) and the learning outcomes for students.

	Essential Learning Area	Software / ICT	Learning Outcomes for Students
	e.g. English/Languages	e.g. Word Processor, Digital camera	e.g. Presenting different points of view
	e.g. Science	e.g. CD Rom tutorial, Spreadsheets	e.g. Applying Motion formulae to problems

**8. How often, on average, do you guide your students to use ICT based activities where the following constituted the main purpose of the activity? Please indicate a frequency of use for the period of the ICT Reverse-mentored programme. Use the 1-5 scale below**

1 = not at all    2 = once or twice in the year    3 = once or twice a term    4 = once or twice a week  
5 = daily/almost daily

	Purpose	Activity	se
	Communication	<i>Text and picture presentation:</i> e.g. making posters, journals, written stories etc.	
		<i>Multimedia presentations:</i> e.g. making slideshows; blogs, podcasts, presenting results of project using PowerPoint or Hyperstudio etc.	
		<i>Online interaction:</i> e.g. emailing or chatting with experts/other students on a current topic or a problem. Videoconferencing, Belonging to e-club or contributing to online communities	
	Creativity	e.g. creative writing, designing and making websites, editing and composing music, video etc. creativity focus	
	Information gathering/processing	e.g. accessing or searching for information on the internet, accessing school library electronic	

		catalogue, or data logging using external devices connected to computers	
	Problem solving	e.g. calculating/analysing data, working through simulations on computer, designing or developing their own spreadsheets or database to solve a problem; interactive fiction; immersive gaming	
	Curriculum practice	e.g. learning from tutoring software, reinforcing pre-taught knowledge or practicing skills; drill and practice	
	Technical skills	e.g. cut and paste, file management, importing digital photographs, key board skills, how to use Inspiration	
	Collaborative learning and social interaction	e.g. working in groups to solve a problem using spreadsheets etc., collaborating on DTP projects, multi-user gaming etc.	
	Motivation/Reward/Engagement	e.g. working on a CD Rom or game etc., as a reward	

**9. To what extent to date do you think you have effectively integrated ICT's into your classroom teaching and learning? (Please tick ONE box only).**

not at all     very little     to some extent     to a large extent     completely

**10. What were the main three benefits you observed for using students to help you in your use of ICT's?**

- a) \_\_\_\_\_  
b) \_\_\_\_\_  
c) \_\_\_\_\_

**11. To what extent were your goals/expectations met by ICT Reverse-mentoring PD programme?** Please answer with regard to the 5 types of goals below, using the following five point scale:

1= not met    2= partially met    3=largely met    4= fully met    5= exceeded

Type of goal	Extent to which goal met
Technical skill development	
Ideas for using ICT's with classes	
Quality teaching and learning enhancement in general	
Using ICT's for administration	
Gaining of Qualification	

**12. Which aspects of the last two terms of your ICT Reverse-mentoring PD programme have you:**

a)  
Most appreciated?

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b)  
Least appreciated?

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**13. a) To what extent has any increase in your use of ICT's with classes over the last year been attributable to the ICT Reverse-mentoring Professional Development Programme? Please tick ONE box only**

not at all attributable       partly attributable       largely attributable       completely attributable

b) If other factors were involved, what were they?

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**14. What are your greatest current concerns about using ICT's in schools?**

*Please rate each of the following as it applies to you, on a 1-3 scale*

1 = No concern      2 = Some concern      3 = Significant concern

Rating

	Access to equipment for my students' use	
	Insufficient technical support	
	Making the links between ICT's and quality teaching and learning	
	Lack of ideas on how to use ICT's with classes	
	Lack of time to cope with it all	
	Need for on-going professional development	
	Keeping up-to-date with required skills and knowledge on ICT developments	

	Technical reliability/equipment breakdown	
	Others: Please specify	

**15. a) How significant has the ICT Reverse-mentoring PD Programme been in your overall development as a teacher?**

not significant       slightly significant       somewhat significant       very significant

b) Comments:

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**Thank you for completing this survey. I appreciate the attention you have given it.**

If you have any queries or comments regarding the survey, please contact:

Michael Peterson

Email: [peterston@hedgeley.co.nz](mailto:peterston@hedgeley.co.nz)

Tel (06) 836-6993; Mob. 02102924858

*Acknowledgement: This questionnaire was adapted from the format created by Core Education for the New Zealand Ministry Education for use in the ICT PD clusters throughout New Zealand. My thanks to Dr Vince Ham and his colleagues for allowing me to adapt their questionnaire for this research project.*

## Appendix B

### Information Form for Parents

Title of Project:

Switching Roles: An investigation into the use of reverse-mentoring by students to encourage teachers' uptake of ICT in their pedagogic approach.

Name of Researcher:

Michael Peterson

Names of Supervisors:

Dr Kathryn Dixon, Curtin University

Dr Lina Pelliccione, Curtin University

Selected students have are being invited to take part in a research study. Before you decide where or not your child should take part, it is important for you to understand why the research is being done and what it will involve. Please take the time to read the following information carefully. Please feel free to ask me if there is anything that is not clear or if you would like more information. Take time to decide where or not you wish to participate.

Who is organising this study?

Michael Peterson

What are the aims of the study?

To investigate whether the provision of a reverse-mentoring system involving ICT literate students helping their teachers, supports the use of ICT in teachers' pedagogies.

Who can take part and why has your child been chosen to take part?

An invitation was sent to teachers who are in the following categories:

- ICT teachers who have students who have demonstrated ability in the use of ICT and are willing to share those abilities to help teachers use ICT in the classroom. Your child has been identified as being one of those ICT literate students;
- Teachers in your child's school who have indicated they would benefit from just-in-time help from the group of ICT literate students and are willing to engage in a mentor-mentee relationship with the students. Your child is considered to have the ability to help teachers in this way.
- There will be no direct contact between the researcher and your child. The data for the programme will come from the volunteer teachers involved.
- 

What does the study involve and how long will it take?

The study focuses on the volunteer teachers who will supply data on the effectiveness of the mentoring programme which is intended to help them develop skills in the use of ICT. The programme will run over two to three school terms and may involve your child helping selected teachers from time to time.

Does my child have to take part?

It is within your discretion to allow your child to take part or elect not to do so. If you do decide your child will take part, you will be given this information sheet to keep and you will be asked to sign a consent form. You have the right to withdraw your child from the study at any time without giving a reason for the withdrawal and without prejudice or threat of being disadvantaged in any way.

Contact for further information.

If you have any questions or require any further information, please contact the researcher or the researcher's supervisors:

Researcher                      Michael Peterson      [peterson@hedgeley.co.nz](mailto:peterson@hedgeley.co.nz)  
Telephone +64 6 836 6993

Researcher's supervisors:    Dr Kathryn Dixon      [K.Dixon@curtin.edu.au](mailto:K.Dixon@curtin.edu.au)  
Dr Lina Pelliccione          [l.pelliccione@curtin.edu.au](mailto:l.pelliccione@curtin.edu.au)

Office telephone 0061 8 9266 2596

Thank you for taking the time to read this Participant Information Form and for considering taking part in the study. The Participation Information Form is yours to keep. If you do wish to take part in the study, please sign the consent form.

Signature of researcher \_\_\_\_\_

# Consent Form for Parents

Faculty of Humanities



School of Education

## CONSENT FORM FOR PARENTS

GPO Box U1967  
Perth Western Australia 6045  
Telephone +61 8 9226 0266  
Facsimile +61 8 9226 2547  
Web www.curtin.edu.au  
CRICOS Provider Code 00301U

I have read the Information Sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:-

1. My daughter's participation in the project is entirely voluntary;
2. I am free to withdraw my daughter from the project at any time without any disadvantage;
3. My daughter will be working with her teacher in this project not directly with the researcher;
4. The data, written notes and audiotapes will be destroyed at the conclusion of the project but any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed;
5. This project involves an open-questioning technique with the teachers concerned, not with your (son daughter). However, if I feel hesitant or uncomfortable with this procedure, I may decline to allow my daughter to take part in the project without any disadvantage of any kind.
6. Participation of my daughter is entirely voluntary. I will not receive any remuneration or compensation.
7. The results of the project may be published but my anonymity and that of my daughter will be preserved.

I agree to allow my daughter to take part in this project.

.....(signature of parent)  
(Date)

.....(printed name of parent)

This project has been reviewed and approved by the Curtin University of Technology Human Ethics Committee

## Participant Information Form

Faculty of Humanities



School of Education

### PARTICIPANT INFORMATION FORM

GPO Box U1967  
Perth Western Australia 6845  
Telephone +61 8 9256 0268  
Facsimile +61 8 9266 2547  
Web www.curtin.edu.au  
CRICOS Provider Code 00301U

#### Title of Project:

**Switching Roles: An investigation into the use of reverse mentoring by students to encourage teachers' uptake of ICT in secondary classrooms.**

#### Name of Researcher:

Michael Peterson

#### Names of Supervisors:

Dr Kathryn Dixon, Curtin University of Technology  
Associate Professor Lina Pelliccione, Curtin University of Technology

You are being invited to take part in a research study. Before you decide whether or not to take part, it is important for you to understand why the research is being done and what it will involve.

Please take the time to read the following information carefully. Please feel free to ask me if there is anything that is not clear or if you would like more information. Take time to decide where or not you wish to participate.

#### Who is organising this study?

Michael Peterson

#### What are the aims of the study?

To investigate whether the provision of a reverse-mentoring system involving ICT literate students helping their teachers, supports the use of ICT in teachers' pedagogies.

Who can take part and why have you been chosen to take part?

An invitation was sent to teachers who are in the following categories:

- ICT teachers who have students who have demonstrated ability in the use of ICT and are willing to share those abilities to help teachers use ICT in the classroom;
- Teachers in your school have indicated they would benefit from just-in-time help from the group of ICT literate students and are willing to engage in a mentor-mentee relationship with the students.

#### What does the study involve and how long will it take?

Semi-structured interviews of about one hour duration will take place with the school's ICT teacher and with each of the teachers willing to work as mentees. The interviews will involve gathering data relating to the mentees' experiences and opinions as users or potential users of ICT in their teaching practice before the mentoring starts. Further such semi-structured interviews will take place over two to three school terms to assess the value of the assistance provided by the students.

## Participant Consent Form

Faculty of Humanities



School of Education

GPO Box U1967  
Perth Western Australia 6845

Telephone +61 8 9206 0268  
Facsimile +61 8 9206 2547  
Web www.curtin.edu.au

CRICOS Provider Code 00301U

### PARTICIPANT CONSENT FORM

*(copy for researcher)*

You have been invited to participate in a research project regarding the implementation of a reverse-mentoring programme for secondary teachers in New Zealand schools. Michael Peterson is conducting this research.

Before signing this consent form, please ensure you have read the **Participant Information Sheet** and discuss this with Michael.

#### Title of Project:

Switching Roles: An investigation into the use of reverse mentoring by students to encourage teachers' uptake of ICT in secondary classrooms.

Name of Research Participant (please print):.....

1. I confirm that I have read and understood the Information Sheet for the above research project and that I have had the opportunity to discuss this and ask any questions.
2. I understand that the strictest confidentiality and anonymity will be preserved; my name will not be published in the final report nor will there be any cross-references made which can link the result of the research project to me.
3. I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason and without prejudice or threat of being disadvantaged in any way.
4. I understand that there will be no personal risk to me by participating in this research project.
5. I agree to take part in the above research project.

\_\_\_\_\_  
Name of participant

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature

Michel Peterson  
Name of researcher

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature

**Please retain a copy for your records**

**This study has been reviewed and approved by the Curtin University of Technology Human Ethics Committee**

## PARTICIPANT CONSENT FORM

*(copy for participant)*

You have been invited to participate in a research project regarding the implementation of a reverse-mentoring programme for secondary teachers in New Zealand schools. Michael Peterson is conducting this research.

Before signing this consent form, please ensure you have read the **Participant Information Sheet** and discuss this with Michael.

### Title of Project:

Switching Roles: An investigation into the use of reverse mentoring by students to encourage teachers' uptake of ICT in secondary classrooms.

Name of Research Participant (please print):.....

1. I confirm that I have read and understood the Information Sheet for the above research project and that I have had the opportunity to discuss this and ask any questions.
2. I understand that the strictest confidentiality and anonymity will be preserved; my name will not be published in the final report nor will there be any cross-references made which can link the result of the research project to me.
3. I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason and without prejudice or threat of being disadvantaged in any way.
4. I understand that there will be no personal risk to me by participating in this research project.
5. I agree to take part in the above research project.

\_\_\_\_\_  
Name of participant

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature

Michel Peterson  
Name of researcher

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature

**Please retain a copy for your records**

**This study has been reviewed and approved by the Curtin University of Technology Human Ethics Committee**