UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

The effect of context on teachers' ability to innovate with information and communication technologies in secondary schools

by

Mary Elizabeth Reynolds

Submitted in partial fulfilment of the requirements for the degree
of Philosophiae Doctor
(Computer Integrated Education)
in the Faculty of Education
University of Pretoria

Supervisor: Professor Johannes Cronje

August 2009

Acknowledgements

My sincere thanks are due to my supervisor, Professor Johannes Cronje for his challenges, his patience and his belief in me. I gratefully acknowledge my colleagues for their friendship and unfailing encouragement and the leadership of Wilding College for the unique opportunity for lifelong learning and professional growth. In particular, I am indebted to Arthur, Bronwyn, Francois, Hennie, Henry, Ineke, Magriet, Maria, Thabo and Richard for so willingly sharing the stories which are at the heart of this project. I am especially grateful to Dr Irene Lategan for her critical friendship, her mentoring and her encouragement through the really tough times. To Jenny and Irene, thank you for your help in proof-reading under impossible deadline pressures. Last, but by no means least, the encouragement, time, space, love, belief, pride and patience with which my family have withstood the last four years has been unflinching. Katy, Jimmy, Buster and Mom: thank you.

This thesis is dedicated to the memory of my father, Leonard Hensman whose faith in education set me on this path; and to the memory of my aunt and mentor, Professor Bertha Hensman, Chair of the Department of Western Languages and Literature, West China Union University, Chengdu from 1937-1951, whose life of scholarship in the face of extreme adversity has always been an inspiration to me.

Table of Contents

Acknowledgements ii
List of Figures xii
List of Tables xiii
List of Appendices xiii
Summary xiv

Chapter 1: Introduction and orientation to the study

1
1.1. Introduction 1
1.2. Background to the study 1
1.2.1. The educational-cultural perspective 3
1.2.2. The national policy perspective 4
1.2.3. The technology-transformation perspective 5
1.2.4. The school perspective 9
1.2.5. The researcher's perspective 12
1.2.6. Towards a research focus 14
1.3. Statement of purpose 14
1.4. Research problem and objectives 15
1.5. Research question 16
1.6. Scope and context of the study 17
1.7. Research methodology, design and process 17
1.7.1. Research design 17
1.7.2. Research approach 18
1.7.3. Unit of analysis 19
1.7.4. Data collection, transcription and analysis 20
1.7.5. Trustworthiness 20
1.8. Ethical considerations 20
1.9. Limitations 21
1.10. Literature control 21
1.11. Definition of key concepts 23
1.12. Outline of the study 25
1.13. Summary of Chapter 1 .....

Chapter 2: Review of the literature and conceptual framework

2.1. Introduction 27
2.2. Searching the literature 28
2.2.1. Recently completed literature in the field 31
2.3. The integration of ICTs into the curriculum 33
2.3.1. ICT terminology 33
2.3.2. The 20th Century: Functional practice 36
2.3.3. The 21st Century: Towards integrative practice 40
2.3.4. 21st Century: Integrative practice 43
2.3.5. Integration of ICTs in context 49
2.3.6. Summary of section 2.3 55
2.4. Innovation theory 56
2.4.1. Innovation, change and reform 58
2.4.2. The diffusion of innovations 60
2.4.3. Innovation and schools 64
2.4.4. Innovation and teachers 68
2.4.5. Innovation and ICT integration 70
2.4.6. Sustainability of innovations 74
2.5. Change, reform and transformation 75
2.5.1. Student competencies and transformation 80
2.5.2. Teachers and transformation 81
2.5.3. ICTs and transformation 86
2.6. Complexity theory 88
2.6.1. Complexity theory and organisational behaviour 88
2.6.2. Complexity theory, knowledge and learning 91
2.6.3. Complexity and schools 93
2.6.4. Complexity and ICTs in schools 94
2.7. Summary of the literature review 95
2.8. Towards a conceptual framework 96
2.8.1. Applying the conceptual framework 98
2.9. Summary of Chapter 2 99

Chapter 3: Research methodology, design and process

3.1. Introduction 101
3.2. The research approach 101
3.3. Research methodology 108
3.4. Research design 112
3.4.1. Unit of analysis 114
3.4.2. Data collection 117
3.4.3. Interviews 118
3.4.4. Observation 122
3.4.5. Document verification 122
3.4.6. Data transcription 123
3.4.7. Data analysis 124
3.4.7.1. Illustration of the data 127
3.5. Trustworthiness 129
3.6. Ethical considerations 133
3.7. Limitations 134
3.8. Summary of Chapter 3 136

Chapter 4: Findings: Organisational interactions and their effect on teachers' practice

4.1. Introduction 139
4.2. The relationship between innovation and context 140
4.3. The school: Wilding College 140
4.3.1. The teachers 142
4.4. Main themes identified in the analysis 143
4.4.1. Curriculum change 143
4.4.2. Inclusive education 144
4.4.3. Professional learning 147
4.4.4. The nature of the subject 148
4.4.5. Systemic factors 149
4.4.6. Teacher beliefs 150
4.4.7. Student beliefs and attitudes 151
4.4.8. Societal and parent factors 153

4.5. How organisational interactions affect teachers' practice …… 153
4.5.1. Organisational interactions: Bronwyn & Ineke ……. 154
4.5.1.1. Curriculum change ……... 154
4.5.1.2. Professional learning ……... 157
4.5.1.3. Nature of the subject …… 158
4.5.1.4. Constraints …… 159
4.5.1.5. Summary and preliminary findings …… 161
4.5.2. Organisational interactions: Magriet *et al.* …… 162
4.5.2.1. Curriculum change …….. 163
4.5.2.2. Inclusive practice …… 167
4.5.2.3. Professional learning …….. 170
4.5.2.4. Summary and preliminary findings …… 173
4.5.3. Organisational interactions: Henry …… 176
4.5.3.1. Curriculum change …….. 177
4.5.3.2. Student, societal and parent factors ……. 178
4.5.3.3. Systemic factors …….. 181
4.5.3.4. Summary and preliminary findings …… 183
4.5.4. Organisational interactions: Richard ……. 185
4.5.4.1. Curriculum change …….. 185
4.5.4.2. Professional learning ..…….. 187
4.5.4.3. Student factors ……. 190
4.5.4.4. Constraints …… 192
4.5.4.5. Summary and preliminary findings …… 193
4.5.5. Organisational interactions: Maria ……. 194
4.5.5.1. Systemic factors ……... 194
4.5.5.2. Inclusive practice …… 196
4.5.5.3. Professional learning ……... 197
4.5.5.4. Summary and preliminary findings 199
4.5.6. Organisational interactions: Francois …… 201
4.5.6.1. Systemic factors ……... 201
4.5.6.2. Curriculum change …….. 206
4.5.6.3. Professional learning ……... 203
4.5.6.4. Summary and preliminary findings ……. 205
4.5.7. Preliminary findings: organisational interactions and

their effect on teachers' practice …… 206
4.6. Summary of Chapter 4 ……... 208

Chapter 5: Findings: collegial and professional interactions and their effect on teachers' practice

5.1. Introduction …….. 211
5.2. Schools as professional learning communities …….. 212
5.3. Formal networking structures …… 213
5.4. Collegial and professional relationships at Wilding College … 214
5.4.1. Working together: Bronwyn & Ineke ……. 215
5.4.1.1. Intra-departmental relationships …… 216
5.4.1.2. Relationship with the school leadership ……... 218
5.4.1.3. Inter-departmental relationships …… 219
5.4.1.4. Relationships beyond the school …….. 220
5.4.1.5. Summary & preliminary findings ……. 221
5.4.2. Working together: Arthur & Hennie, Magriet & Thabo … 223
5.4.2.1. Intra-departmental relationships …… 223
5.4.2.2. Inter-departmental relationships …… 227
5.4.2.3. Relationship with the school leadership ……... 228
5.4.2.4. Relationships beyond the school …….. 230
5.4.2.5. Summary & preliminary findings……. 236
5.4.3. Working together: the case of Henry ……..... 240
5.4.3.1. Intra-departmental relationships …… 240
5.4.3.2. Relationship with the school leadership ……... 244
5.4.3.3. Relationships beyond the school ……... 244
5.4.3.4. Summary & preliminary findings …… 245
5.4.4. Working together: the case of Richard ……. 247
5.4.4.1. Intra-departmental relationships …… 247
5.4.4.2. Relationship with the school leadership ……... 248
5.4.4.3. Relationships beyond the school …….. 249
5.4.4.4. Summary & preliminary findings ……. 251
5.4.5. Working together: the case of Maria ……. 252
5.4.5.1. Intra-departmental & leadership relationships …. 252
5.4.5.2. Relationships beyond the school ……... 255

5.4.5.3. Summary & preliminary findings: Maria ……. 256
5.4.6. Working together: the case of Francois …… 256
5.4.6.1. Intra-departmental relationships …… 257
5.4.6.2. Relationship with the school leadership ……... 258
5.4.6.3. Relationships beyond the school 258
5.4.6.4. Summary & preliminary findings: Francois ... 260
5.4.7. Preliminary findings: collegial and professional interactions and their effect on teachers' practice ……. 261
5.5. Summary of Chapter 5 …… 266

Chapter 6: Findings: ICT interactions and their effect on teachers' ability to innovate

6.1. Introduction …….. 269
6.2. Innovation and ICTs …… 269
6.3. ICTs and innovation at Wilding College …….. 271
6.4. ICTs and innovation: introduction to the cases …….. 273
6.4.1. ICTs and innovation: the case of Bronwyn & Ineke …… 274
6.4.1.1. Process innovation ……..... 274
6.4.1.2. Information literacy …….. 278
6.4.1.3. Enablers and constraints …… 282
6.4.1.4. Summary & preliminary findings ……. 284
6.4.2. ICTs and innovation: the case of Arthur et al. ……. 286
6.4.2.1. Process innovation …….. 286
6.4.2.2. Product innovation ……... 290
6.4.2.3. Information literacy …….. 294
6.4.2.4. Enablers and constraints …… 295
6.4.2.5. Factors influencing ICT use …… 300
6.4.2.6. Discontinuation of innovation …… 305
6.4.2.7. Intra-departmental collaboration in ICT use …… 306
6.4.2.8. Summary & preliminary findings …… 307
6.4.3. ICTs and innovation: the case of Henry ……... 310
6.4.3.1. Process innovation …….. 310
6.4.3.2. Product innovation …….. 313
6.4.3.3. Information literacy …….. 313

6.4.3.4. Enablers and constraints 315
6.4.3.5. Summary & preliminary findings 319
6.4.4. ICTs and innovation: the case of Richard 321
6.4.4.1. Process innovation 322
6.4.4.2. Factors influencing ICT use 324
6.4.4.3. Intra-departmental collaboration in ICT use 325
6.4.4.4. Enablers and constraints 326
6.4.4.5. Summary and preliminary findings 327
6.4.5. ICTs and innovation: the case of Maria 330
6.4.5.1. Process innovation and information literacy 330
6.4.5.2. Constraints 331
6.4.5.3. Summary and preliminary findings 332
6.4.6. ICTs and innovation: the case of Francois 333
6.4.6.1. Product innovation 333
6.4.6.2. Constraints 335
6.4.6.3. Summary and preliminary findings 337
6.4.7. Preliminary findings: ICT integration and innovation 339
6.5. Summary of Chapter 6 342

Chapter 7: Findings: School leadership and its effect on teachers' ability to innovate

7.1. Introduction 345
7.2. ICTs, innovation and school leadership 345
7.3. School leadership and ICT management at Wilding College .. 346
7.4. ICTs, innovation and school leadership 347
7.4.1. Leadership perceptions of ICTs 348
7.4.2. Curriculum change 350
7.4.3. Curriculum innovation 354
7.4.4. Working together 356
7.4.5. ICTs and innovation 358
7.4.6. Constraints to ICT integration 361
7.4.7. Encouraging teachers to integrate ICTs 364
7.4.8. Perceptions of the future 366
7.4.9. Preliminary findings: school leadership 368

7.5. Summary of Chapter 7 371

Chapter 8: Discussion of findings; conclusions and recommendations

8.1. Introduction 373
8.2. Synoptic overview of the study 373
8.2.1. Chapter 1 373
8.2.2. Chapter 2 374
8.2.3. Chapter 3 376
8.2.4. Chapter 4 377
8.2.5. Chapter 5 378
8.2.6. Chapter 6 379
8.2.7. Chapter 7 379
8.3. Discussion of the findings from a theoretical perspective 380
8.3.1. The study of complex contexts 381
8.3.1.1. The context of Wilding College 381
8.3.1.2. Complexity & the context of Wilding College 382
8.3.2. Innovation 384
8.3.3. Professional learning 388
8.4. Discussion of the findings from an empirical point of view 389
8.4.1. The effect of organisational interactions 389
8.4.2. The effect of collegial and professional interactions 394
8.4.3. The effect of ICTs on teachers' ability to innovate 400
8.4.3.1. From an organisational perspective 400
8.4.3.2. From a pedagogic perspective 402
8.4.3.3. From a relationship perspective 404
8.4.4. The effect of leadership interactions 405
8.5. The effect of context on teachers' ability to innovate with ICTs 409
8.6. Conclusions 411
8.7. Reflection 412
8.7.1. Methodological reflection 412
8.7.2. Scientific reflection 414
8.7.3. Substantive reflection 415
8.7.4. Personal reflection 416

8.8. Recommendations ……... 416
8.8.1. Recommendations for policy and practice ……... 417
8.8.2. Recommendations for further research …… 418
8.9. Limitations of the study …… 418
8.10. Conclusion ……. 419

List of references ……... 421

Appendices …….. 447

List of Figures

Figure 2.1: Relationship between ICTs and innovation 29
Figure 2.2: The flux and change of innovative processes 57
Figure 2.3: The interrelationship of reform, transformation, change and innovation in the school context 85
Figure 2.4: Relationship between perspectives 97
Figure 2.5: Conceptual framework 98
Figure 3.1: Four paradigms of social research 104
Figure 3.2: Research design 113
Figure 3.3: Example of direct interplay of factors 128
Figure 3.4: Example of indirect interplay of factors 128
Figure 4.1 Organisational effects: Bronwyn & Ineke 162
Figure 4.2: Organisational effects: Magriet and Thabo 174
Figure 4.3: Organisational effects: Arthur and Hennie 175
Figure 4.4: Organisational effects: Henry 184
Figure 4.5: Organisational effects: Richard 193
Figure 4.6: Organisational interactions: Maria 199
Figure 4.7: Organisational effects: Francois 205
Figure 5.1: Collegial & professional interactions: Bronwyn & Ineke 222
Figure 5.1: Collegial & professional interactions: Magriet & Thabo 237
Figure 5.3: Collegial & professional interactions: Arthur & Hennie 238
Figure 5.3: Collegial & professional interactions: Henry 245
Figure 5.6: Collegial & professional interactions: Richard 252
Figure 5.7: Collegial & professional interactions: Maria 256
Figure 5.8: Collegial & professional interactions: Francois 260
Figure 6.1: ICT factors: Bronwyn and Ineke 285
Figure 6.2 ICTs and innovation: Arthur and Hennie 300
Figure 6.3: ICTs and innovation: Thabo and Magriet 308
Figure 6.4: ICTs and innovation: Henry 320
Figure 6.5: ICTs and innovation: Richard 328
Figure 6.6: ICTs and innovation: Maria 333
Figure 6.7: ICTs and innovation: Francois 338

List of Tables

Table 1.1: Definition of key concepts 21
Table 2.1: Literature search terms 28
Table 2.2: Aspects of ICT integration 44
Table 2.3: Table of ICT integration into different subject areas 45
Table 2.4: Components of the Classical Diffusion Model 61
Table 2.5: Framework of inter-related competencies 81
Table 2.6: Six principles of Complexity Science 90
Table 2.7: The nested organisation of knowledge 92
Table 3.1: Case study characteristics 110
Table 3.2: Types of case studies and their purposes 112
Table 3.3: Research timeframe 113
Table 3.4: Representativeness of teachers/leaders by department 116
Table 3.5 Complexity characteristics 124
Table 3.6: Sample of coded data 125
Table 3.7: Sample of coding spreadsheet 126
Table 3.8: Criteria for trustworthiness 131
Table 4.1: Table of teachers interviewed 142
Table 6.1: Convergent factors between ICTs and innovative practice 341
Table 6.2: Disconvergent factors between ICTs and innovative practice..... 342
Table 7.1: Convergence between leadership and teacher roles 369
Table 8.1: Interplay of organisational factors 390
Table 8.2: Interplay of relationship factors 398
Table 8.3: Interplay of ICT factors 405
Table 8.4: Interplay of leadership factors 408
Table 8.5: Summary of findings 410

List of Appendices

Appendix 1.1 Teacher-librarian role 447
Appendix 1.2 Ethical clearance certificate 453
Appendix 2.1 Keyword relationships 454
Appendix 3.1 Questions guiding teacher interviews 455
Appendix 3.2 Questions guiding leadership interviews 456
Appendix 4.1 Table of changes 457
Appendix 6.1 Anti-plagiarism policy 460

Summary

This qualitative case study explores how secondary school teachers innovate in the face of complex simultaneous and ongoing mandated changes and in particular, how they innovate with ICTs. The study argues that by understanding the whole-school context, the integration of ICTs can be better understood. The research setting is a complex independent, monastic secondary school in South Africa. Rather than select exemplary projects which are the usual focus of ICT research, the school was chosen for its combination of highly developed ICT infrastructure, but relative lack of exemplary achievement with ICTs.

Using Sherry and Gibson's (2005) terminology – convergence, mutuality and extensiveness – derived from their sustainability research, this study investigates the interplay of contextual factors that affects teachers' ability to innovate in their practice, focussing on process innovation and arguing from a complexity and innovation theory point of view. Contextual factors were identified broadly as organisational factors, collegial and professional relationship factors, and ICT factors. Although all teachers were willing to innovate in practice, particularly in response to radical mandated curricular change and an inclusive philosophy, it was found that contextual factors have differing effects on their individual ability to innovate. The study identifies patterns in which not only positive factors converge, but negative factors (termed disconvergent factors) also converge. Collegial and professional relationship factors affect the diffusion or extension of innovation. These are limited by a lack or under-exploitation of lateral communication means.

The study concludes that the effects of context are unique to each individual teacher and that their professional learning trajectory needs to be scaffolded and personalised. Both ICT-based and collaborative opportunities should be provided in support of a professional learning community to address the need to diffuse innovation laterally and to enable sharing that will reduce current overload and stress levels.

Contents

Chapter 1: Introduction and orientation to the study

1.1. Introduction 1
1.2. Background to the study 1
1.2.1. The educational-cultural perspective 1
1.2.2. The national policy perspective 3
1.2.3. The technology-transformation perspective 4
1.2.4. The school perspective 5
1.2.5. The researcher's perspective 9
1.2.6. Towards a research focus 12
1.3. Statement of purpose 14
1.4. Research problem and objectives 14
1.5. Research question 15
1.6. Scope and context of the study 16
1.7. Research methodology, design and process 17
1.7.1. Research design 17
1.7.2. Research approach 17
1.7.3. Unit of analysis 18
1.7.4. Data collection, transcription and analysis 19
1.7.5. Trustworthiness 20
1.8. Ethical considerations 20
1.9. Limitations 20
1.10. Literature control 21
1.11. Definition of key concepts 21
1.12. Outline of the study 23
1.13. Summary of Chapter 1 25

Chapter 1

Introduction and orientation to the study

1.1 Introduction

This study describes and documents the interaction between secondary school teachers and their context as they respond to multiple simultaneous changes in the school environment by innovating in their classroom practice, including innovating with information and communication technologies (ICTs). These interactions are described in terms of three critical processes: convergence, mutuality and extensiveness as defined by Sherry and Gibson (2005, p.6) which permeate the boundaries between different levels of a school system and are thus essential to the sustainability of innovations. This chapter will orientate the reader with regard to the study, starting with the background.

1.2 Background to the study

This section will describe five different but interlinked perspectives that constitute the background to the study and show how they inter-relate. These perspectives are what I have termed the educational-cultural perspective, the national policy perspective, the technology-transformation perspective, the school perspective and the researcher's perspective.

1.2.1 The educational-cultural perspective

Bruner (1996, pp.2-7) contrasts two opposing views of the mind. The computational approach sees the mind in terms of information processing, with distinctive inputs and outputs in which the flow of information supposes systematic outcomes. Culturalism, on the other hand, claims that the mind could not exist without culture, in that reality is "*represented by a symbolism shared by members of a cultural community in which a technical-social way of life is both organised and construed in terms of that symbolism".* Learning

and thinking are situated in this cultural setting. Culturalism has to do with hermeneutic meaning making whereas information processing is systematic. Culturalism asks about the *"enabling resources made available to people to cope"* … and is constantly *"concerned with constraints imposed on the process of education"* such as the organisation of schools and classrooms or teacher recruitment. Against this background Bruner (1996, p.67) describes the antinomies or contradictions that exist in education today. While it is the function of education to enable individuals to achieve their full potential its counterpart is that the function of education is to reproduce the culture that supports it to further economic, political and cultural ends. Bruner's arguments underlie the conundrum between the demands *for* ICTs and the demands *of* ICTs and set them within the cultural context of the school.

The demands for technology have seen schools worldwide investing in ICT infrastructure for almost two decades in response to the desire to equip students for today's global, collaborative and digital working environment. The demands of technology are that the affordances of ICTs will improve student, professional and organisational learning as well as assist in managing learning. However, such demands do not account for how each individual makes meaning or how a culture assimilates ICTs.

Sceptics such as Monke (1997, unpaged), Cuban (2001, p.132) and Oppenheimer (1997) highlighted the gulf between expectation and delivery of the value of ICTs in schools and brought the issues into the open. They criticised the wholesale introduction of ICTs into schools at great expense with little rational justification, and advocated instead evidence-based approaches to ICT implementation. Different ways of evaluating ICTs were explored by Means, Blando, Olson, Middleton, Morocco, Remz and Zorfass (1993); Roschelle, Pea, Hoadley, Gordin and Means (2000) and Windschitl (1998). Means *et al.* (1993, Ch.6b) cautioned that expectations of ICTs in transforming education could not be realised without a focus on the cultural aspects: curricular goals; compatibility with assessment; the need for teachers to collaborate; community involvement; and the need for ongoing pedagogical

as well as technical support. Roschelle *et al.* (2000, p.76) argued that, rather than focusing on effective ways of using technology resources, research should focus on understanding the mutual evolution of technological and pedagogical curricular innovations. Windschitl encapsulated this approach in his call for a new research focus:

> *'If the goal is to maximize the possibilities for student learning with technology, then a critical examination of the intersection of the affordances of information technology, pedagogy and learning is required"* (Windschitl 1998, p.28).

The question that arises from this perspective is how do schools assimilate ICTs into their culture and at the same time understand and implement the potential that they offer to both student and professional learning.

1.2.2 The national policy perspective

In South Africa since 1990 there have been simultaneous and ongoing national political and societal changes. Ensuing education policy changes culminated in the *Revised National Curriculum Statement* (DoE 2002) and resulted in a profoundly changed curriculum approach that has impacted every school and every teacher.

The most direct impact on South African teachers has been the series of curriculum changes under the new political dispensation since 1994. The draft *Curriculum 2001* became *Curriculum 2005* which was found to be too complex and resulted in the current *Revised National Curriculum Statement* (DoE 2002). Concurrent with curriculum development was the formulation of an ICT policy for education issued as *The Draft White Paper on e-Education* (DoE 2003). This ICT policy was influenced by South Africa's political and economic development, by curriculum change and by the rapid development of the Internet and digital technologies which all followed similar timelines since 1990. The *Draft White Paper* (2003, p.18) addresses four issues: to provide access to learning opportunities; to redress inequalities; to help improve the quality of learning and teaching; and to deliver lifelong learning.

The underlying belief was in the potential of ICTs to accommodate student differences in learning styles and remove barriers to learning by expanding opportunities and individualising learning experiences. According to the Draft Paper, in such a transformed environment there is a shift from "*teacher-centred, task-oriented, memory-based education (with technology at the periphery), to an inclusive and integrated practice where learners work collaboratively, develop shared practices, engage in meaningful contexts and develop creative thinking and problem-solving skills"* (Draft White Paper 2003, p.18). This paper has influenced the development or actions of various ICT initiatives in South African schools including, *inter alia*, SchoolNet, the NePAD initiative, Gauteng Online and the *Intel Teach to the Future* course as well as directly influencing individual schools.

Given the combination of radical curriculum change and approaches and the imperative to incorporate ICTs into schools the question arises of just how schools face this dual transformation and whether they are able to leverage mutual benefit from each.

1.2.3 The technology-transformation perspective

ICTs are commonly described as catalysts (Lemke & Coughlin 1998, p.15; Looi, Hung, Bopry & Koh 2004, p.92) which, if present, will lead to transformation of schools. In some cases they are even described as having the potential to revolutionise schools (Blasik, Williams, Johnson & Boegli 2003, p.44; Tearle 2003, p.579). Venezky & Davis (2002, p.10) counter the notion of ICTs as catalysts for transformation, arguing instead for ICTs as levers of transformation. They describe how a catalyst, in a chemical sense, speeds up a reaction whilst remaining unchanged itself, precipitating or causing a predicted change. ICTs, they argue, do not cause a predicted change. Their view is supported by Mehan, Hubbard and Stein (2005, p.353) who argue that the change brought about by introducing ICTs is not predictable, sometimes does not happen at all and may result in the opposite effect to what is intended as earlier research had shown. Instead, ICTs are

levers that can be applied to influence the *process* of change, but not the outcomes (Venezky & Davis 2002, p.10-14). Such leverage is one of many dynamic interactions in the complex system of a school and such unpredictability of outcomes is characteristic of complex systems (Davis & Sumara 2005, p.455). This notion of unpredictability is central to this study: if ICTs can influence process but not outcomes, it needs to be asked what those influences *are* and *how* they affect the process of change, and what the role of ICTs is relative to a specific context?

The problem of integration of ICTs does not necessarily arise from either the ICTs themselves or their implementation. The problem arises from the complexity of the learning environment in which they are intended to be implemented and in which they are expected to wield some degree of transformation in tandem with other transformation that is occurring. Transformation by its very nature implies sustainability: innovations that are not sustained, that do not become embedded, cannot transform either themselves or their environment. The challenge for a school is to maintain momentum in its transformation process on all fronts. For transformations to become embedded they need to be embraced and absorbed into classroom practice by teachers. However, there is no direct one-to-one correspondence between a policy decision to transform and the response of the teacher through altered practice. Rather, there are complex, contextual factors that affect a teacher's ability to change their practice. Each teacher is affected by and interacts with such contextual factors in a different way. What is required is an understanding of how teachers interact with these contextual factors and what role ICTs play in these interactions.

1.2.4 The school perspective

The school that is the case of this study is an independent boys' secondary school with a strong academic tradition situated in a South African urban area. The school operates in a complex partnership with a group of other schools with which it shares certain facilities, including its ICT network.

Major structural and policy changes have occurred in the school in response to the national political and curriculum changes as well as from following its own evolutionary path. The formal introduction of the new national OBE curriculum and its concomitant assessment requirements in Grade 8 (2004) and in Grade 10 (2006) was preceded by two years of experimentation by teachers in outcomes based learning strategies. This development saw the first collaborative attempts between departments, particularly between Science and Biology and between History and Geography which formed the basis of the two new Grade 8 and 9 learning areas of Natural Science and Human and Social Sciences respectively.

The introduction of the OBE curriculum was supported in 2001 by a fundamental policy change from exclusive practice, in which students were accepted into the school on academic merit alone, to inclusive practice in which each student was selected on his potential, including students with learning difficulties. From the start, the focus of inclusion was not only the small number of students with special educational needs, but the range of individual needs manifested by all students, requiring a differentiated approach to pedagogical practices. This policy change has been implemented in practice over the past eight years and has significantly influenced teaching practices, although the process is still ongoing. The change to inclusion was headed by a learning support specialist, specifically appointed to direct the process and with whom I collaborated significantly over the four years of her tenure.

Apart from inclusion (2000) and the change to OBE (2004) the school has faced various other inter-related transformation challenges: gender issues in amalgamating a monastic school into a partnership (1998); an extensive leadership and community service programme (2000) based on the notion of servant leadership[1]; a vertical house-based tutorial system in contrast to a horizontal grade-based system (1999); employment equity requirements and

[1] The term "Servant Leadership" was coined by Robert K. Greenleaf in *The Servant as Leader*, an essay first published in 1970. http://www.greenleaf.org/whatissl/

a strategic move towards greater diversity (2000). Apart from these ongoing transformations the post-1994 democratic changes in South Africa (1994) precipitated social adjustment impacting school culture, curricula and individual rights and the development of a formal transformation policy. Whilst some of these innovations involve ICTs, they are not dependent on ICTs, nor are they a result of the presence of ICTs. However, like ICTs, they are part of the many changes that have occurred in the last decade that have placed considerable demands on students, teachers and school management alike, impacting most aspects of school life and stirring debate that has tested the fundamentals of educational practice.

Adaptation to new curricula, the integration of ICTs, the adoption of inclusive principles into practice, the impact of gender equality and formal embracement of diversity are manifestations of the difference the school has tried to make in the face of multi-faceted change. Each teacher has had to try to understand and implement new ways of facilitating learning, to adapt to multiple simultaneous changes and to learn to collaborate with others. Each student has had to accept a degree of experimentation, to adapt to new ways of learning and contribute to the change process alongside teachers through reflection and interaction. The school as an organisation has had to adapt without ever losing sight of the fact that it must serve current students to the best of its ability and, as an independent school, the parents who pay for the education it provides. The context to which I refer is therefore the learning environment in which students, teachers and the school as an organisation are all learning as part of an ongoing and multi-faceted transformation process.

The school's adoption of ICTs began in the early 1980s and coincided with the building of a purpose-built new resource centre to replace the old single-room library, although the introduction of ICTs to the school and the development of the resource centre were not necessarily planned together. At first, a few Commodores were set up in a small processing room off the main library. At a later stage (c.1985) the lower floor of the resource centre was taken over by

a collection of stand-alone PCs (personal computers) which could accommodate a single class of approximately 25 students. The facility was then known as 'the computer room' and later as 'the lab'. When I arrived at the school in mid-1989, this facility was run on a part-time basis by mathematics teachers seconded to the role and was largely under-utilised. In 1991 I introduced a small Linux-based network of four computers to run the OPAC (Online Public Access Catalogue) and issue system. In 1993 the first stand-alone multi-media machine arrived in the library with the first CD-ROMs. Once a network manager was appointed in 1994 to introduce, *inter alia*, laptop technology, I observed the development of an extensive Windows-based network, early Internet and email access followed by fast bandwidth access for every student and teacher and a proliferation of ICTs in additional computer labs and, more recently, in classrooms. Throughout this development I became involved in supporting teachers and students from a curriculum point of view, but had no responsibility for technical support.

Whereas under-utilisation of the ICT lab facilities characterised the school's implementation of ICTs in the 1990s, much as it had done elsewhere (e.g. Kramer, Walker & Brill 2007, p.530; Tinio 2003, p.13; UNESCO 2004, p.75), this problem was gradually displaced by more complex problems. These now include a seemingly insatiable demand for ICT facilities and subject specific solutions; conflict with the mobile technology generation of students; rapid multi-media and social-networking developments of ICTs requiring complex and expensive upgrades, plagiarism controls and network security as well as diffusion of ICT integration across a larger student population, a new curriculum and more diverse teaching staff. The integration of ICTs in this school can therefore not be considered as an isolated area of study. It is necessary, in the detailed study of its particular context to determine the relative position of ICT integration against the complexity of the organisation. It is also necessary to understand the demands placed on teachers grappling with implementing the ongoing changes outlined above within the complexity of the context.

This school has not been selected as a case study because it is an example of ICT best-practice, but rather for its typicality in relation to similarly resourced schools (without benefaction) globally. Despite the considerable ICT infrastructure at the school, there has been no associated revolution[2] (Blasik *et al.* 2003, p.44; DfEE 1997, p.4) but rather a somewhat unsteady continuum of change in classroom practice with erratic rather than wholesale innovation. Primarily, the school provides a research opportunity because of the richness of the interactions resulting from the complexity of its transformation process and the depth of the data that can be drawn on. From a purely practical point of view, my familiarity with the school over a long period of time as well as the demands that the school makes on me, limiting time for contact with less accessible organisations, are also significant factors in the case selection.

1.2.5 The researcher's perspective

It is incumbent on a qualitative researcher to systematically reflect on how self affects the ongoing flow of everyday life and is affected by it (Rossman & Rallis 2003, p.10). It is therefore important to this study that my perspective as a participant-researcher is understood.

In my role as teacher-librarian at the school, I am an intermediary between students, teachers and the organisation on the one hand and information, resource materials and technology on the other hand. I have had the opportunity over my twenty-year tenure to work closely with school management, ICT administrators, teachers and students alike. I am responsible for anticipating, providing and supporting the resource needs of management, teachers, students and the wider curriculum of the school. In the library-as-classroom I am an observer, co-teacher or crutch in interactions between teachers and students on issues of technical support, differentiated learning design, and challenges to thinking as teachers and students alike

[2] *Revolution = any complete change of method or conditions etc; revolutionise = to alter a thing completely (Oxford Study Dictionary)*

grapple with new curricula, systems, concepts, technologies, challenges and approaches. I collaborate and co-teach with teachers in the design and integration of thinking and information skills. As an ICT innovator[3] I have been involved in the design of scaffolds, assessment formats, reporting structures and most recently, have introduced and begun implementing the *Moodle* online learning management system. I am therefore involved on a daily basis with the challenge of what works and what does not work. It is inevitable that through these interactions I have heard, contributed to and reflected upon the stories - the triumphs and the frustrations - of the individuals I have encountered.

This study developed out of these experiences at the school as well as informal reading and research on the nature of the implementation and integration of ICTs in the whole school context. As my reading progressed I realised, as other researchers have, that ICT integration is inextricably bound to curricular and organisational transformation and that an understanding of what is effective in the integration of ICTs would also require understanding the wider transformation context with which ICTs are intertwined. Reading deeper into these issues brought sharper focus to concepts such as student learning and understanding, information literacy, teacher beliefs and professional learning and what these meant in a transforming environment.

My formal research into ICT integration began in 2003 as an exploration of the relationship between the effective integration of ICTs and transformation in the secondary school. A link between effectiveness and evidence-based practice emerged from the search for definitions and links between ICT effectiveness and reform or transformation[4] became evident from the literature (Means *et al.*1993, Ch.Ia; Peck, Cuban & Kirkpatrick 2002, p.51; Roschelle *et al.* 2000, p.77; Windschitl 1998, p.28). The literature did not agree on the criteria for effective integration of ICTs and suggested that research still needed to

[3] Innovator/inventor as a level of ICT competency as identified by Dwyer, Ringstaff & Sandholtz (1991, p.49)
[4] The interpretations of 'reform' and 'transformation' are clarified in Chapter 2, Section 5.1, p.77.

establish such criteria (Finger, Jamieson-Proctor & Watson 2003, p.1; Pang, Kim and Kim c.2000, p.1). Therefore, as far as could be established, effective integration of ICTs into the curriculum relied on:

- the understanding of the learning environment and how effective student learning occurs
- the level and intensity for which teachers are prepared through professional development practices and support
- the links between policy and practice
- the configuration of the ICT infrastructure, appropriate classroom support and the role of management.

The 2003 study therefore explored a range of criteria that had not necessarily been identified as a unified range for the specific purpose and attempted to understand what relationships might exist between them. A preliminary analysis of the responses from teachers and management revealed *inter alia*:

- complex relationships between different contextual factors
- relationships between teacher perceptions of their own competency levels and their understanding of their students' competencies in using ICTs
- the effects of school structure and structures on teachers' ability to integrate ICTs and sustain innovative strategies.

Through the process of reading more deeply into the literature around ICT integration and teacher innovation the wider I discovered the field to be. It was important for me to peel away further layers to get to the core and relevance of the research problem. I felt also that it was important to remain open-minded in view of what might have been published in the interim. I deliberately reviewed the recent literature pertaining to ICT integration and transformation and allowed my thinking to take its course without revisiting, after a considerable time-lapse, the existing study. The existing study was then set aside.

The literature path emerged as a dynamic network with little linearity in which the concepts of ICT integration, curriculum development, transformation of the learning environment, teacher practices and context were interwoven with complexity theory and innovation theory, eventually drawing together the concepts of complexity, ICT integration, innovation and context. Of particular significance to me in this literature network has been the work of Windschitl on the intersection of the affordances of ICTs, pedagogy and learning (1998, p.12; Clarke, Bossange, Erb, Gibson, Nelligan, Spencer, and Sullivan (2000) on *The Dynamics of Change in High Schools* which led me into complexity; Sherry *et al.'s* work on innovation (Billig, Sherry & Havelock 2005; Sherry, Lawyer-Brook & Black 1997; Sherry & Gibson 2005); Hargreaves and Fullan on educational change (Fullan 2001; Giles & Hargreaves 2006; Hargreaves & Goodson 2006) and, more recently, Beetham and Sharpe (2007, p.7-8) on learning design in *Rethinking Pedagogy for a Digital Age*.

Questions raised by the literature interacted with my observations of day to day experiences: I was reading the literature through the lens of the practitioner and applying increasing amounts of theory to my thinking about practice. My challenge was to draw theory and practice together and this study is the response to that challenge.

1.2.6 Towards a research focus

The focus of this study evolved from the questions that arose from the consideration of the perspectives described above:

- **Educational-cultural perspective:** *The question that arises from this perspective is how do schools assimilate ICTs into their culture and at the same time understand and implement the potential that they offer to both student and professional learning.*
- **National policy perspective:** *Given the combination of radical curriculum change and approaches and the imperative to incorporate ICTs into schools the question arises of just how schools face this dual*

transformation and whether they are able to leverage mutual benefit from each.

- **Technology-transformation perspective:** *Rather, there are complex, contextual factors that affect a teacher's ability to change their practice. … What is required is an understanding of how teachers interact with these contextual factors and what role ICTs play in these interactions.*
- **School perspective:** *The integration of ICTs in this school can therefore not be considered as an isolated area of study. It is necessary, in the detailed study of its particular context to determine the relative position of ICT integration against the complexity of the organisation. It is also necessary to understand the demands placed on teachers grappling with implementing the continuum of changes outlined above within the complexity of the context.*
- **Researcher's perspective:** *How do I find a focus that draws theory and experience together?*

Distilling these multiple perspectives into a focus that encapsulates the essence of the problem has been an iterative and emergent process much like the complexity that it aspires to describe. How was I to adapt and maintain coherence of the problem and the process in the face of ever changing realisations (Davis & Sumara 2005, p.455)? Defining the problem and the questions that arise from it has been much like *'nailing jelly to a tree*[5]*.* The book of this title, coincidentally to do with computers, crossed my path within the first few days of my tenure at the school, but the phrase has remained cached in my memory ever since and captures aptly the challenges of zooming in on the essential. What was missing from the broader view was the teacher's perspective and hence my decision to focus on the teachers stories of how they innovate in the face of change and the relation of ICTs to their context. This focus is described in the next sections.

[5] Willis, J. & W. Danley (1981) Nailing jelly to a tree. Beaverton OR: Dilithium Press.

1.3 Statement of purpose

The purpose of this research is to explore and describe how teachers in a specific context innovate in the face of complex simultaneous changes and in particular how they innovate with ICTs in relation to that context.

1.4 Research problem and objectives

The research focus derived from the questions that emanate from the above perspectives is to establish how teachers are able (or unable) to innovate in practice and how they are able (or unable) to sustain innovative use of ICTs relative to demands for them to innovate across the multiple facets of complex changes within secondary schools. The research problem is therefore to understand the context of ICTs in teacher innovation in secondary schools. This research therefore explores the contextual interactions that affect innovation and ICT innovations in particular.

The problem is addressed by exploring how teachers innovate, including how they innovate with ICTs, in terms of the interactions that enable or inhibit the sustainability of their personal innovative practices and determining to what extent these interactions are context specific. The interactions are examined in terms of the three critical processes – convergence, mutuality and extensiveness – as defined by Sherry and Gibson (2005, p.6) and which derive from innovation theory.

However, this study is not limited to the positive convergence of resources that enable and sustain teacher personal innovations in the context, but also describes how negative factors converge to constrain such innovations. I have termed this convergence of negative factors 'disconvergence' and use the term 'convergence' in its positive sense. The interplay between convergent and disconvergent factors defines the context.

Case studies are studies of singularities (LeCompte & Preissle 1993, p.332). The objective of this research is therefore firstly to understand the singular,

unique case which is the focus of this study. Understanding the dynamics of sustaining innovations in the complex environment of a secondary school and particularly the role played by ICTs will benefit the school that is the focus of this contextual study and allow it to more effectively channel the uncertainty (Lissack 1999, p.120-121) that arises from complex interactions.

This study does not claim that the phenomena of this particular context are generalisable to other schools whether similar to this one or not; rather it will describe the effects of the context on teacher practice. All schools, and not only those in South Africa, face multiple complex global changes and there is a recognised need for research into context-specific factors (Breuleux 2001, p.7; Mumtaz 2000, p.335; Sherry 2002, p.211; Sikes 1999, p.x; Tearle 2004, p.347). The study may therefore be of interest to a wider audience in addressing these complex factors. In use, this study may be compared to other similar studies on contexts or the sustainability of ICTs in schools and thereby contribute to a wider purpose. The study may also be relevant locally in view of the expectations of delivery on outcomes of the rollout of ICTs to schools in parts of South Africa (Gauteng online[6]) and Africa (NePAD initiative[7]).

1.5 Research question

The research question derived from the above is:

> *How do teachers innovate in the face of complex, simultaneous and ongoing changes and, in particular, how do they innovate with ICTs amidst such changes?*

[6] Gauteng online is currently equipping each public school in the province with a 25-workstation computer laboratory to be used for curriculum delivery in order to attain the main outcome of the Government's White Paper: *"Every South African learner in the GET and FET bands will be ICT capable (that is, use ICTs confidently and creatively to help develop the skills and knowledge they need to achieve personal goals and to be full participants in the global community) by 2013."* http://www.gautengonline.com/pilot_project.htm

[7] 600 000 schools in Africa are to be connected via a satellite network *'in a bid to help schools produce maths and science whizz-kids'.* The e-School initiative of the New Partnership for Africa's Development (NePAD), aims 'to equip all African primary and secondary schools with information technology apparatus such as computers, and to connect them to the internet'. http://www.schoolnetafrica.net

This question was broken down into a number of sub-questions which evolved over time during the course of the research. The purpose of the sub-questions was to reveal the interplay of interactions. Given the dynamic and unpredictable nature of interactions within complex contexts, as these interactions emerged during the analysis stage, the relationships between the different terms used to describe the context influenced the questions in an iterative way. The sub-questions that finally emerged were:

- *How do organisational interactions influence teachers' ability to innovate and to sustain innovation in practice?*
- *How do collegial and professional interactions influence teachers' ability to innovate and to sustain innovation in practice?*
- *How do ICTs influence teachers' ability to innovate and to sustain innovation in practice?*
- *How do leadership interactions influence teachers' ability to innovate and to sustain innovation in practice?*

The study argues that by understanding the whole-school context, the relative role of ICTs in the secondary school can be better understood.

1.6 Scope and context of the study

The understanding of context from a teacher's point of view involves the interaction of policy and practice. Policy dictates the direction and detail of change, but does not account for how a teacher responds to that change. The teacher's response is at a personal level: how they[8] grapple with personal innovation and creative ideas to interpret and implement the requirements of policy, how they use available resources and how they collaborate with others to change and improve their practice. In order to understand these dynamics, this study draws on innovation theory (Ch. 2, Section 2.4, p.56) and complexity theory (Ch. 2, Section 2.6, p.88).

[8] For ease of reading this study will use 'they' and 'theirs' rather than 's/he' and 'his/hers' to imply gender equality when both are referred to.

This research was conducted between 2006 and 2009 in the independent boys' secondary school in South Africa in which the researcher is employed. The school first implemented computer technology in the early 1980s and currently has an extensive network serving computer laboratories, the resource centre, classrooms and management and administration services. Teachers are expected to be computer literate[9] and familiar with basic Microsoft applications, email and the school administration system. The school has a highly prescriptive policy on the purchase, management and control of access to both ICTs and to ICT-based information sources. On the other hand there is no specific policy regarding use of ICTs or the way ICTs are to be integrated into classroom practice, nor is there a policy on the further training or development of teachers in such use of ICT. At the same time, simultaneous changes are happening in the school requiring significant changes in teacher practices. This research therefore describes the relationship between teacher innovation, context and ICTs at a particular juncture in which multiple simultaneous educational changes were occurring through documenting the experiences of teachers. The next section will describe the methodology used to conduct the study.

1.7 Research methodology, design and process

This section will introduce the research methodology, design and the process that are described in detail in Chapter 3.

1.7.1 Research design

The overall research design is illustrated in Figure 3.2 (Chapter 3, Section 3.4, p.113) and outlined below.

1.7.2 Research approach

To describe the experiences of teachers in context I chose to use a naturalistic, qualitative approach based within the subjective-interpretive

[9] A requirement to this effect is included in the advertisements for all teaching posts

paradigm and conducted as a case study that seeks out specific phenomena. Qualitative research is appropriate to the description and interpretation of human experience (Cohen, Manion & Morrison *et al.* 2000, p.22) in which the voice of the participant rather than that of the researcher should come to the fore. I chose to use a case study design as, in the words of Nisbet and Watt (1984, p.78) and in keeping with complexity theory, a case study *"is more than the sum of its parts"*. Sturman describes a case study as *"the generic term for the investigation of individual, group or phenomena"* and explains:

> *"The distinguishing feature of a case study is the belief that human systems develop a characteristic wholeness or integrity and are not simply a loose collection of traits. As a consequence of this belief, case study researchers hold that to understand a case, to explain why things happen as they do, and to generalise or predict from a single example requires an in-depth investigation of the interdependencies of parts and of the patterns that emerge"* (Sturman 1994, p.61).

Qualitative case studies are appropriate to naturalistic, context-specific settings (Patton 2002, p.39) in which the researcher is involved and immersed (Golafshani 2003, p.600) and through interpretation retells the stories of the participants. The approach to this research is therefore from a post-modern point of view foregrounding socially constructed knowledge through a series of interviews and based on experience and insight of a personal nature. The study views the teachers, the organisation and the researcher as learners involved in the construction of knowledge.

1.7.3 Unit of analysis

The unit of analysis is a group of ten teachers and three members of the school leadership from Wilding[10] College who were interviewed in groups or individually. The group was determined by convenience sampling (Cohen *et*

[10] Wilding College: pseudonym for the school

al. 2000, p.103) due to the busyness of the teachers and the practicalities of finding common free time.

1.7.4 Data collection, transcription and analysis

Consistent with qualitative case studies this research employs multiple methods such as interviewing, observation and gathering documentary evidence in a systematic way (Rossman & Rallis 2003, p.179). Standardised open-ended interviews which allowed the voices of the teachers to come through were the primary format. These were supported by informal observation as well as documents that were used to verify data where or when necessary.

Teachers were interviewed singly or in pairs and the questions adjusted to accommodate their specific subject area. Interview data was recorded on video tape in order to obtain an accurate record of the teachers' stories and in order to note more closely the effects of body language, expression or gesture. I transcribed the interviews personally into a tabular format in a word document as part of my process of understanding what had been said.

Consistent with naturalistic research the analysis of the transcribed data employed inductive reasoning (Cohen *et al.* 2000, p.4). In the analysis phase I employed descriptive coding with each segment of data analysed and coded in detail. Codes were recorded in a table and assigned to a category within a broad area or recurring theme and refined throughout the process of analysis. These categories and broad themes were used to describe the findings. To retain the cohesiveness of each teacher's story in writing up the findings, I organised them by interview and then by theme using the selective approach (van Manen 1990, p.79) for formulating analytic statements. These statements were illustrated by graphics in order to compare the different dynamics relevant to each subject area that each teacher represented. Similarities and comparisons were drawn using the themes derived from the codes.

1.7.5 Trustworthiness

Issues of reliability and validity are viewed in terms of the social and linguistic construction of reality rather than a positivist view of knowledge as a map of an objective reality (Kvale 2002, p.300). These issues are therefore dealt with in terms of the post-modern view of trustworthiness replacing the traditional view of validity and reliability. Trustworthiness incorporates integrity, honesty, authenticity, dependability, accuracy, balance and appropriateness. Such trustworthiness is assessed by how well the study conforms to standards for acceptable and competent practice and whether it meets standards for ethical conduct with sensitivity.

1.8 Ethical considerations

Ethical considerations are closely tied to matters of trustworthiness. This study has been conducted in terms of the school research policy, the university's ethic's policy and individual rights to privacy, reflected in the as ethical clearance certificate (Appendix 1.2). Teachers were invited to participate, assured of anonymity as far as possible and signed agreements in terms of the principles of informed consent. Respondent checks were used for the transcriptions and preliminary findings.

1.9 Limitations

Common limitations of case studies are that results may not be generalisable, it is difficult to cross check for data selectivity or bias and that, as it involves the researcher as a participant in the process, the interpretations will always be subjective (Nisbet & Watt 1984, p.76).

This study does not centralise ICTs but focuses on the context in which they are integrated. It is not a longitudinal study, but looks instead at a transverse period in time although my interpretation is influenced by the period of time I have spent in the context. This study does not claim generalisation to the full context, rather it shows how the combination of factors affects each individual in a unique way. The school is not a typical South African school, but many of

the issues that it grapples with are typical. It is typical of schools with an accessible ICT infrastructure necessary to this study.

1.10 Literature control

A comprehensive literature study was undertaken prior to and as part of this study. Literature on the theoretical concepts of complexity and innovation as well as that on ICT integration was pursued in depth in order to identify the focus of the research topic. This study responds to calls for further research into the context of ICT use such as that of Windschitl (1998) and others identified in 1.4 above. Further literature was sought out where necessary to elucidate issues around factors raised by the teachers.

1.11 Definition of key concepts

The following definitions of key concepts are used in this study:

Table 1.1: Definition of Key Concepts

Concept	Explanation	Further reference
Complexity theory	Understanding of the interaction of parts rather than of the parts themselves.	Chapter 2, Section 2.6, p.88
Convergence	In its literal sense, convergence means to come to the same point. As a critical process in innovation it implies the same. Convergent factors are those that align or come to a point with a positive effect.	Chapter 2, Section 2.5.2 p.84
Disconvergence	Disconvergent factors are those that come to a point or align with a negative effect on innovation.	
Extensiveness	Extensiveness refers to the extent to which an innovation reaches across all levels of a school system	Chapter 2, Section 2.5.2 p.84
Generative use of ICTs (c.f. representational use of ICTs)	Using ICTs to construct new ideas e.g. note-taking to restructure or synthesise rather than to record.	Hokanson & Hooper (2000, p.544, Table 1)

Concept	Explanation	Further reference
ICTs	Information and Communication Technology: "*ICT is the combination of networks, hardware and software as well as the means of communication, collaboration and engagement that enable the processing, management and exchange of data, information and knowledge"* (DoE 2003, p.16).	Chapter 2, Section 2.3.1, p.34
Innovation • **Product innovation** • **Process innovation**	Innovation is the introduction of something new that is intended to be useful. To implement a product innovation requires a paradigm shift while process innovation involves modifications of existing processes (Whitehurst 2009)	Chapter 2, Section 2.4, p.56
(the) Leadership	The principal and deputies at the school	
Learners and students:	'Learner' is a term that has arrived with the new curriculum. However as the teachers in the interviews still referred mostly to students than learners, the term 'students' is preferred in this study. Where the term learner occurs in a quote, it is retained. The term student also reads more comfortably as e.g. in 'student learning' as opposed to 'learner learning'.	
Learning environment	The classroom and wider school environment and what it offers.	
Mutuality	Mutuality refers to the need for a common benefit of the innovation to either side of a boundary.	Chapter 2, Section 2.5.2, p.84
Participant researcher	A researcher that is part of the context that is the focus of the research; an insider.	
Professional development	Development of the individual, not necessarily core task-related, more to do with values and attitudes.	

Concept	Explanation	Further reference
Professional learning	Teacher learning that occurs on the job or that is specifically designed to enable the core processes of the job.	Chapter 2, Section 2.4.4, p.69
Representational use of ICTs (c.f. Generative use of ICTs)	Automation of standard procedures e.g. email, calculation, looking at images c.f. creating images or websites, problem-solving through collecting and analysing data.	Chapter 2, Section 2.3.1, p.35. See: Hokanson & Hooper (2000, p.544, Table 1)
Secondary school	Grades 8-12; also known as high school; the phase between primary and tertiary education.	
Students	see learners	
Teacher librarian	The teaching/academic role of the librarian in the school as opposed to the administrative role.	see Appendix 1.1 for description of the role.
Teacher	The person with responsibility for student learning. Used in this study to imply all aspects of the role, including facilitation.	
Transformation	Desired condition as a result of change processes in policy and practice.	Chapter 2, Section 2.5, p.78

1.12 Outline of the study

This study consists of the following Chapters:

Chapter 1: Introduction and orientation to the study

Chapter 1 has provided a general introduction to the study. The background has been described from differing perspectives and illustrates the derivation of the research question. An orientation is provided to the methodology and design of the study and includes definitions of key concepts.

Chapter 2: Review of the literature and conceptual framework

This chapter provides an overview of the literature. It shows how the conceptual framework derives from the broader literature on ICTs and the theoretical literature on complexity and innovation.

Chapter 3: Research methodology, design and process

In this chapter the research methodology, design and process are explained and described in detail. Included are descriptions of how issues of trustworthiness (validity and reliability), ethical issues and the limitations of the study were dealt with.

Chapter 4: Findings: Organisational interactions and their effect on teachers' practice

The chapter looks specifically at interactions between mandated changes and teachers' ability to innovate in practice in the face of mandated changes, seeking evidence of convergence or disconvergence. The chapter introduces the school and the main themes identified in the analysis of data, and then describe the effect of mandated changes on teachers' ability to innovate.

Chapter 5: Findings: Collegial and professional interactions and their effect on teachers' practice

This chapter describes the collegial and professional interactions at Wilding College and their effect on teachers' ability to innovate, seeking evidence of mutuality. The chapter provides a brief overview of professional learning communities; describes the formal networking structures to which the school is linked and describes the collegial and professional relationships as a theme that emerged from the interview data.

Chapter 6: Findings: ICT interactions and their effect on teachers' ability to innovate

Against the background provided in the previous two chapters, this chapter describes how the presence of ICTs affects teachers' ability to innovate.

Chapter 7: Findings: School leadership and its effect on teachers' ability to innovate

This chapter describes the perspective of the school leadership on interactions that enable or inhibit innovation and the integration of ICTs.

Convergent and disconvergent interactions in the relationship between teachers and the school leadership are described.

Chapter 8: Discussion of the findings; conclusions and recommendations

This chapter draws together and compares findings of Chapters 4-7 with the views expressed in the literature. Conclusions are drawn and recommendations made.

1.13 Summary of Chapter 1

This chapter has provided a general introduction and outline to the study. The background has been described from differing perspectives and shows how the research question is derived from these. The justification for the naturalistic qualitative approach using a case study methodology within a subjective-interpretive paradigm is outlined. The design and process of the study as well as issues of trustworthiness, ethical issues and limitations of the study are outlined. The following chapter will review the literature relevant to this study and show the derivation of the conceptual framework.

Contents

Chapter 2: Review of the literature and conceptual framework

2.1 Introduction 27
2.2 Searching the literature 28
2.2.1 Recently completed literature in the field 31
2.3 The integration of ICTs into the curriculum 33
2.3.1 ICT terminology 33
2.3.2 The 20th Century: Functional practice 36
2.3.3 The 21st Century: Towards integrative practice 40
2.3.4 21st Century: Integrative practice 43
2.3.5 Integration of ICTs in context 49
2.3.6 Summary of section 2.3 55
2.4 Innovation theory 56
2.4.1 Innovation, change and reform 58
2.4.2 The diffusion of innovations 60
2.4.3 Innovation and schools 64
2.4.4 Innovation and teachers 68
2.4.5 Innovation and ICT integration 70
2.4.6 Sustainability of innovations 74
2.5 Change, reform and transformation 75
2.5.1 Student competencies and transformation 80
2.5.2 Teachers and transformation 81
2.5.3 ICTs and transformation 86
2.6 Complexity theory 88
2.6.1 Complexity theory and organisational behaviour 88
2.6.2 Complexity theory, knowledge and learning 91
2.6.3 Complexity and schools 93
2.6.4 Complexity and ICTs in schools 94
2.7 Summary of the literature review 95
2.8 Towards a conceptual framework 96
2.8.1 Applying the conceptual framework 98
2.9 Summary of Chapter 2 99

Chapter 2

Review of the literature and conceptual framework

2.1 Introduction

This chapter will review and draw together the literature relating to the integration of ICTs in secondary schools in relation to innovation in and transformation of whole school contexts. The review will show the complexity of contextual interactions that enable or inhibit teacher innovations, including innovations with ICTs, as identified in the literature. The review will also define and describe the concepts associated with ICT integration and innovation and show their inter-relationships as illustrated in Figure 2.1. The chapter will conclude by showing how the development of the conceptual framework derives from the literature and guides the study.

The literature search evolved from an initial exploration of the relationship between the concepts of 'integration of ICTs into the curriculum' and 'transformation of the learning environment' in secondary schools. Initial reading revealed the link between the two concepts and the fact that one could not be described without reference to the other, recognising their interdependence. Further and deeper examination of the literature indicated that the relationship between these two concepts is further complicated by other factors within the immediate or classroom environment, the school environment, and the national, educational and global environments. Recent research on either or both of the two concepts refers to complex contexts, complexity or the application of complexity theory in understanding the current secondary school environment in which ICTs are being or attempting to be integrated. The focus of the literature search therefore shifted from only that of the relationship between the two concepts within secondary schools to that of the relationship specifically within secondary school environments as manifestations of complexity. Secondly, the path of research on ICTs leads

into the study of innovation and innovation theory which itself is closely tied to complexity theory.

This review will begin with the literature on ICT integration and show the development of the conceptual pathway from ICT integration to innovation theory and then to complexity theory.

2.2 Searching the literature

The initial general reading for this study was conducted largely through web searches using Google scholar and its citation feature to identify journal articles, conference presentations of research and research reports that covered one or more aspects of ICT integration and transformation. An in-depth approach then followed to locate more recent research articles published between 2003 and 2006 using the Academic Search Premier (ASP) and ERIC databases. Using Boolean operators, the following combinations of search terms and their semantic alternatives were employed:

Table 2.1: Literature search terms

ICTs (information and communication technology/ies)/computers/technology	and	reform/ transformation
ICTs (information and communication technology/ies)/computers/technology	and	secondary/ high schools
ICTs (information and communication technology/ies)/computers/technology	and	integration/implementation
ICTs (information and communication technology/ies)/computers/technology	and	innovation/sustainability of innovation
innovation/sustainability of innovation	and	secondary/high schools
secondary/high schools	and	reform/ transformation
innovation/sustainability of innovation	and	complexity theory

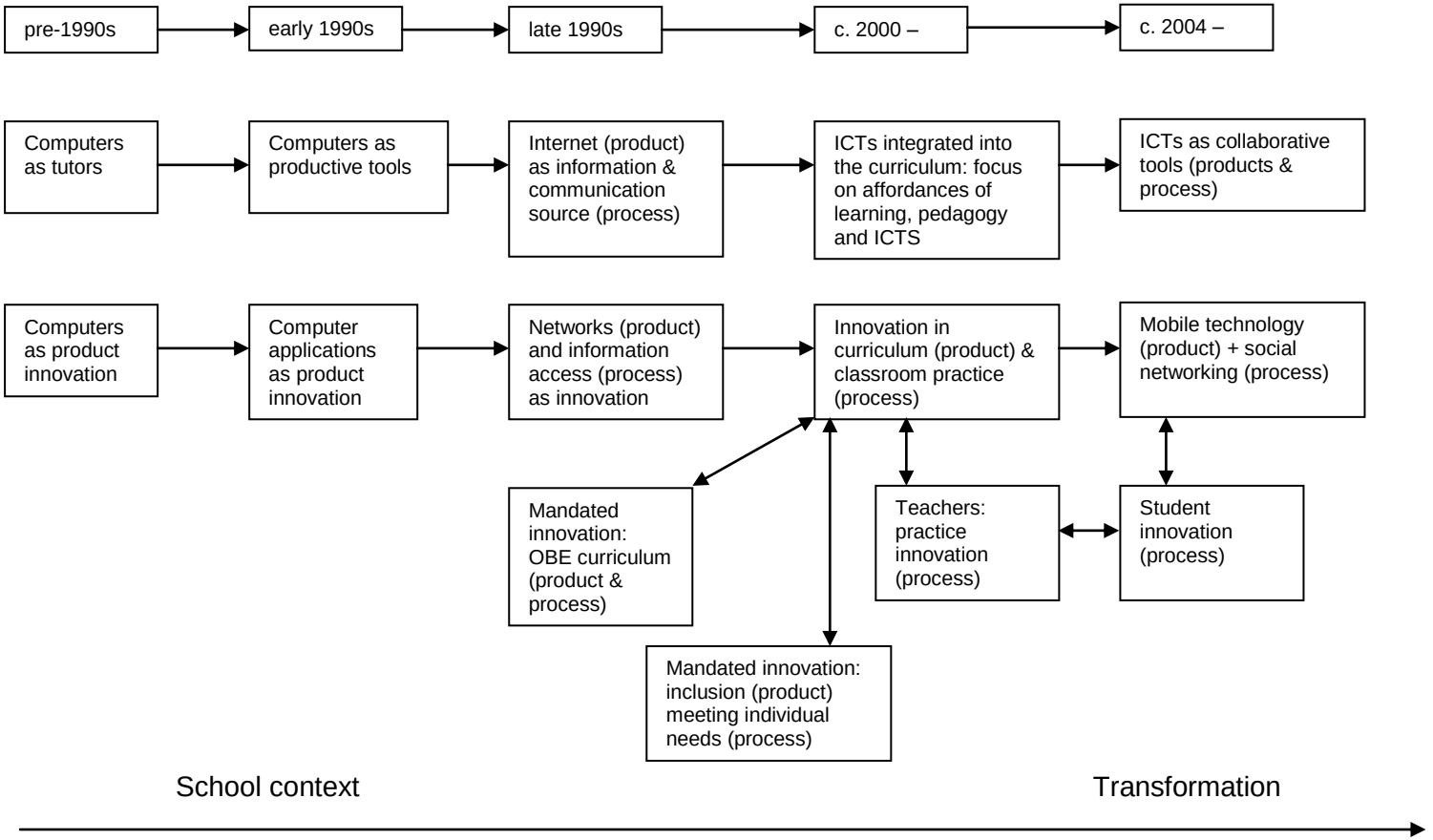


Figure 2.1: Relationship between ICTs and innovation

The search was also broadened by combining 'schools' and related key terms (see Appendix 2.1) and narrowed to specific topics using combinations of concept or aspect keywords. The searches on these terms and their combinations resulted in a collection of abstracts which were scanned for appropriateness and rejected or downloaded electronically. More recent and therefore embargoed issues of journals that could not be accessed electronically were accessed in printed format from the University Academic Information Service. The considerable collection of books available in the university library was also consulted, particularly for the methodology.

Citations that led deeper into the post-2000 literature were followed where appropriate. Such citations led not only to articles but also to an ever-expanding range of journals that cover the broad topic of ICTs in education. Apart from consulting the cited articles directly, certain cited journals were accessed by title and followed backwards from 2006 to 2000 to identify relevant articles. This returned a further large number of articles which had not been netted by the original search. This discrepancy is attributed to the fact that any search is dependent on the human factor as well as nuances and inconsistencies in allocating keywords by the indexer. By following the broad path from the citations, the extent of the field was more evident than by narrowing the search from citations only. Owing to the number and variety of journals that cover the field of technology and ICTs in education there may be omissions. However, this divergent field provides an extensive and lively range of research while at the same time hampering the search for convergent findings (Lagrange, Artigue, Laborde & Trouche 2001, p.3).

In each article research issues were identified and tabulated in a format that could be manipulated to create links between related issues in different articles. This review therefore synthesises recent literature with reference made to earlier work (articles and books) only where such works provide the origin, or enhance the definition, clarity or context of a concept.

Ex post facto reading to keep abreast of the literature has been maintained throughout the course of this study, not on a systematic basis but as part of my role as an intermediary between the school as an organisation and information sources. Where relevant articles were sourced by this means they have been interwoven into the narrative of this chapter, some as recently as June 2009. As a study of the broader context the range of literature is extremely broad. However, in some instances, literature relating to specific factors that have come to light in the findings (e.g. use of mobile technology, leadership approaches) has been targeted to gain a clearer understanding of their implications.

2.2.1 Recently completed research in the field

A search of the Scirus ETD database for 2000-2006 revealed over 11,000 theses and dissertations mentioning instructional technology in their abstracts, indicating the immense interest in the field of ICTs. This number was reduced by limiting the search to those abstracts containing the words 'secondary schools' and 'contexts', but the number reduced only to some 8,000 studies. Many of these dealt with specific aspects of instructional technology such as teachers' conceptions of learning, contexts such as rural schools, subject areas such as mathematics or roles such as that of technology teachers. Reducing the search to those which included the word 'context' in the title indicated three studies, none of which were relevant to the effect of context on teachers in school situations. The single study that appeared to be highly relevant was that of Chen (2006) entitled *"Investigating the Influences of Teacher Belief and Contextual Factors on the Technology Integration of Taiwanese High School Teachers"*. Chen used a qualitative approach to investigate the beliefs of 10 Taiwanese teachers.

Chen's approach (p.157) was based on Zhao, Pugh, Sheldon and Byer's contention (2002, p.484) that the innumerable studies on contextual factors that affect teachers ability to integrate ICTs are limited in that they do not identify the characteristics of such factors, their applied contexts and the

relationship amongst the factors. Chen therefore investigated the effect of such factors on teacher beliefs *and* [my italics] technology integration. Chen's findings indicated that teachers need opportunities to investigate their own beliefs and practices and to explore new instructional strategies with ICTs in order to improve teaching and learning.

This study differs from that of Chen in three ways. Firstly it explores how the different contextual factors, *including* teacher beliefs interact, specifically seeking evidence of convergence, mutuality and extensiveness amongst the interactions. Secondly, it looks at how these interactions affect teachers' ability to innovate with ICTs within the context. Lastly, the contexts of a Taiwanese public school and an independent school in South Africa are different. However, the two studies will together contribute to a knowledge base on contextual factors and ICT integration.

A study found to have some relevance to the topic of innovation and ICTs was that of Thomas (2006). However, he took a retrospective approach, examining the problems associated with a specific large-scale implementation project at provincial level in South Africa.

Another study is the mini-dissertation of Morgan (2001), a quantitative study that investigated the integration of computers in a South African secondary school from the technology perspective. The purpose of her study was an attempt to discover "*if the implementation of CAE*[1] *was feasible and even desirable in the South African context through an investigation and description of a working CAE programme in an ideal South African school situation*".

Morgan found that integration at the school was successful at levels of school policy, provision of technology resources and positive attitudes of teachers and learners. She recommended increasing IT staff in order to increase teacher training in methods of integrating ICTs into the curriculum and

[1] CAE = Computer Assisted Education, similar to CAI or CBI using computers as a direct means of delivering curriculum (e-learning).

providing teachers with incentives for reskilling. However, although Morgan initially presumed the school situation to be ideal, she had limited access to the school, did not receive the co-operation of the principal and intended the study as a *"summative evaluation not intended to change the practice or contribute to the development of the already implemented program".*

2.3 The integration of ICTs into the curriculum

This review will first address the literature on ICT integration followed by that on complexity and innovation as this sequence traces the pathway followed through the literature. However, the body of literature is not linear; instead it forms a network or web of inter-related connections. This review has therefore been structured in an attempt to show these interconnections.

The review follows a broadly chronological path in order to demonstrate the evolution of the concepts, the formation and clarity of their definition and their implications and interdependence. Embedded in the chronological approach are references to the types of research (meta-analysis, individual case studies etc) and the foci of research (organisations, schools, teachers and ICTs) used to understand the concepts.

2.3.1 ICT terminology

Terminology used to refer to the use of computers and related technologies in schools has changed along with the rapid evolution of such technologies. The terms 'ICTs' and 'integration' therefore require elucidation. Earlier studies referred to the hardware as 'computers' and sometimes inferred the use of computers by the broader term 'technology'. With the proliferation of networked access and peripherals in schools from the mid 1990s the term 'information and communication technologies' or ICTs evolved to incorporate the communication aspect that Internet connectivity, email and multi-media provided. ICTs became the accepted term in general use in Australia (Kearns & Grant 2002), the UK (OFSTED 2003) and Canada (BCED 2002). However ICTs, although commonly accepted, is not a universal term (Finger *et al.*

2003, p.2). The USA based International Society for Technology in Education (ISTE 2002) prefers the term ECT (educational computing and technology). In South Africa 'ICTs' is used in both the Draft e-Education White Paper (DoE 2003) and the SITES[2] report on South Africa (Howie, Muller & Patterson 2005, p.xi). The Draft White Paper defines ICT as follows:

> "[ICT is] *the convergence of information technology and communication technology. ICT is the combination of networks, hardware and software as well as the means of communication, collaboration and engagement that enable the processing, management and exchange of data, information and knowledge" (*DoE 2003, p.16).

This study uses the parameters of this definition of ICTs to mean both the hardware and the means it provides.

Similarly, as the focus shifted from computers to the pedagogical aspects, terms such as 'computer-assisted instruction' (CAI) or 'computer based instruction' (CBI) (Alessi & Trollip 2001, p.4) were displaced by references to the 'integration of ICTs into the curriculum'. The integration of ICTs in schools is a wide field with many interpretations of both terminology and intent (Finger *et al.* 2003, p.6). 'Integration' is defined as the combining or formation of constituent parts into a whole (Oxford Study Dictionary[3]). For ICTs, this definition suggests that to integrate ICTs they are not seen as a separate entity alongside other curricula components, but become a constituent part of the curricula components themselves. However, a theoretical definition does not imply consistency of application or understanding of the concept in practice. Integration differs from implementation which is defined as the process of putting into effect (OSD). Fullan (2001, p.69) describes implementation as *"the process of putting into practice an idea, program or set of activities and structures new to the people attempting or expected to*

[2] SITES = Second Information Technology in Education Study
[3] Oxford Study Dictionary will be referred to as OSD.

change". Implementation is therefore taken to mean the more physical aspects of introducing and putting into effect of computers although, as interpreted by Tearle, implementation can include integration as described in her words *"implementation into working practice"* (2003, p.579). Richardson (2000, p.3) uses both implementation and integration interchangeably. Other terms used in the context include infusion (Akbaba-Altun 2006, p.186; DoE 2003, p.16; Lan, He, Ouyang, Zhonghai & Bao 2000; Peck *et al*. 2002, p.472), diffusion (Venezky 2004, p.3), uptake (Cox, Preston & Cox 1999); assimilation (Mioduser, Nachmias, Tubin & Forkosh-Baruch 2003, p.23); and penetration (Anderson & Becker 2001, p.13). Sometimes these terms are used exclusively but are often used interchangeably with integration. Tearle suggests that the meaning of such terminology be scrutinised through further research (Tearle 2003, p.279).

Brackett (2000, p.3) defines ICT integration in the context of practice, distinguishing between functional, integrative and transformative practice. "*Functional practice"* or reproductive learning uses representational ICT tools to enhance students' learning outcomes and automate traditional classroom processes. "*Integrative practice"* is an integral component of broader curricular reforms, which changes not only *how* students learn but *what* they learn, including the development and redrafting of ICT artefacts. "*Transformative practice"* is doing things that would be impossible without harnessing the affordances of ICTs (Brackett 2000, p.30). In transformative practice ICTs become an integral component of the transformation of the school structure and organisation (Bialobrzeska & Cohen 2005, p.32; Finger *et al.* 2003, p.3; Fluck 2004, p.6; Rodrigo 2003, p.95; Yuen, Law & Wong 2003, p.166). For the purposes of this study 'integration' is understood to refer to ICTs as an integral part of curricular use and teachers' working practice.

The terms interaction/s[4], innovation/s, change/transformation/reform and complexity were found to be recurring in the literature relating to ICT integration and the question of the relationship between these concepts arose. However, these terms relate more logically to the theoretical aspects and are therefore included in the sections on innovation theory (p. 56) and complexity theory (p. 87) from which the conceptual framework is derived.

Having established a working definition of the concept of ICT integration this review will now investigate the literature pertaining to ICT integration considering firstly, developments in the 20th Century and then in the 21st Century borrowing from Brackett's terminology of functional, integrative and transformative practice.

2.3.2 The 20th Century: Functional practice

The use of computers in classrooms in the 20th Century was characterised by functional or reproductive learning uses to automate traditional classroom processes. Research reports on the use of computer-based technologies in education began appearing in the 1970s (Fouts 2000, p.*i*) although Coulson had published a report entitled *Computer-based instruction* in 1968, presupposing the use of computers in education by that time. The computer was first perceived as a technological product innovation and education attempted to harness its power to calculate and process. Earliest reports focused on the use of computers as tutors or surrogate teachers (Fouts 2000, p.*i*) by automating learning processes in a mechanical way. Research in the 1980s and early 1990s on the use of ICTs in schools focused on quantitative analyses (e.g. Lazarowitz & Huppert 1993) and meta-analyses (e.g. Kulik & Kulik 1991) of computer-assisted instruction intended to prove that the use of computers increased student achievement levels in contrast to traditional methods of performing similar tasks. Later reports focused on student use of computers as tools (word processing, spreadsheets etc) to automate traditional productive learning processes (Fouts 2000, p.*i*). With the advent of

[4] Interact = 'to have an effect on each other' (OED)

email and the Internet in schools from the mid-1990s computers provided potential access to unlimited resources and communication with fellow students as well as practitioners in all fields, supporting constructivist approaches to student-centred learning in contrast to instructivist teaching with behaviourist expectations (Hokanson & Hooper 2000, p.543).

The earliest questioning of the value of educational computing appears to date back to Hyer (c.1960 cited in Counts 2004, p.59). More recent sceptics such as Monke (1997), Peck, Cuban and Kirkpatrick (1986), Cuban (2001) and Oppenheimer (1997) highlighted the gulf between expectation and delivery of the value of ICTs in schools and brought the issues into the open. Whilst such sceptics were not against ICTs per se, they criticised the wholesale introduction of ICTs into schools at great expense with little rational justification, advocating instead evidence-based approaches to ICT implementation (Cuban 2001, p.150-151; Monke 2007, p.9; Peck, Cuban & Kirkpatrick 1986, p.54; Oppenheimer 1997, p.1).

Different ways of evaluating ICTs were explored by Means *et al.* (1993); Roschelle *et al.* (1999) and Windschitl (1998). A national study was conducted on behalf of the United States Department of Education by Means *et al.* (1993) on the relationship between technology and education reform. They identified many different projects that provided challenging instruction promoting collaborative involvement in authentic multidisciplinary tasks. Their recommendations (1993, Ch.VIb) focused on curricular goals, compatibility with assessment, the need for teachers to collaborate, community involvement and the need for ongoing pedagogical as well as technical support. They also highlighted the role of business (1993, Ch.6c) in providing technology to schools, but cautioned that such provision did not ensure that transformation using technology happened. Means *et al.* (1993, Ch.VIa) concluded, however, that ICTs fail in many instances as instruments for transforming schools because of the ways in which they are implemented: either by adaptation to traditional teaching methods or because they are

confined to inaccessible laboratories, attributing the failure to inflexibility of traditional school structures. Rather than focusing on effective ways of using technology resources, research should focus on understanding the mutual evolution of technological and pedagogical curricular innovations (Roschelle *et al.* 2000, p.10). This approach was encapsulated in a call for a new research focus:

> *"If the goal is to maximize the possibilities for student learning with technology, then a critical examination of the intersection of the affordances of information technology, pedagogy and learning is required"*. (Windschitl 1998, p.28)

In the 1990s large scale projects such as the Apple Computers of Tomorrow (ACOT) (Dwyer 1994); Centre for Applied Special Technology (CAST 1996) and the Software Information Industry Association series of studies (SIIA 2000) led the way to different approaches to ICT use and subsequent research, but these were largely studies funded by businesses that provided the technology and training to a small sector of schools to specifically enable integration or ICT use. While these studies were valuable in gaining an understanding of the potential of ICT integration, they did not account for the challenges that the majority of unsupported schools face in integrating ICTs.

A comprehensive study of teaching, learning and computing concluded that teachers' philosophy and practice impacted their use of the Internet for teaching and learning (Becker 1999 cited in Ravitz, Becker & Wong 2000, p.55). In a further analysis of the same data reported on by Becker (2001), the validity of large scale surveys is questioned. Becker (2001, p.26) concludes that:

> *"Large-scale surveys of teachers, such as the one providing data for this analysis, can only provide suggestions about the kinds of forces that lead teachers to use resources like computer technology to*

different extents and in different ways. The numerical precision of these descriptions and analyses should not be mistaken for certitude."

Similar doubts on studies of the use of computers in education were cast by Fouts (2000, p.29). He describes these studies as generally non-experimental, ex post facto in design and reliant on *"various multivariate statistical analyses in an attempt to control for confounding variables to isolate the technology variable",* and traditional measures of achievement. According to Fouts, in some studies the increase of computers and related technology is also coupled with a wide range of other school reforms that makes it very difficult, if not impossible, to isolate the technology component to imply any type of cause and effect relationship.

Both Becker and Fouts are sceptical of surveys and statistical analyses in understanding the pedagogical challenges that teachers face. If the outcomes of such approaches could *"not be mistaken for certitude"* then what approaches could be used to determine the challenges that teachers face? While there was a plethora of significant research reported on extensively in academic journals, in commissioned reports, in professional journals, at conferences and in the popular press, there was no agreement on either the effectiveness of ICT use in schools or on the validity of the research itself. The argument was against research that isolated ICTs from their contexts.

The 20th Century was therefore largely characterised by functional use of computers. Research studies focused on means of recording small improvements in student learning targets that were anticipated to arise from the automation of traditional learning practices. However, the limitations of this were already being recognised towards the mid 1990s at which stage the focus started shifting towards more integrated practice and an emphasis on the pedagogical aspects of ICT use.

2.3.3 The 21st Century: Towards integrative practice

Integrative practice is an integral component of broader curricular reforms, which changes not only *how* students learn but *what* they learn, including the development and redrafting of ICT artefacts (Brackett 2000, p.30).

Prior to the Millennium there was acknowledgement of the necessity to focus on pedagogy and educational goals rather than the technology itself. Teachers were commonly aware of the imperative to be technologically literate, but insufficient resources were being allocated to the pedagogical needs of integrative practice. Anderson and Becker (2001, p.3) revealed the disparity between spending on ICT hardware and spending on the support of teachers in using ICTs in the classroom: only 20% was allocated to support, 7% to software and the rest to hardware. They concluded that, without concomitant spending on support, technology purchases would go largely unused. However, Anderson and Becker measured support in terms of expenditure on technology support staff and not on other forms of investment in teacher development such as release time for planning new approaches. Spector (2001, p.7) suggests similarly that problems associated with lack of training and preparation are sidelined by demands to acquire and implement new technologies, identifying short-sighted policy and planning as the underlying cause of such problems. Without training in the pedagogical aspects of using ICTs as well as the potential that ICT applications could offer, teachers continued to perceive and use ICTs in traditional ways.

Following his research on schools in Silicon Valley, Cuban argued that the majority of teachers still used ICTs to "*sustain existing patterns of education, rather than to innovate"* (2001, p.134) and that the promise of fundamental change through the integration of ICTs had not been realised (Peck, Cuban & Kirkpatrick 2002, p.478). In an effort to contextualise the use of technology appropriately, Roschelle *et al.* (2000, p.76) called for the focus to shift from computers to the *how* and *what* of student learning with computers. They identified twenty-one major studies on the effectiveness of computers as learning tools. From these studies Roschelle *et al.* (2000, p.90) identified

challenges to implementation such as the need for appropriate teacher support, curriculum modernisation, student evaluation and assessment and capacity for change. However, of the twenty one studies, five assessed gains in student learning from kindergarten to high school and only one study dealt with secondary schools specifically and then only with science process skills.

Other factors identified from recent literature that affect ICT integration are teacher beliefs and attitudes, teacher demographics, systemic and physical constraints, the degree of involvement of school leadership, formality of structures and socio-cultural dimensions.

Amongst those that have written on teacher beliefs and their effect on the integration of ICTs are Albion (2003); Hennessy, Ruthven and Brindley (2005) and Otto and Albion (2002). Teacher beliefs are dependent on a variety of factors: some are external, others are internal.

Age is a significant factor in teacher attitudes towards ICTs Albion (2003, p.2). Albion borrows Prensky's (2001, p.1) terminology that distinguishes between *"natives"* or the student generation born into the age of ICTs and *"immigrants"*, those teachers who have had to adapt to the presence of ICTs and may or may not eventually feel at home with them. Albion's research compared beliefs of graduating teacher education students in both 1991 and 2002 and concluded (2003, p.7) that young graduating teachers in 2002 rated their comfort with using ICTs much higher than the earlier group. However, as revealed by an Australian government study (Senate Employment Education and Training References Committee 1998; Ewing 2003, p.30); the average age of Australian teachers was above 46, which means that a significant percentage were unlikely to have had exposure to computer use as students. Similar demographic patterns characterise the teaching fraternity elsewhere, including South Africa (Peltzer *et al.* 2005, p.63). If practicing teachers' pre-service exposure to ICTs is limited to younger graduates, then their exposure

to all other transformation practices is likely to be similar. However, there is a contradiction in age factors in that the baby boomer[5] generation of teachers is:

> *"… in general numerically dominant and often most politically influential group in their schools throughout their careers. They were formidable forces of change and also, especially later, of resistance to it"* (Hargreaves & Goodson 2006, p.24).

It could be argued from such demographic patterns that exposure to ICTs at a pre-service age is a critical factor in determining teacher competency in using ICTs which might then affect their ability or willingness to integrate ICTs into the curriculum. However, Peck, Cuban and Kirkpatrick (2002, p.478) showed in their Silicon Valley studies that this is not the case and that in fact a high percentage of teachers are competent users irrespective of age. Instead they identify structures that limit collaborative cross-pollination of innovative ideas: access only to laboratory models of ICT use, time constraints resulting from both teacher workload and timetabling, technology defects and unsupportive assistance patterns as well as competing educational priorities. In a similar UK study conducted over a range of schools, Hennessy *et al.* investigated "*teachers' perceptions of the contribution made by using ICT, its impact on subject pedagogies, and the extent to which ICT is integrated into classroom practice in these areas"* (2005, p.166). Opportunistic access to computer labs, lack of reliable resources, lack of time and lack of control over the learning process as well as pressure to use ICTs were identified as constraints to integration. Lack of support and collective experience were found to limit teachers' comfort and confidence in using ICTs with students. Teachers believed in the transformational potential of ICTs, but their beliefs were tempered by caution arising from the need to enhance the learning process (Hennessy *et al.* 2005, p.181).

[5] Baby boomers are the generation born between after World War II that resulted in a peak in births between 1946 and 1959. This generation is now retiring.

The involvement of school leadership in the integration of ICTs is critical (Breuleux, Laferrière, & Lamon 2002, p.10; Otto & Albion 2002, p.3; Sharma 2005, p.53; Staples *et al.* 2005, p.305). School leadership needs to understand the difference between traditional and productive use of technology and the differing implications of each. Acquisition of ICTs is fundamental, but should not be privileged over professional development; rather they should be planned for and happen simultaneously (Staples *et al.* 2005, p.306). This point is emphasised by Staples *et al.* in their call for *"a nuanced understanding of what it means to provide leadership and professional development at a school site"* (p.305-306). The beliefs that a principal holds have a significant impact on the culture that supports the creative integration of ICTs for teaching and learning and determine the interpretation of the vision for learning through either action or inaction (Otto & Albion 2002, p.4). Otto and Albion's argument support the contention that the resulting school culture has a greater effect on the adoption of ICTs by teachers than the influence of ICTs on educational reform.

Since approximately 2004 mobile technologies e.g. mobile phones, i-pods as reported by, for example, Batchelor (2007); Botha (2006); Brown (2005); Kukulska-Hulme and Traxler (2005); Wishart, McFarlane and Ramsden (2005) and social networking web applications e.g. *Facebook*, *Youtube*, *My Space* and *Flickr* have impacted the patterns of ICT use, particularly by students. Attention is now focusing on how such technologies are being incorporated into practice and the effect of such technologies on classroom practice, for example, Attwell (2007), Bryant (2006) and Lorenzo, Oblinger and Dziuban (2006).

The focus has shifted from the functional use of computers towards integrative practice, but the response of schools to the professional learning that needs to take place to fully integrate ICTs as part of a transformative process has not yet been realised.

2.3.4 21st Century: Integrative practice

Windschitl's work (1998, 2000) had had *"a very significant impetus"* in prompting research questions on ICTs in education (Kuiper, Volman & Terwel 2005, p.286). Subsequent to Windschitl's call for *"a critical examination of the intersection of the affordances of information technology, pedagogy and learning"* (1998, p.28), there has been more focus on the pedagogical aspects rather than the technological aspects of ICT integration.

Table 2.2: Aspects of ICT integration

Aspect	Authors
Barriers to or influences on ICT integration	Mumtaz (2000); Selwyn (1999); Lenard (2005)
Teacher beliefs that influence the use of ICTs	Albion (2003); Otto & Albion (2002); Hennessy, Ruthven & Brindley (2005); Hernández-Ramos (2005); Ilomäki, Lakkala, & Lehtinen (2004); Webb & Cox (2004); Zhao & Cziko (2001); Kirk & Macdonald (2001); Van Braak (2001).
The success of ICT integration and the ability of ICTs to reform education	Blasik *et al.* (2003)
Counter-claims of the ability of ICTs to reform education	Baggott la Velle, McFarlane & Brawn (2003)
Analysis of trends in integration of ICTs in specific countries	Ali & Proctor (2005); Rodrigo (2003); Kangro & Kangro (2004); Pang, Kim & Kim (c.2000); Looi, Hung, Bopry & Koh (2004); Mioduser, Nachmias, Forkosh-Baruch & Tubin (2004); Ilomäki *et al.* (2004); Soule (2003).
Large scale studies looking at integration across a broad spectrum of schools	PISA study (Bielefeldt 2005) in Europe; SITES study (Quellmalz & Kozma 2003) of ICTs in twenty-three countries, including South Africa
Large scale statistical analyses	Anderson & Becker (2001); Bielefeldt (2005)
Meta-analyses	Venezky (2004)
In-depth case studies	Baggott la Velle *et al.(*2003); Matheos, Daniel & McCalla (2005); Staples Pugach & Hines (2005)
Teacher strategies	Hennessy, Ruthven & Brindley (2005)

According to Finger *et al.* (2003, p.1) there has been limited research into ICT integration to date. Finger et al acknowledge that there is still difficulty in

defining what ICT curriculum integration comprises and how it can be effectively measured. However, contrary to their claim of a dearth of literature in the field, a comprehensive body of literature on ICT integration was located and found to cover various aspects of the topic as illustrated in Table 2.2.

There is also an increasing body of evidence of integration of specific ICTs into specific learning areas which are summarised in Table 2.3 below.

Table 2.3: Table of ICT integration into different subject areas

Subject	ICT Tool	Author
Sciences	Multi-media, data loggers, simulations, and virtual modelling and micro-worlds	Baggott La Velle *et al.* (2003); Cox, Abbott, Webb, Blakeley, Beauchamp & Rhodes (2004a); Cox *et al.* (2004b); Wilson, (2005); Webb (2005)
Mathematics	Interactive graphing	Godwin & Sutherland (2004); Crisan, Lerman & Winbourne (2007)
History	Internet multi-media provides excellent primary and secondary sources	Hillis & Munro (2005); Hills (2008)
Geography	Geographic Information Systems (GIS); Google Earth	Morgan & Tidmarsh (2004); Turner (2006)

Various studies were located that explore general issues relating to curriculum integration such as those suggested by Baggott la Velle *et al* (2003, p.197). According to Finger *et al.* (2003, p.1) the key to understanding the notion of integrating ICTs into the curriculum is the curriculum itself. Huffman and Rickman (2004, p.36) show optimism about the ability of ICTs to transform teachers, students and institutions, pointing out that "*it is imperative to remember that technology integration begins in the classroom with the teacher"*. However, they stress (2004, p.39) that integration is the focus to avoid technology becoming an "*add-on to the curriculum instead of an element of the curriculum"*. Dede (2000, p.282-283) explored the emerging influences of ICTs on the curriculum and suggests a number of innovative

ways in which ICTs can be integrated to enhance learning while Hokanson and Hooper (2000, p.533) argue the need to focus on the process of using ICTs in the classroom in a generative way rather than in a representational way. Rodrigo (2003, p.120) endorsed the call for educational goals to advocate the integration of ICTs into subject areas and to specifically exclude the development of computer-related skills as ends in themselves. Rodrigo's study focused on secondary schools, challenging claims that ICTs are themselves enablers that optimise student-centred pedagogical methods and fundamentally change the way education is conceived and delivered to students (2003, p.95). She found that, although teachers believed in such potential of ICTs, the reality of what they were able to achieve was far removed from their expectations.

The relationship between school culture and the integration of ICTs into the curriculum was explored by Staples, Pugach & Himes (2005). They advocate an alignment between the curriculum and the school mission, along with teacher leadership, as key to integrating ICTs. Staples *et al.* (2005, p.307) point out how traditional professional development encourages teachers to develop their practice within traditional structures and familiar contexts. When ICTs are introduced, teachers and principals need to toggle between the traditional and the unfamiliar in more complex ways. While technology first and foremost serves the curriculum, considerable time and effort needs to be invested in acquiring and learning to use ICTs in order for it to serve the curriculum. A curriculum-related vision is essential to keep ICTs appropriately focused. To achieve this end the technology leadership, supported by school leadership, must have a strong curriculum focus aligned with technical expertise. In cases where both the technology leader and the principal are focused on acquisition, teacher leadership of the curriculum aspect is essential. Using qualitative methods Staples *et al.* explored three cases and were able to provide a greater understanding of the *"complex interplay of curriculum, technology, and professional growth and development activities"* (2005, p.307). Staples *et al.* suggest that their study was able to illustrate

"unvoiced subtleties" associated with ICT integration. As a result of their study, they recommend (2005, p.307) that further research should investigate areas such as:

- decision making processes for technology purchases and the role of curriculum in these decisions,
- alignment between technology and the curriculum and
- the connection between technology and curriculum in the process of professional development.

Staples *et al.* conclude that professional development required for successful integration of ICTs must be aligned with curricular development:

> *"To be integrated successfully, there must be a clear understanding that technology creates a new layer for professional development. […] What seems critical for this to happen, however, is a deep understanding of how technology relates to curricular goals, how professional development must be layered to embrace both technology learning and curricular alignment in relationship to one another, and how carefully constructed professional development can support technology's most judicious use"* (Staples *et al.* 2005, p.308).

An example of curricular use of ICTs that illustrate the problem of how ICTs are integrated is provided by Baggott la Velle *et al.* (2003, p.187-197) who describe a case study of a Science unit. They found that despite student preferences for the approach used, there was little evidence of the students' understanding of the unit concepts. In their example, the teacher had used computer simulation instead of a lab practical to exclude inconsistencies and noise, rather than to use it as a new way of supporting student understanding. Baggott la Velle *et al.* suggest that it is not only the teacher's competency and confidence in using ICTs that is important, but that their understanding of how ICTs can support and enhance the learning task is vital. They argue that socio-constructivist approaches and cognitive tools embedded in ICTs,

together with pedagogical content knowledge are essential to the transformation that enables understanding. They advocate uses that allow students to "*explore, develop, express critically and redraft ideas and concepts"* (p.196) rather than using ICTs as a sterilised form of lab work. Transformation needs to take place in the teachers' knowledge and understanding, for example, knowing which applications to use and when, and how to differentiate to accommodate student's individual capabilities and characteristics. It is recommended that research should give careful consideration to productive pedagogies, the relationship between developing technologies and subject content, reflective and evidence-based practice, knowledge management practices that make knowledge of new developments accessible to teachers and, finally, finding alternatives to the pressures of accountability that might release creative opportunities (Baggott la Velle *et al.* 2005, p.197).

Staples et al and Baggott la Velle therefore concur on the need for professional development to focus on the learning process. To enable transformative practice that incorporates both technological and pedagogical aspects requires an emphasis on designing for learning.

Recently, Beetham and Sharpe in the introduction to their jointly edited *Rethinking Pedagogy for a Digital Age*, propose that bridges between technology and the transformation of education need to be built through *"a reconsideration of the pedagogical practices that underpin education"* (2007, p.1). Even by 2007 then, such bridges were still envisioned as a future occurrence and not something that has been achieved. Beetham and Sharpe examine the nature of pedagogy in the light of the change of focus from an emphasis on teaching content to passive recipients to one of active participation by unique learners in the learning process, arguing that pedagogy embraces the active learning process; the preparation, scaffolding and facilitation of that process and reflective practice (2007, p.2-3). In the context of the digital age these aspects of pedagogy that were previously

taken for granted become much more visible necessitating a much greater emphasis on the design of the learning process. At the same time as the approach to learning becomes more systematic, the creative, contingent and unpredictable nature of classroom interactions needs to be accommodated and the relationship between teacher and student is paramount (2007, p.7-8).

It would appear that the focus of ICT integration research has shifted to the balance between technology and pedagogy and that professional development issues are starting to receive the attention they require. However, few research studies have focused on the contextual variables that impact this relationship between ICTs and the curriculum. The study conducted by Staples *et al*. explored the relationship in three elementary schools. These schools were also supported by a publicly funded tertiary partnership. A similar study investigating the case of secondary schools is thus indicated. Further, the case of an unsupported school might also provide a differing perspective. Curriculum issues and professional development issues are issues of context and not of ICTs themselves. The following section will therefore review studies of context in relation to ICT integration.

2.3.5 Integration of ICTs in context

It is apparent from the above that the studies of the integration of ICTs cannot be separated from their contexts. Studies of ICTs in contexts include, *inter alia*, those of Clarke *et al*. (2000); Dede (2000); Doig (2005); Looi *et al.* (2004); Plomp (2006); Tearle (2003; 2004) and Venezky (2004).

Tearle's (2004) work is significant in that her approach is a single whole school case study in which she considers the process of implementing the use of ICTs across the school for teaching and learning as a special case of implementing change. Tearle derived a conceptual framework model from the literature on change management and ICT implementation and tested her case study against this model. Her model (2004, p.345) is illustrated as concentric circles containing the influences on the ICT implementation process. The intention of her model was *"to offer a useful focus from which to*

consider planning a strategy for the introduction of ICT, or reviewing an existing one" (2004, p.348). As such it is a valid model. At the centre of her model is the use of ICTs in practice. According to the model, practice is affected by individual characteristics and competencies (attitudes, skills, beliefs and ICT knowledge and understanding) which, in turn are affected by the implementation process. The implementation process is determined by characteristics of the whole school context (2004, p.336).

Whilst Tearle recognises the influences of the different elements on ICT practice, her model assumes the centrality of ICTs. It is this *centrality* of ICTs in studies of ICT integration that remains unchallenged. Secondly, Tearle's research was based in an education system that has a National Curriculum for ICT implementation, an imperative that teachers in those schools need to be accountable for (Tearle 2003, p.581) whereas in South Africa, although there is a national policy on ICT integration, there is no national ICT curriculum. A further aspect of Tearle's study is that the chosen case exemplified not only ICT implementation but was an exemplary school in other ways as well i.e. it was chosen for its success in implementing ICTs. While the choice of case was entirely appropriate to Tearle's intentions, her model and its test case do not address the situation in schools at large which, by Tearle's own admission, form by far the majority of schools (2004, p.340). If her model was to be applied to schools at large they might give a measure of the discrepancies between the ideal and the school, but not necessarily account for those discrepancies. Tearle admits that her model does not show how the various factors interact, nor does it illustrate the relative importance of each feature or the complexity of the whole situation (2004, p.344). Tearle also acknowledges that individual characteristics accounted for the fact that *"the underlying messages behind the theoretical framework and case study findings were markedly different"* and that there was little evidence in the case setting of what difference teacher beliefs made (2004, p.347). The question of the interaction of such factors and their relative importance remains.

It is important to understand the difference between, on the one hand, integration in purpose built environments or projects supported commercially with the expressed intention of accelerating integration and, on the other, trends in schools in general that are not necessarily subject to such advantage. Purpose built environments may provide a vision or model of what is achievable with ICTs, but do not account for the reasons why the majority of schools do not achieve such success with integrating ICTs.

Similar to Tearle's study, Dede's (2000) study, whilst contextualising ICT integration in whole school environments and complexity, focuses on exemplary projects that *"illustrate the potential of computers and telecommunications to convey higher-order skills and knowledge"* (p.282). According to Dede ICT integration requires a:

> *"… complex implementation process that includes sustained, large-scale, simultaneous innovations in curriculum; pedagogy; assessment; professional development; administration; organizational structures; strategies for equity; and partnerships for learning among schools, businesses, homes, and community settings"* (Dede 2000, p.282).

A further study was conducted in two New Zealand schools by Doig (2005). However, the schools were once again exemplary in that they were qualified as *"designated character"* schools set up *"to be foundationally different from traditional schools through opportunities to explore radical innovation"* (2005, p.*i*) rather than incremental change. Doig questions what makes for radical innovation in schools and how the use of ICTs is implicated in innovation in schools. Doig's use of the term "*incremental change"* (2005, p.34) as opposed to "*radical change*" is pertinent. It is incremental change (Whitehurst 2009, p.1; Clarke *et al.* 2000, p.7), or continuous change that happens in small steps that characterises the majority of schools, that is, schools that are not exemplary cases.

Plomp (2006, p.7) refers to the international SITES studies (see Section 2.3.1, p.34) as reported by Pelgrum and Anderson (1999). Again, the SITES schools were purposefully selected. The selected cases had *"to represent the innovation aspirations of each country rather than what was already going on in many classrooms"*. The criteria were that ICTs had to be utilised and pedagogic practices had to show innovative trends, although the definition of innovation was left to each country to determine. Also, although Plomp's report is dated 2006, the original studies were conducted prior to 1998 and, given the rapid development of ICTs, may no longer reflect the current situation. However, of interest in Plomp's account is that pedagogical innovation plays a role.

An important study that looked at whole-school issues is the meta-analysis based on 94 OECD[6] case studies as reported by Venezky (2004). The purpose of the OECD studies was to understand the relationship between ICT and educational innovation. Venezky acknowledges the significant educational changes that were happening at the end of the 1990's. Such changes were from individualistic towards collaborative learning, from reproduction of information to higher-order thinking skills, and from rote learning of content to in-depth study. To achieve these goals, a wide range of professional development, collaborative community, curriculum revision and learning facilitation strategies were being implemented in some countries, whilst other countries relied on standards and their relevant performance assessments. At the same time the provision of ICTs to schools was proliferating, although not evenly, and varying degrees of staff development in ICT use was provided. The OECD studies explored the relationship between *"the successful implementation of educational innovation and successful installation and use of ICT"* (2004, p.5). By exploring this relationship, these studies came closer to contextualising ICTs. However, the multiple studies synthesised in the OECD report were conducted prior to 2000 and more

[6] Organisation for Economic Co-operation and Development

recent research taking further educational and technological developments into account is indicated.

Looi *et al.* (2004) describe research conducted in Singapore on ICT innovations intended to enhance the critical and creative capacity of that country's human resources. Key areas of Singapore's IT Masterplan II 2003-2007 are *"to use IT to enhance the connections between the curriculum, instruction, and assessment methods"* and to *"stimulate thinking and creative endeavour among learners"* through engaged learning (2004, p.92). The ICT infrastructure and adequate training for learner-centred ICT integration are identified as fundamental and ICT is seen as a catalyst for capacity building for the knowledge era. In order to achieve their goal of transforming learning the Singaporean education ministry set up an experimental Learning Sciences Lab (LSL). The purpose of this was to enable educators *"to go back to the basics of understanding learning from scientific and interdisciplinary perspectives".* The goal of the lab was that:

> "… *ideas and concepts related to learning interactions and teaching pedagogies can be prototyped and implemented in classrooms and schools. Through a continuous spiral process of experimentation and exposing school leaders, teachers, and students to workable ideas and developed prototypes, LSL provides those individuals with experiences that can transform mindsets toward empowered learning and lifelong learning"* (Looi *et al.* 2004, p.92).

The Singapore example is one that demonstrates innovation in its approach to ICT integration at a national level in a well-resourced country. The theoretical framework described by Looi *et al.* (2004, p.93) places emphasis clearly on the *learning* rather than the ICTs and is based on the concepts of situated cognition and communities of practice. Their theoretical framework derives from three sets of related pairs of issues:

- Epistemologies of teachers coupled with designing for learning (teachers' perspective)
- Meaning-making for learners coupled with learning technologies (students' perspective)
- Scalability and sustainability coupled with school policies and practices (schools' perspective) (2004, p.92).

The value of the Singapore initiative (which, at the time of this review, was still underway and not yet finally and fully evaluated) is that, although the earlier phase concentrated on the provision and support of ICTs, the subsequent phase removes the centrality of ICTs and places the emphasis clearly on learning at a student, professional and organisational level across a national context within a wider purpose of building capacity in critical thinking skills. It is this focus that is considered to be paramount in ICT integration research. However, not all countries have access to such facilities and support and the question of integration and transformation in schools in general, without access to such experimental facilities, remains.

The study of Vermont schools by Clarke *et al.* (2000) is a study of complex innovations rather than a study of ICTs. However, ICTs played a part in the changes brought about in each of the case studies that Clarke *et al.* describe. Clarke *et al.* concluded that:

- interactions between all five levels of school organisation (student, teacher, system, district and state) need to be aligned and *"adapt a shared "vision" with each interaction"*
- *"interactions between individuals across organizational lines fuel the change process"*
- ongoing change is fuelled by student-teacher interactions
- interactions between policy and districts *"create structures that support continuing growth"* and
- *"failure to adapt at any level starves the rest of the organization of resources necessary to change"* (2000, p.156)

Clarke *et al.*, as participant observers, investigated and described a single innovative case within each of four different secondary schools and each case was described in relation to its context. Patterns of innovation within the context of school transformation emerged. The resultant transformation of the context is described in the following way:

> *"[P]artners engaged in a reform initiative continuously adapt to each other, changing in ways that allow the initiative to "grow" in strength and coherence. When change began to generalize within a school, interactions among many individuals occurred in increasingly complex patterns. In these interactions, no individual or system component could remain stable while others changed. The change process could not be controlled from any single vantage point. Growth in classrooms, programs, schools, and school systems must be mutual growth, we concluded, providing all participants with the sense that they benefit personally to the extent that others benefit from their work. Systemic change therefore depends on increasing the energy of interactions across organizational lines so that growth occurs among many connected efforts. This then supports the evolution of a common sense of direction at all levels of the organization."* (Clarke *et al.* 2000, p.55)

In this way, Clarke et al bring together the concepts of context, innovation and complexity as pointers to transformation.

2.3.6 Summary of section 2.3

This section has traced the development of the concept of ICT integration, provided definitions and demonstrated how the concept has been explored in various studies. Encountering, in particular, the report on Clarke *et al.*'s study brought to mind the importance of *"a commonality of being"*[7], of the

[7] *As described by a New Zealand teacher I interviewed in 2001: "One of the strengths of the school is the sense of people working together. When people need a hierarchy its there, but the fact of the matter*

importance of good collegial relationships and partnerships. It also led the literature path into the theoretical underpinning of innovation and complexity theory. The first of these two theoretical concepts, innovation theory, and its relationship to school contexts, to ICTs and to complexity theory will be reviewed in the next section.

2.4 Innovation theory

A broad definition of innovation is the introduction of something new that is intended to be useful (Whitehurst 2009, p.1). Two critical dimensions of innovation are:

Effective <----------> Ineffective

Process <----------> Product

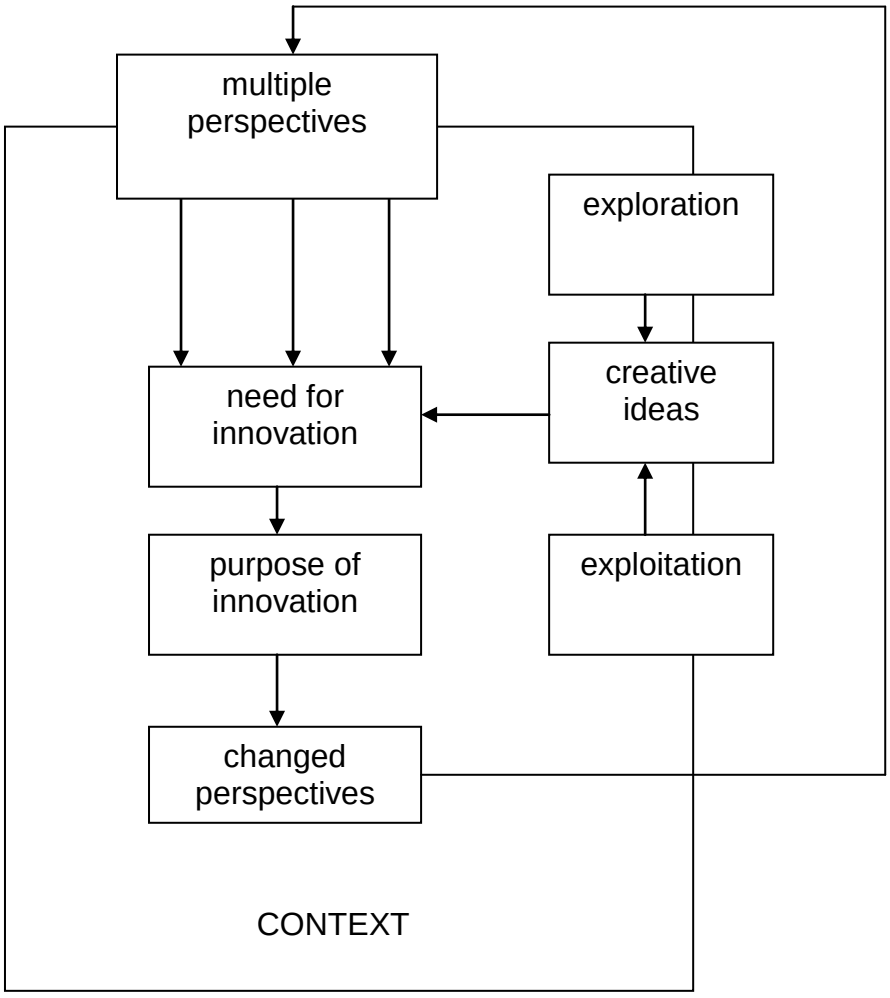
Whitehurst (2009) explains that effective innovations enhance desired outcomes, whereas ineffective innovations do not. To implement a product innovation requires a paradigm shift while process innovation involves modifications of existing processes. The aim of process innovation is to improve the efficiency, productivity or functionality of existing products. Process innovation is usually incremental and occurs over a period of time. The practice, the outcome, and the improvement to be achieved by a process innovation should be evident and clearly related (2009, p.1-2). Implementing ICTs in schools is a product innovation whereas using it in transformative ways (Brackett 2000, p.30) is process innovation. Schools need to pay more attention to process innovation (Whitehurst 2009 p.7).

The concept of innovation in the abstract may be distinguished from particular innovations (Glatter, Castle, Cooper, Evans & Woods 2005, p.384). Abstract innovation may be defined as *"learning to do things differently in order to do them better"* (Hargreaves 2004, p.6). A particular innovation is *"a significant change in processes, provision and/or organisation intended to help meet*

is that […] it's a very friendly place, a commonality of being, a sharing place. It's a strength. […] There's a lot of resource sharing and co-operation".

educational goals more effectively or to promote new goals" (Glatter 2005, p.384). Glatter *et al.* (2005, p.389) refer also to *"strategic innovations"* and *"specific innovations"*. Strategic innovation is the implementation of top-down reform, which needs to be matched with specific, significant sub-innovations of smaller scope and focus *"mainly on one or two of process, provision or organisation"* (Glatter *et al.* 2005, p.390). A specific innovation must introduce something new to the particular context, have consequences that are *"noteworthy, highly valued and relevant to the priorities of the organisation"* and be *"connected to the larger strategic innovation"*. In the case of South African schools the new curriculum would be an example of strategic innovation and how a teacher responds by changing their practice would be a process innovation in the sense intended by both Whitehurst and Glatter.

Figure 2.2: The flux and change of innovative processes



A basic assumption of innovation within a system is that the system needs to be improved in some way. Such an assumption is subjective, arising from the perspective and interests of different stakeholders (Assié-Lumumba 2004, p.73). Glatter *et al.* (2005, p.385) raise three questions about the nature of innovation: its novelty, its effectiveness and its size. Innovations are context-dependent: what is new in one context may not be so in another. Innovation is generated through exploration, but can also be the result of exploitation of other's ideas. To be effective, an innovation needs to have a purpose and to have been implemented in practice to a certain extent, while its success will depend on the particular perception of it. Change occurs in very small steps, evolving gradually, therefore an innovation does not have to be on a large scale, but the *"continual flux and change"* of organisational complexity plays a role (Glatter *et al.* 2005, p.386). These ideas are illustrated in Figure 2.2.

2.4.1 Innovation, change and reform

The terms innovation, change, transformation and reform are sometimes used interchangeably in the literature. These terms need clarification and the relationships between them established.

Innovation is defined as *"a change that is new relative to the organization that is adopting that change"* (Lane 2001, p.12). Innovation can be either top-down or bottom-up. Top-down innovation is associated with mandated or policy change and reform (OECD 2000, p.54). Bottom-up innovation is the change in practice that responds to mandated change. However, small scale creative changes can occur in response to problems or challenges that are not necessarily related to larger scale actions (Hargreaves 2000, p.54), but occur as instances of *"localised experiment and renewal"* (OECD 2000, p.43). In such cases, the change is new relative to the individual. Hargreaves (2000, p.54) argues that apart from top-down policies there should also be policies that direct innovation at school level.

The notion of innovation is commonly regarded as beneficial but innovations such as the gun or the guillotine belie such an axiom (Cros 2000, p.65). Similarly, reform and change, sometimes associated with conflict, can have negative associations (Cros 2000, p.66). The term educational change as used by Hargreaves & Goodson (2006, p.4) implies either positive or negative transformation over time, whereas the normative use of reform implies only positive change Labaree (2006, p.161).

An organisation lacking innovation is deemed conservative. Based on the OECD/CERI[8] study, Cros (2000, p.65) identifies four ideas that constitute the innovation paradigm in education:

- the idea of the new and novel as a form of creativity, newness
- the idea of addressing unmet social needs and values; a measure of carrying out reform and guaranteeing quality; optimising and energising
- the issue of power; innovation introduces uncertainty into centre/periphery relations
- the idea of change; changing behaviour, attitudes, approaches and ways of thinking; appearing in situations of transition or questioning

If innovation is continual, burnout and a return to routine will result. In order to avoid such retrogression, innovation needs to become institutionalised or part of the culture of the organisation in which it occurs. Sustainability of innovation therefore implies institutionalised or ongoing innovation (Cros 2000, p.67).

Common notions about innovation are questioned by Milton (2005). She asks whether policy can be innovative, suggesting that government reform and educational innovation are different. There is a paradox between the need that the knowledge-based society has for a culture of innovation and the need of the knowledge economy for a successful educational foundation. Milton suggests that little attention is paid to *"how we do education itself"*. A further question that she poses is: *"If innovation is a significant change in how we do*

[8] OECD/CERI = OECD Centre for Educational Research and Innovation

things, then when does what has changed become the way we do things all the time? In other words, if truly transformational when does the work cease to be an innovation?" Milton argues that the need for change is often recognised, but thinking about ideas for educational innovation does not run deeply enough: *"common beliefs and faulty assumptions about central concepts of intelligence, instruction, motivation and intention, if unexamined, limit the likelihood of significant change in educational practice"*. When such myths are challenged, the reaction is either to reject the new ideas as wrong or to graft them onto the older mental models. However, to transform educational practice it is essential to reassess assumptions (2005, p.2-7).

Multiple perspectives and interpretations of innovation therefore exist, particularly within the context of change or reform in schools. However, for the purposes of this study innovation is used in the sense of a bottom-up incremental process of beneficial changes in teacher practices at a particular time and in a particular context as a response to multiple simultaneous, top-down, mandated, policy-based changes.

Having established a working meaning of the term innovation, the next section will address the diffusion of innovations or how they spread.

2.4.2 The diffusion of innovations

According to SAITIS[9] (2002 p.10), Rogers is the recognised authority on diffusion. He defines diffusion as *"the process by which an innovation is communicated through certain channels over time among the members of a social system"* (Rogers, 1995 p.5). Rogers continues by acknowledging that diffusion is a form of communication that conveys new ideas between individuals with the intention of reaching a mutual understanding. His definition implies that:

[9] South African Information Technology Industry Strategy Project

> *"… [c]ommunication is a process of convergence (or divergence) as two or more individuals exchange information in order to move toward each other (or apart) in the meanings that they give to certain events"* (Rogers 1995, p.5) and that
>
> *"… [d]iffusion is a kind of social change, defined as the process by which alteration occurs in the structure and function of a social system. When new ideas are invented, diffused, and are adopted or rejected, leading to certain consequences, social change occurs"* (Rogers 2005, p.10).

Rogers applies the term diffusion to both the spontaneous, unplanned spread of new ideas and diffusion that is directed and managed. Thus the main elements identifiable in each diffusion process are the innovation, communication channels, time and the social system in which the innovation diffuses (p.10). The components of Rogers' diffusion model are summarised in Table 2.4 below from the SAITIS (2002, p.10) table.

The terms innovation and technology are often conflated. A technology may be defined as *"a design for instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving a desired outcome"* (Rogers 1995, p.12). A technology usually has a hardware or tool aspect and a software component that consists of the information base for the tool. Using a computer as an example Rogers illustrates the obvious relationship between a tool and how it is used. However, Rogers argues that the social embedding of a technology is not as visible as its tool aspects. A technological innovation creates uncertainty in the minds of the adopters about whether it will work or not for the given need. The decision to use an innovation occurs through an information-seeking process designed to lessen the uncertainty (Rogers 1995, p.12-13).

Table 2.4: Components of the Classical Diffusion Model (adapted from SAITIS 2002 p.10)

Component	Definitions/Generalisations
Typical Diffusion Pattern	Process starts out slowly among pioneering adopters, reaches "take-off" as a growing community of adopters is established and the effects of peer influence arise, and levels off as the population of potential adopters becomes exhausted, thus leading to an "S-shaped" cumulative adoption curve.
Innovation Characteristics	Innovations possess certain characteristics (relative advantage, compatibility, complexity, trialability, observability) which, as perceived by adopters, determine the ultimate rate and pattern of adoption.
Adopter Characteristics	Some potential adopters are more prone to innovate than others, and can be identified as such by their personal characteristics (education, age, job tenure etc.). Adopters can be usefully classified according to where they adopt relative to others (innovators, early adopters, early majority, late majority, laggards.)
Adoption Decision Stages	The adoption decision unfolds as a series of stages, flowing from knowledge of the innovation through persuasion, decision, implementation and confirmation. Adopters are predisposed towards different kinds of influence (e.g., mass market communication versus word-of-mouth) at different stages.
Opinion Leaders and Change Agents	The actions of certain individuals (opinion leaders and change agents) can accelerate diffusion, especially when potential adopters view such individuals as being similar to themselves.

Besides Rogers' model of diffusion, Cros (2000) identifies a range of contemporary forms of innovation diffusion or generalisation which recognise the complexity of innovation. Amongst these is the social interactionism model. Cros explains that, in this model, the interplay of influences and individual decisions and their effects are key. Given and received information is recomposed in the mind of each individual. Communication networks, and particularly personal networks, are key to social influence. Social participation is reassuring and fosters the development of the innovation. Conflicts and

crises also play a role as do conformity, power relations, minorities and social pressure (Cros 2000, p.70-74).

Communication is essential to diffusion and clusters or networks are key to the communication of creative ideas. Lewis and Romiszowski (1996) investigated the relationship between networking and learning organisations in education. They recommended at the time that further research was required to explore the optimum mix of networking and other learning activities as well as the decision making factors that influence the level of support given to innovations (1996, Section 4.1.2). Networking is common in business practice and its principles should also apply to schools. Networks are the means of diffusing innovations. Whilst interaction in networks is mostly informal, it is part of an organisation's larger knowledge management strategy for knowledge creation (Steiner 2004, p.1). Steiner identifies clusters and networks or social technologies as a regional development tool as well as a means of co-operative knowledge creation and diffusion between regional structures and individual companies. Clusters and networks are *"the result of an evolving process shaped by policy activities and entrepreneurial behaviour responding to new challenges"* (2004, p.4). While Steiner argues that to be excluded from clusters or networks exacerbates the economic divide (2004, p.2) in a business sense, to be excluded in an educational sense would have similar effects over a knowledge divide.

The most important spill-overs occurred at the proverbial 'waterhole', training sessions and seminars, through the appointment of new staff and on-the-job learning (Steiner 2004, p.9). Within networks similar levels of thinking linked joint research and development activities, management learning through improvement of routines and procedures and marketing through development of new products together with clients. The clusters therefore played the role of learning organisations. Within the different clusters, there was variation in the degree of collaboration. Some shared and created knowledge in an informal way, some in a more organised way and others working on research

and development together with tertiary institutions (Steiner 2004, p.8-10). If applied to schools, the same principles apply. It is imperative for teachers to have access to and make use of clusters or networks in order to remain updated with creative ideas rather than have to rely on their own resources. Schools, as learning organisations, need to optimise interactive learning within such clusters to encourage the diffusion of innovative ideas.

2.4.3 Innovation and schools

Schools are required to respond as organisations to policy change. Innovations are diffused within a school as follows:

> *"A ministry of education or a municipal or regional equivalent can request or require teachers to teach in specified ways but this will not guarantee that they, in fact, behave as desired. The school principal will attempt to enforce such an administrative request with greater or lesser enthusiasm and teachers will demonstrate the same variability in following the directions of the principal. Thus, it is important to understand how innovations in education come to be adopted or rejected by teachers"* (Venezky & Davis 2002, p.20).

Organisational innovation is *"substantive planned change in a school system to solve a problem, without regard for whether the change resulted in the adoption of novel or traditional procedures"* (Venezky 2004, p.5). This view contrasts with that of Clarke *et al.* (2000, p.17) who state that changes in larger systems force new innovations to emerge, that is, change needs to occur first. Venezky is describing innovation as planned organisational change whereas Clarke *et al.* describe innovation as resulting from change. Venezky states that *"where teaching innovations occurred, most of the major components of planned change were present"* (2004, p.10). These differences aside, either way, both Venezky and Clarke *et al.* recognise the dynamic interplay between change and innovation, innovation and change. What is not clear from the literature is the *cycle* of innovation and change, that

is, whether change (a condition) supports innovation, or whether innovation (a changed learning process) results in change.

There is a difference between the acquisition of an innovation and its deployment (Venezky & Davis 2002, p.22). Venezky and Davis provide examples of staff acquiring good personal ICT skills, but not integrating them into the teaching and learning process because of either lack of professional development in this area, or lack of appropriate infrastructure or access to it. They argue that where such a differential gap is large then policy predictions will be false. Accordingly, diffusion could refer to a variety of aspects: to teachers' ICT competencies, to their classroom practices with ICTs or to the use of ICTs for professional and community purposes. Venezky & Davis also identify the difference between diffusion into the organisational structure of a school and diffusion into its pedagogical structure (2002, p.22).

The problem with innovation in schools is the proliferation of *"disconnected, episodic, fragmented, superficially adorned projects"* which cause overload (Fullan 2001, p.21). Similarly, Cros (2000, p.69) challenges the idea of innovation in schools asking what it is that those who wish to disseminate innovations want to achieve. She argues that an innovation cannot be transposed without a recurrence or renewal of the process. Each individual has to *"re-invent a new way of working together in a socially constructed space"*. In a sense she is linking to Sherry and Gibson's mutuality in that if there is convergence, then there needs also to be a mutual benefit for the innovation to take hold.

Innovation does not necessarily follow from policy changes and particularly in secondary schools: where innovation occurs it is as likely to counter trends as to support trends (Glatter *et al.* 2005, p.382). Glatter *et al.* attribute this to the dominant grammar of the secondary school and argue that structures for the evaluation and dissemination of innovation need to be established (2005, p.383). Innovation requires not only ideas, but consistent planning, evaluation

and dissemination (OFSTED, 2003, p.69) particularly as in schools, compared to corporate organisations, risk is a far more significant factor (Glatter *et al.* 2005, p.383).

Three aspects of innovation need to be understood within schools: the *predispositions* to innovation, the *pressures* towards innovation *and the potentialities* for innovation (Hargreaves 2000, [italics in original]). Predispositions are the inclination of the organisation or its readiness to engage in new ideas: the stronger the controls, the more stifling the culture will be towards innovation. Pressures are the forces that drive innovative educational activity even in the face of antipathy towards innovation. Potentialities are the factors that make it easier for a school to engage in the kind of innovation that it desires e.g. schools that are well-provisioned with ICTs are in a stronger position to use ICTs for organisational change (2000, p.52-53).

Schools in the complex knowledge society need to become learning organisations with innovative structures and processes that encourage the development of professional learning capacity to cope with unpredictable and changing environments (Senge 2006, p.308). A school as a professional learning community (Wenger 1998, p.2) emphasises collaborative opportunities amongst professional teachers. It also focuses on teaching and learning and the collection and use of assessment and other data to evaluate progress over time (Giles & Hargreaves 2006, p.126). Giles & Hargreaves point out that professional learning communities are difficult to establish in secondary schools because of hierarchical administration and the strong subject-based structure that counters collaboration. They also identify the conflict between informal relationships in a professional community and formally established collaborative networks (2006, p.127).

A paradoxical tension exists between change and innovation (Giles & Hargreaves 2006, p.152). Teachers can cope to a certain extent with the change forces that threaten the sustainability of innovations and offset the

"evolutionary attrition of change" by distributing leadership, planning for leadership succession, managing community relationships and renewing their teacher culture, but they cannot withstand the standardised reform agenda that undermines their innovative efforts. Detailed, prescriptive reform also undermines professional learning communities (2006, p.152-153).

For innovations to flourish, it is critical that the *"mechanisms which can sustain and encourage"* innovations are understood (Sharma 2005, p.51). Sharma argues that while individual or pedagogical innovations at the classroom level are important, school level innovations are *"far more complex and challenging"*. Individual innovations need to be encouraged and supported for them to be sustained at school level. Whilst the need to adopt innovations at school level has been repeatedly recognised examples are scarce and research on the organisational perspective in schools is rare (2005, p.52).

For innovations to succeed in schools the following conditions, as identified by Sharma should be present:

- supportive leadership in an atmosphere of trust and collaboration and a tolerance of constructive controversy and risk taking
- networks to encourage lateral thinking rather than strongly hierarchical structures that discourage creativity and innovation
- resources are essential to innovation, but an abundance of resources does not guarantee innovation
- effective group processes: group members need to be part of the processes of decision-making and setting objectives
- organisational goals and objectives need to be outlined clearly
- mutual concern for quality as well as positive support (2005, p.54-56).

In describing his study, Sharma (2005) focuses on schools that have implemented innovative practices in teaching methodology, curriculum design, evaluation, resource mobilisation or administration for more than five years. He points out that while research has provided useful information on innovations in education, there is little that provides insight into how such

innovations are initiated and managed and calls for further studies to enable understanding of the processes that facilitate or inhibit innovation (2005, p.58). In Sharma's study the choice of school is once again based on exemplary features and his is a management-orientated perspective conducted by an outside researcher.

The degree of complexity of an innovation affects the implementation process (Rowan, Camburn & Barnes c.2005, p.17). Whilst simpler designs can be implemented more smoothly and faster, more complex designs produce more fundamental change, but only if it is delivered in small sequential steps. In some designs instructional practices are clearly described, in others they are not specified and teachers are given the aims, such as *"authentic, learner-centered, interactive, continuous and inclusive learning"* but not the tools (Rowan *et al.* c.2005, p.19) and are expected to rely on their own *"discovery learning"*.

The response of a school as an organisation to mandated change is therefore a complex process. However, it is a process that is intertwined with teacher innovation as, without teacher innovation the purpose of organisational innovation cannot be achieved.

2.4.4 Innovation and teachers

Much of the focus of innovation in schools has been from an organisational perspective. However, Fullan and Hargreaves (1992, p.1) focus on the teacher's role in innovation arguing that the successful implementation of innovations is directly related to teacher development. They argue that effective implementation involves alterations in curriculum materials, instructional practices and behaviour, as well as in beliefs and understandings on the part of the teachers involved. Essentially, implementation of an innovation is a learning process. Fullan and Hargreaves point out that schools not only implement one single innovation at a time but are typically required to manage *"multiple innovations simultaneously"* (1992, p.4). Little is

known or understood about the *"teacher's sense of purpose, the teacher as a person, or the context or conditions under which they work"* (1992, p.4). To understand these elements requires a professional development process that allows teachers to act on their sense of purpose, provide them with the opportunity to voice their opinions, assumptions and beliefs and to create a collaborative community together. The process should also take into account individual characteristics such as age, gender, career stage and life experiences that might affect their response to an innovation. Secondary school contexts provide very different challenges to primary schools and socio-economic factors also play a role. According to Fullan and Hargreaves, collaborative work cultures that promote continuous teacher development rather than individualism are essential (1992, p.6).

Later research indicates that the type of professional learning opportunities that teachers require in order to be able to innovate with ICTs is still being called for, almost a decade after Roschelle *et al.* (2000, p.76) called for a focus on the pedagogy rather than the technology. Such opportunities include:

- pedagogical development days and workshops (OECD 2000, p.116; Fogelman, Fishman & Krajcik 2006, p.186)
- a culture that epitomises a learning organisation (OECD 2000, p.116)
- collaborating with colleagues on organisational, pedagogical and pastoral issues (OECD 2000, p.117; Peurach, Glaser & Gates, 2004, p.5-6; Fogelman *et al.* 2006, p.186)
- developing expertise in student-centred learning (OECD 2000, p.117)
- the ability to use and integrate ICTs (OECD 2000, p.118)
- networking (OECD 2000, p.124; Rowan *et al.* 2005, p.38)
- embedding professional learning in the development of instructional materials (Rowan *et al.* c.2005, p.22)
- setting up model classrooms (Rowan *et al.* c.2005, p.22)
- providing on-site instructional leadership and support for learning design (Rowan *et al.* 2005, pp.22, 39)

- ensuring common planning periods to discuss practice (Rowan *et al.* c.2005, p.22)
- leadership attitudes; opportunity to collaborate with colleagues (UNESCO 2004, p.61, 119)
- adapting hierarchical structures to enable collegiality, collaboration and strong relationships (Giles 2006, p.13)
- leadership to provide clear short and long term goals and buffer teachers from distractions (Rowan *et al.* c.2005, p.22)

Whilst the need to improve teaching and learning is an important focus for teachers, individuals manifest an internal need to innovate tied more to their teaching style than to their subject (Lane 2001, p.88). From his research in tertiary institutions Lane concludes that teaching and learning innovations are sustainable when they become part of and are integrated within the individual and that institutionalisation and integration of innovation on a personal level cannot be separated. Interactions with colleagues are crucial to continuous learning about different innovations and helping teachers avoid pitfalls in sustaining the innovations (Lane 2001, p.89-90).

Innovation diffusion theory is also applicable to the study of ICT innovations and has provided insight into ICT integration (Prescott 1995, p.16) as product innovation. According to Prescott, the resulting research has contributed to the development of innovation diffusion theory as well as providing guidance in the introduction of ICTs, particularly in the workplace. The next section will consider this link between innovation and ICT integration.

2.4.5 Innovation and ICT integration

Innovation in the educational context is defined as pedagogical practices that promote active and independent learning; encourage collaborative and project-based learning in real-world contexts; heighten sensitivity to individual needs and diversity; redefine traditional space and time learning configurations; and increase parent and community connections with the

school (Mioduser *et al.* 2003, p.26). Together with Nachmias, Cohen, Tubin and Forkosh-Baruch, Mioduser conducted a series of investigations on pedagogical innovations involving ICTs in Israeli schools. They developed a configuration of factors involved in these innovations (Nachmias *et al.* 2004, p.70). The factors included roles within the school; roles outside the school; learning configuration; organisational climate; staff training; ICT infrastructure and ICT policy. These factor all impact on more central factors such as student role; curriculum; teacher role and learning configuration.

There are many similarities between Tearle's (2004, p.345) model of the implementation process and that of Nachmias *et al.*'s. Both were derived from the literature and tested in practice, although while Tearle's was tested against a single case study, that of Nachmias *et al.* was tested against a range of ten schools. Although Tearle focused on the implementation of the technology, while Nachmias *et al.* focused on successful innovative educational pedagogies (Nachmias *et al.* 2004, p.296), both highlight the inter-relatedness of contextual factors. At the centre of Tearle's diagram is ICTs in practice; at the centre of Nachmias' is the interplay of curriculum, learning, teacher roles and student roles. However, similar to Tearle, the Israeli research series focused on the exemplary, selecting specific innovative practices within the schools and not schools as a whole as described in the report by Tubin *et al.* (2003, p.8). Whilst the Israeli research provides a model for what should be, it does not account for schools in general that may not be considered exemplary.

Numerous factors affect innovation, but do so unevenly (Nachmias *et al.* 2004, p.305). In the light of the findings of Nachmias *et al.* that personal knowledge acquisition by leading staff is more significant than organised staff training, they claim that the contention of teacher training as significant is only partially correct (2004, p.305). Nachmias *et al.* confirm Venezky and Davis's (2002, p.22) view that computers alone do not create innovation, although they found that many schools still interpret the student-computer ratio as an

indicator of the extent of ICT implementation. They acknowledge that their research produced shallow results and suggest that a much wider study involving many more schools would be necessary to validate their results. Nachmias *et al* suggest that further research investigates the relative importance of the factors; their relation to the innovation life-cycle; the correlation between the factors; and the nature and properties of innovation (2004, p.306-307).

A further phenomenon from the Israeli study is identified by Tubin *et al. (*2003). Termed the *"islandness"* phenomenon, Tubin *et al.* found that an innovation was limited by its specific characteristics and demands on resources amongst surrounding traditional practices (2003, p.22). However, this did not apply to all instances and in many cases there were intricate webs of innovation, not limited to ICT-related practices. With regard to the "*islandness"* phenomena, Tubin *et al.* recognise the potential for identifying and examining the whole set of factors e.g. human resources, infrastructure, staff training, policy, outside-school agents affecting the emergence and sustenance of innovative practices within schools.

Further significant studies that have investigated the relationship between ICTs and innovation, reform or change include that of Owston (2006); Venezky and Davis (2002) and Venezky (2004). Owston's model for sustainable classroom innovations (2006, p.8) resulted from his analysis of school and classroom contexts based on data obtained from the SITES M2 data (Quellmalz & Kozma 2003). Venezky and Davis (2002, p.4) describe the impact studies on ICT and organisational change and ICT and information handling skills initiated and conducted by the OECD/CERI in 1998. The focus of the case studies was to understand the relationship between ICT and educational innovation. They identified far-reaching changes taking place in schools within the OECD countries:

> *"… a variety of instructional reforms driven by a perceived need to reorient schooling from rote learning, shallow but wide coverage, and individualistic learning processes to higher level skills, problem solving, in depth study, and collaborative learning"* (Venezky & Davis 2002, p.5).

The central finding of Venezky and Davis's study was that ICT rarely acts as a catalyst by itself for schooling change, yet it can be a powerful lever for realising planned educational innovations (2002, p.13-14). They show how the intended use of the ICTs to realise particular goals lead to their conclusion of ICTs as a lever rather than a catalyst. According to Venezky and Davis a catalyst is an agent that provokes a specific, anticipated change, but can act beyond its immediate goal. A lever, on the other hand, must be applied intentionally to produce a desired change. If ICTs were catalysts then expected changes would result from their introduction, which the OECD studies that they analyse demonstrated did not happen (2002, p.10-14). Venezky and Davis argue that the distinction between a catalyst and a lever is critical for policy:

> *"If the mere application of ICT within a school generally led to more student centred teaching, then countries that desired changes in that direction could focus resources solely on bringing a strong ICT infrastructure into schools and assuring that teachers used it in their teaching. The opposite finding, which is what we are reporting, leads to a different strategy wherein both the ICT infrastructure and the planning and professional development for pedagogical change are required to achieve more student centred teaching. However, ICT can act as a lever for change, providing a strong push toward innovative practices, but the direction of change must be carefully mapped in advance and the staff prepared for it"* (Venezky & Davis 2002, p.14).

In certain cases Venezky and Davis found that where ICTs had been introduced as levers for particular purposes, they had a catalysing effect on other aspects of schooling (2002, p.15).

ICT implementation at a school level should be viewed in the context of school improvement plans and not simply as a technical issue. Problems that schools face should be identified, strategies for overcoming these problems designed, and progress indicators designated. The highest returns on ICT in education appear to come when ICT is seen as part of a strategy for solving an important problem rather than as an end in itself (Venezky & Davis 2002, p.42-43).

There is a complex relationship between ICTs and innovation in schools. Innovation in schools is pedagogical practice supported by ICT, but factors affect innovation unevenly. Certain characteristics of innovations can be limiting and conflicting demands may impact its implementation. ICTs are often assumed to be catalysts for change, but, as argued by Venezky and Davis, they should be used as levers for change. For an innovation to be sustained there need to be mechanisms in place to ensure that their benefits are shared. However, the notion of sustainability also requires clarity.

2.4.6 Sustainability of innovations

The terms 'sustainability' and 'institutionalisation' are often used interchangeably. Institutionalisation occurs when an innovation is assimilated into the culture of an organisation and becomes a part of it, losing its own identity (Miles 1983 cited in Billig, Sherry & Havelock *et al.* 2005, p.987). A sustainable innovation is one that retains its own identity and endures over time as part of the organisational culture (Billig *et al.* 2005, p.987).

Schools that consciously establish themselves as learning organisations and professional learning communities are not always able to sustain their early promise of success in the face of predictable cycles of the attrition of change

(Giles & Hargreaves 2006, p.124). Giles and Hargreaves found that innovative schools possessed some properties of learning organisations and professional learning communities, but were unable to sustain the innovations over time. This ability of schools to sustain innovations over time is addressed by Mioduser *et al.* (2003, p.6) who identify the institutionalisation process as the key element. To be institutionalised requires the innovation to be integrated harmoniously into the *"grammar of schooling"* (Tyack & Tobin 1994, p.453) or the structure of the school as an organisation.

Sustainability is also measured not only by time but also by space: by social organisations, human interactions and virtual spaces (Hargreaves 2002, p.194-197). Two further conditions for sustainability are identified by Mioduser *et al.* (2004, p.7). These conditions are transferability (or the extent to which an innovation succeeds in other settings) and scalability (or the ability of the innovation to perform optimally as it develops). However, as Owston points out, it is the benefit that derives to student learning that is the ultimate test of sustainability of any innovation (Owston 2006, p.14). On the other hand, Louis (2006, p.170), in referring to Giles and Hargreaves' research, notes that it is external pressures such as accountability and budgetary decisions that grind away at school innovation and undermined the creative efforts of teachers.

This section has taken the theoretical perspective of innovation and the diffusion of innovations and explored the implications of innovation for ICT integration. However, the concept of innovation is embedded in the notions of 'change', 'reform' and 'transformation'. It is therefore necessary to establish clarity on these terms and their implications for ICT integration and for whole-school contexts.

2.5 Change, Reform and Transformation

This section will attempt to clarify the nature and understanding of the concepts of 'change' and its associated terms, 'transformation' and 'reform'

and their link to the concept 'innovation' and illustrate the relationship between the terms. The section will also touch briefly on the links between teachers and transformation and between student competencies and transformation.

Hargreaves and Fink (2000) use the terms change and reform interchangeably. In their article on educational reform they refer to *"educational change agentry requiring more than strategies to promote change"* (p.2), *"the ultimate goal of educational reform … continents of change"* (p.5), *"deep and sustainable transformations"* and *"deep, sustainable, generalisable reform"* (p.5). On the same page (p.5), they refer to *"three moral and strategic touchstones of reform"* directly under the heading *"Touchstones of three-dimensional change"*. Their example is typical of the assumed interchangeability of the terms. However, they do also refer to reform in the policy context (p.5), to transforming educational systems (p.1), to *"technological, structural and curriculum innovations"* in schools (p.3) and change as "*what actually happens over time"* (p.2) or the capacity for change (p.4), implying that the four terms refer to each of these domains.

Educational reform is understood as *extrinsic* mandated change such as the *No Child Left Behind Act* in the USA or the Ontario reforms (Jordan 2001, p.349). These reforms came about for economic reasons: the former to improve the skills base of American students and the latter, although it included curricular reforms as part of the process, was designed to effect budgetary limitations (Hargreaves 2003, p.74). In South Africa, educational reforms were designed to address the multi-faceted inadequacies and inequalities of the restrictive apartheid era education policy, as part of national democratic reforms. These reforms have evolved over the fourteen years of democracy into an outcomes based, inclusive education policy and curriculum in which human rights are deeply embedded. However, legislated reform does not precipitate transformation or actual change taking place in practice in schools (Venezky & Davis 2002, p.6; Elmore 1996b, p.23; Billig, Sherry & Havelock 2005, p.998). Global and local societal and technological changes

also set an agenda for reform in schools that, although not mandatory, cannot be ignored. Advances in the understanding of cognition and learning processes suggest the need for reforms in teaching and learning approaches that require radical alteration of teachers' paradigms and pedagogy.

Schools throughout the 20th Century were typified by features such as classes, lessons, age grades, subject-based curricula and lesson-based timetabling and testing (Tyack & Tobin 1994; Giles & Hargreaves 2006, p.124). Tyack and Tobin (1994, p.453) refer to these typical features as the *"grammar of schooling"*. As 20th Century schools attempted to reform through introducing interdisciplinary or open-plan innovations, these grammar of schooling features restrained them and the innovations were short-lived. Where innovative schools have emerged, they have failed to sustain innovative momentum for three reasons (Giles & Hargreaves 2006, p.125). Firstly, they are perceived as *"unlike real schools"*. Secondly, their life-spans are predictable and evolutionary, moving through the stages of *"creativity and experimentation, overreaching and entropy and then survival and continuity"*, after which they succumb to cumulative forces such as parental expectations, pressures from surrounding institutions and some teachers proclivity to the conventional grammar of schooling. The third reason is the occurrence of critical incidents such as reduction in resources and changing power relations (Giles & Hargreaves 2006, p.125).

The effect of mandated reforms on teachers is immense (Hargreaves & Goodson 2006, p.34). Mandated reforms often require teachers to spend so much non-classroom time in meetings or administrative duties that little time remains for informal interaction. Other teachers resist reforms to defend both student and teacher rights and learning and teacher needs. Mandated change or the 'top-down' approach often occurs on a large scale and does not necessarily change how teachers and students experience schooling or what is done in classrooms (Assié-Lumumba 2004, p.78; Hargreaves 2000, p.54; Rowan *et al.* c.2005, p.3). Rather, successful improvement depends on the

interplay of external change agents, school leadership and teachers and students working co-operatively. In other words, the actual changes that happen are 'bottom-up' or ultimately dependent on what happens in the classroom (Rowan *et al.* 2005, p.2). Hargreaves suggests that the problem with most large-scale reforms is that they are not trialled beforehand by governments who are therefore loath to admit when the reforms do not work (Hargreaves 2000, p.56). The question arises of the extent to which *any* educational reform or innovation is trialled beforehand.

Transformation, on the other hand refers to the pedagogical and curricular changes that happen *as a result of* educational reforms, despite educational reforms or as a reaction *to* or against educational reform (Fullan 1991, p.4). Transformation is therefore *intrinsic*. Transformation may take place at different levels: in student and teacher thinking, within a subject or grade level, or across an entire school organisation or district. However, as pointed out by Carlson (2005, p.42), a school exists within a "*discursive economy"* that is unique and efforts to transform need to take cognisance of the complex characteristics of that economy. Mehan *et al.* (2005, p.356) concur with this view in cautioning against applying reforms successful in one school in another with a different context or at a different level (e.g. from primary to secondary school). It is also necessary to understand constraints on teachers' change efforts in order to be able to support such efforts (Rousseau & Powell 2005, p.29-30). Change cannot be managed or controlled, but it can possibly be led (Fullan 2001, p.33). According to Fullan, a clear understanding of complexity science is essential to lead change because leading change means *"unlocking the mysteries of living organisations"* (2001, p.46).

Transformation results from a dynamic interplay of change and innovation. Mehan *et al.* (2005, p.353) describe how introducing innovations into complex systems can result in push-back factors which are *"sometimes predictable, sometimes mysterious"*. These factors have technical, cultural and political

dimensions. In the case described by Mehan *et al.*, technical factors related to capacity and cultural factors concerned the meanings teachers attributed to *"new norms, beliefs and standard operating procedures"* which conflicted with their *"long standing and deeply held beliefs about leadership and teaching roles"*. Political factors emerged from district power dynamics. They suggest that reform is *"a messy, dialogic, and convoluted process, not a linear, direct, and rational process … [that must] … actively engage participants from all local contexts in [its] co-construction"* (Mehan *et al.* p.353-355).

The process of transformation, or the cycle of change and innovation, in any secondary school is not linear, but part of an evolutionary process. Each school will manifest patterns of *"emergence and sudden decay"* in innovations that arise, but are not sustained (Clarke *et al.* 2000, p.1-5). Clarke *et al.* apply systems thinking and complexity theory in an attempt to understand complex transformation patterns in their case studies of Vermont schools. Their work complements that of Tearle (2003, 2004) referred to above, but removes the centrality of ICTs as a change agent and locates them comfortably within the wider transformational context as expressed by Fullan:

> *"It is no longer sufficient to study factors associated with the success or failure of the latest innovation or policy. It is no longer acceptable to separate planned change from seemingly spontaneous or naturally occurring change. It is only by raising our consciousness and insights about the totality of educational change that we can do something about it" (*Fullan 1993, p. vii).

Secondary schools adapt less readily to change than elementary schools and particularly to the changing needs of their students (Hargreaves & Goodson 2006, p.4). Amongst the reasons for this are their size, their complex hierarchical structures, their focus on subject disciplines and their alignment to university entrance (Hargreaves & Goodson 2006, p.4). Given these circumstances, it is very difficult for innovations to become institutionalised.

Change processes need to be studied in context and over a long period of time rather than as detached episodes (Pettigrew, Woodman & Cameron 2001, p.3; Hargreaves & Goodson 2006, p.5; Labaree 2006, p.157) and over a broad cross-section of settings (Hargreaves & Goodson 2006, p.13). Hargreaves and Goodson identified five change forces that had the most significant impact on the structure, culture and identity of schools over time (2006, p.13):

- waves of policy reform
- changes in leadership and leadership succession
- changing teacher demographics and their impact on teachers' generational missions
- shifting student and community demographics and
- changing patterns of relations among schools

To understand change and change forces is therefore to understand context and the effects of context over a period of time. Labaree (2006, p.157) advocates longitudinal studies to understand change as *"an interaction between school and context over decades"*.

Determinants of change include competencies determined by the workplace and that are built into curricula. These competencies are now described.

2.5.1 Student competencies and transformation

Skills required of the 21st Century workplace and therefore of school-leaving students are determinants of change. Determinants include, for instance the SCANS[10] competencies or the similar skill prerequisites embedded as critical outcomes in South Africa in the Revised National Curriculum Statement (DoE 2002, p.4) at school level. The extensive OECD DeSeCo project resulted in a framework of inter-related competencies (2005, p.10-15) that students nearing the end of their schooling careers could be expected to posses to enable them

[10] SCANS = US Departments of Labor and Education Secretary's Commission on Achieving Necessary Skills

to participate fully in society. These SCANS competencies and their indicators are summarised in Table 2.5.

The expectations of competent individuals are therefore that they are able to use a wide range of tools for interacting effectively with the environment including both physical ones such as ICTs and socio-cultural ones such as the use of language. They need to understand such tools and be able to adapt them for their own purposes, to use tools interactively. Secondly, in an increasingly interdependent world, individuals need to be able to engage with others, and interact in heterogeneous groups. Thirdly, individuals need to be able to take responsibility for managing their own lives, situate their lives in the broader social context and act autonomously (OECD 2005, p.5). The implication of these student competencies is therefore that they are prerequisites of teachers responsible for the education of their students.

Table 2.5: Framework of inter-related competencies (Summarised from OECD 2005 pp.10-15)

Category of competency	**Indicator**
Using Tools Interactively	The ability to use language, symbols and text interactively The ability to use knowledge and information interactively The ability to use technology interactively
Interacting in Heterogeneous Groups	The ability to relate well to others The ability to cooperate The ability to manage and resolve conflicts
Acting Autonomously	The ability to act within the big picture The ability to form and conduct life plans and personal projects The ability to assert rights, interests, limits and needs

2.5.2 Teachers and transformation

The traditional classroom is an autonomous zone in which the teacher is free to conduct his or her *"private practice"* (Mehan *et al.* 2005, p.7). However, the traditional classroom can also be an area of enforced isolation (Farmer *et al.* 2005, p.59). Both views need to be countered through effective professional

development (Farmer *et al.* 2005, p.59) to create communities of practice (Hargreaves 2003, p.98; Wenger 1998) and facilitate the development of key competencies in both teachers and students. Effective professional development places the teacher in the role of student, stimulating thinking in new ways of learning. This is essential to encourage *"culturally responsive pedagogy"* in which teachers learn to acknowledge and value the experiences of their students and learn how different a learning experience is from the content of a text book (Farmer *et al.* 2005, p.69). Through culturally responsive pedagogy teachers also learn how to recognise, value and discuss different learning styles and incorporate them in their learning designs. Also, teachers benefit from multiple assessment formats and discover what constitutes authentic assessment. A further aspect of professional development is that *"just as the best teaching empowers students, the best professional development empowers teachers"* (Farmer *et al* p.70). This culturally responsive approach addresses the concerns that culture is the most difficult aspect of a school to transform. Farmer's view aligns with Fullan's suggestions (2001, p.46) of change involving living organisations.

Teachers do not resist change per se, but resist change because they have not been provided with the opportunity to make sense of it (Fullan 1991, p.4). On the other hand, as maintained by Clarke et al. (2000, p.176), where teachers are able to understand the pattern of interactions that support change, it may assist them to shape the process of innovation and change.

In their study of five Vermont high schools Clarke et al. (2000, p.5) identify changes that are self-sustaining within their environments and have become *"permanent features in high schools across the state, with very little policy support from the standards movement"*. In these cases transformation occurred despite mandated reforms. They describe this polarity in terms of, on the one hand, a conservative systemic change that establishes policy structure, common goals, standards and measures of productivity to be applied across the school system. On the other hand, a progressive tendency

"move[s] change incrementally from the bottom of the educational structure, identifying elements of teaching and learning that succeed in one context, then seeking ways to generalize those elements to related situations", favouring responsiveness to individual needs. Clarke *et al.* conclude that both policy and practice need to be aligned for both to be successful (2000, p.6-7).

Clarke *et al.* explored and tracked the complex interaction between policy and practice during a period of dynamic change and developed a *"visible form for the invisible dynamics of change"*. The various stages of development culminated in their visual representation of *"Hypothetical phases of change"* (2000, p.31) and *"Hypothetical patterns of energy flow"* (2000, p.33). These visual representations showed that "*rather than new practices being developed to fit new policies, we discovered existing programs that were continuously adapting to new opportunities"* (2000, p.11). Clarke *et al.* have provided the framework that Tearle calls for in her recommendations as well as locating ICTs within the whole school context (Tearle 2003, p.581).

From their research Clarke *et al.* (2000) were able to draw inferences on student engagement (2000, p.153), the dependence of change on the presence of a *"dogged pioneer"* and support from reliable partners within and beyond the school (2000, p.154). They also found that:

> "*Increased interaction across organizational lines increased the rate and depth of the change process within the schools, … that promoting reform within any high school depends on expanding existing patterns of growth in that school, rather than on a unitary version of how change should occur in all settings*; … *that systemic change depends upon high levels of energy exchange among all levels of school organization, self-organizing to actualize a shared vision of student learning within that school" ...* [and that] *"change in high school teaching proceeds from existing strengths within a school program, gaining momentum*

> *through connections with related ideas that are also forming within a particular school"* (Clarke *et al. 2000,* p.154-155)

The dynamics of high school reform are explained by Clarke *et al.* through the features of complexity theory: "*adaptation, self-organising growth, confluence of energy, convergence of resources, mutual empowerment, organizational reciprocity and leadership density"* (2000, p.157). Change flows from the frequent interaction of individuals up to organisational level at the same time generating sustaining energy as innovations generalise and become part of the change process. Clarke *et al.* conclude that interactions need to be sustained between individuals across organisational levels (2000, p.156).

Sherry and Gibson built on Clarke and Gibson's model and extracted three principles from their research on adoption of ICTs by teachers that form a *Systemic Sustainability* model (2002, p.9). These principles – convergence, mutuality and extensiveness – categorise the interactions between different layers of a school system. The principles are critical processes that allow interactions between different levels of the system and are thus essential to the sustainability of transformation. Sherry and Gibson explain that convergence refers to the highest level of a school hierarchy – classroom, school, district or virtual learning community – to which an innovation diffuses. For example, an innovative teacher will be able to influence colleagues in different departments if support is offered by the school leadership. Mutuality refers to the need for a common benefit of the innovation to either side of a boundary. Mutuality ensures the flow or confluence of resources and influence across boundaries, particularly through dialogue between individuals, for example, encouraging an innovative teacher to provide peer leadership will encourage further innovation by that teacher as well as assist the diffusion of the innovation into other classrooms. Extensiveness refers to the extent to which an innovation reaches across all levels of a school system and is sustained over time. The important features of the innovation need to be identified and supported in *all parts of the system*. Where resources

converge, sparking mutual benefits across at least two levels, further extending their influence over time, systemic sustainability is possible and transformation occurs (2002, p.7-9).

The terms reform, change, transformation and innovation, whilst often used interchangeably in the literature, are therefore understood in the following way. Transformation is the expected process or processes through which schools within the educational system strive to meet the requirements of mandated or top-down reforms. Change is what actually happens within a school as an organisation as a result of transformational processes, although the resulting change may or may not be what is intended by the actual reforms. Innovations are the changed practices as implemented in the classroom. Innovations may be personalised, that is, emanating from an individual teacher's own pedagogical practice, or institutionalised, resulting from a top-down developmental process. The interrelationship of these terms is illustrated in Figure 2.3 below.

Figure 2.3: The interrelationship of reform, transformation, change and innovation in the school context

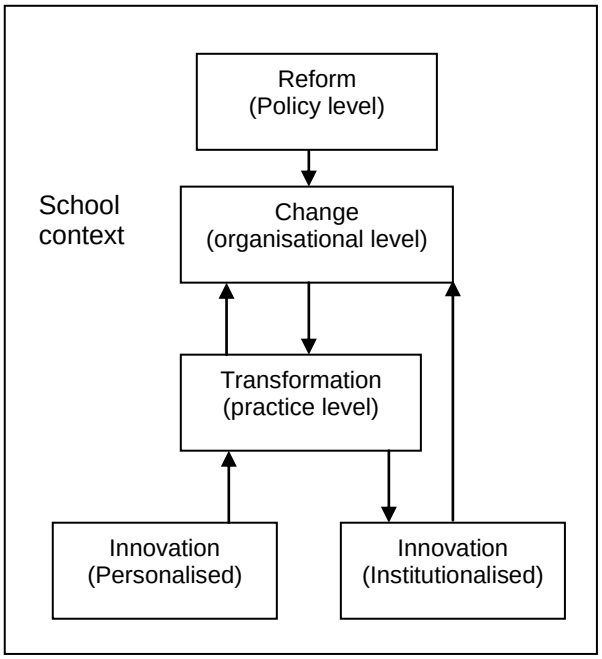


Figure 2.3 illustrates how reforms are generated at policy level for implementation at the organisational level. As implementation proceeds, change happens within the organisation as a whole. Transformation happens in teacher practice when changes are internalised at the personal level. As transformation in practice spreads, innovations become institutionalised and change is accomplished.

The relationship between ICTs and transformation will now be explained.

2.5.3 ICTs and transformation

Early expectations of ICTs were that they would revolutionise schools. However, if ICTs had only to be provided in order to effect such a revolution then that revolution should have occurred. Whilst ICTs can contribute to the transformation of learning environments, they cannot do it by their mere presence alone. Brackett explains the issue of ICTs and transformation in this way:

> *"Technologies do not change schools in any sense worth talking about. Thoughtful, caring, capable people change schools, sometimes with the help of technology, sometimes not and sometimes even despite it. Too often, we focus on the technology rather than the reform. … Admittedly, some reforms might seem impossible without new technologies. But the essential reform here … is the engagement of these students in doing real science, in collaboration with real scientists, instead of reading and talking about science and repeating memorized science factoids. … It's the pedagogy, not the technology that's the key. … It's a mistake to put technology centre-stage as we plan and execute educational reforms"* (Brackett 2000, p.29-30).

In contrast to Brackett's view, there is a tendency to perceive ICTs as the salvation of education such as espoused by Blasik *et al.* (2003, p.44). On the strength of one successful project she states that "*districts across the nation*

can replicate a program that ensures high school completion while readying students for college education, post-secondary technical study and mid- and high-level employment". Tearle (2003, p.579) also refers to *"the more exciting and challenging vision of ICT to revolutionise the way we teach, or facilitate others to learn"*. Beastall (2006, p.97) is more circumspect of the potential of "*technology transforming [the] British education system"* echoing in response to this adage Windschitl's earlier call to concentrate on pedagogy, not ICTs.

Without comprehensive reforms involving contextual variables the benefits of ICT integration to student learning cannot be achieved and ICT integration cannot be understood. These variables include instructional leadership, extensive professional development, a whole-language approach to learning, establishment of libraries, de-emphasis on remediation and emphasis on fostering student creativity (Carrigg & Honey 2003, p.6). Similarly, Scrimshaw (2003, p.93) locates ICT integration within curriculum innovation, recognising that new developments can originate at school, community, national or regional level and be disseminated in a variety of ways. Scrimshaw echoes the competencies (Ch.2 Table 2.5, p.81) suggesting that schools should be able to provide universally high levels of achievement in core skills, achieve greater levels of competence in *"workplace attitudes and skills and develop school leavers with the attitudes, motivation and skills needed to equip them for a life of self-managed learning"* (p.89). Scrimshaw offers (2003, pp.93-97) various complex curriculum scenarios at global national, local and school levels, supported by network connectivity, which all depend on the level of ICT integration in individual schools.

Accordingly, the integration of ICTs in secondary schools is interwoven in complex ways with the whole school context. To understand ICT integration therefore requires an understanding of the complexities of context. To understand context it is necessary to understand the interactions within the context. Such interactions are defined within complexity theory. The pathway to complexity as the theoretical underpinning of this study was influenced

particularly by the work of Clarke *et al.* (2000) and of Sherry and Gibson (2002) on innovation and interactions within complex contexts. The next section will therefore explore complexity theory and its application to school contexts and to ICT integration and show the derivation of the conceptual framework for this study.

2.6 Complexity theory

This section will consider literature relating to complexity as a theoretical underpinning to the integration of ICTs in schools. Complexity theory is defined and described and then related to knowledge and learning, to schools and to the integration of ICTs in schools in terms of organisational behaviour.

2.6.1 Complexity theory and organisational behaviour

Complexity theory falls within the ambit of systems thinking (Boulding 1956, p.197; Senge 2006, p.69; McElroy 2000, p.200) as applied to organisations as well as to the physical sciences (Davis & Sumara 2005, p.443). *"Complexity theory, or the science of complexity, is the study of emergent order among disorderly systems. Complexity theory offers an explanation of how cognition happens in human social systems … systems thinking applied to the behavior of natural systems"* (McElroy 2000, p.196). With origins in 19th Century evolutionary and social science thinking, complexity theory emerged in the 1950s in response to a need for a way of explaining the complex relationships between disparate phenomena within the empirical world (Boulding 1956, p.197). Complexity theory does not assume a single theory as the explanation of everything; rather, it aims to *"highlight similarities in the theoretical constructions of different disciplines"* (Boulding 1956, p.197). Complexity theory does not try to understand the whole by understanding its parts; but rather aims to understand the interaction of its parts (Phelps & Hase 2002, p.510). It is the interaction of such parts within a complex context that is of interest in this study.

Change in a complex system is dynamic and to understand the parts, it is necessary to understand the whole for it is small changes that force larger systems to adapt and changes in larger systems that force new innovations to emerge (Morris 1997, p.24; Clarke *et al.* 2000, p.17). At the same time, as each innovation affects its intended environment, the innovation itself must adapt in response to the change in the environment (Morris 1997, p.24). Change and adaptation are therefore mutually inclusive and contribute the dynamic element of complexity. Lissack (1999, p.120-121) notes that, whilst organisations had previously focused on *controlling* the uncertainty that arises from dynamic interactions, since the 1990s complexity science has focused instead on *understanding* and *channelling* that uncertainty.

Complex systems display certain characteristics. They are unpredictable (Davis & Sumara 2005, p.455), self-steering (Lissack 1999, p.112), non-linear (Wheatley 1994, p.119), structure-determined and emergent (Lissack 1999, p.112; Davis & Sumara 2005, p.455). Complex systems operate in identifiable complex patterns of interactions between change and innovation. Complexity theory describes the entities that generate innovation as agents. Multiple agents exist within a system. An agent could be anything from a neuron to an experience or an individual person, depending on the point from which the learning or change process is viewed (Doolittle 2001, p.2). Agents interact with each other producing energy. The greater the interactions, the higher the energy levels generated. The higher the energy levels, the less likely the predictability of the outcomes (Clarke *et al.* 2000, p.18). As innovations become embedded within a system, the more complex the interactions between agents become and the sustainability factor of the innovation rises. Sustainability emerges from within and cannot be applied externally therefore complex entities are largely self-steering. Multiple interactions form a non-linear web of systemic change (Wheatley 1994, p.118). Controlling uncertainty implies imposing a level of order within this web, whereas unbridled stimulation of creative energy can lead to chaos or weakening of its tensile strength (Lissack 1999, p.120-121).

Table 2.6: Six principles of Complexity Science (adapted from Webb & Lettice c.2005 p.2)

Principle	Associated organisational behaviours
Self-organisation & emergence:	*Organisations show self-organising behaviour is supported by an enabling environment. Self-organisation means that the system organizes itself, i.e. that the single agents of the system find a structure bottom-up on their own, without having a master-plan or an observational guider telling them how to organise.*
Edge-of-Chaos:	*The edge of chaos can be interpreted as the balance between structure and flexibility that a company needs to become robust. In complexity science, the edge of chaos, i.e. the zone between complete stability and complete chaos, is the area, where the system is most productive;*
Diversity:	*Organisations need a diverse set of agents to be successful and to enable an effective structure to emerge. In companies, this means that the right mix of people is indispensable for innovation and creativity. Self-organising teams cannot work if all team members have the same strengths and weaknesses; it is the combination of different abilities that makes such a system creative, but also robust;*
History and Time:	*Organisations have a sense of historicity. This means that, although the future behaviour of an organisation cannot be extrapolated from the past, the past of this system is still important for its present and future position;*
Unpredictability:	*The notion of unpredictability implies that the development of an organisation cannot be foreseen, i.e. not extrapolated from past behaviour) and not calculated on the basis of linear cause-effect relationships.*
Pattern Recognition:	*Organisational and employee behaviour show patterns. In the natural sciences these patterns can, for example, be observed in a flock of birds or the complex structures of bee hives. Human beings, however, have a natural urge to identify patterns in the evolution of complex systems, which can be helpful but also dangerous in the corporate context (because the human brain tries to identify patterns even if there are no patterns).*

Complexity theory differs from traditional analytic scientific theory in that it studies phenomena at the point at which they emerge or self-organise (Davis & Sumara 2005, p.455). In contrast, scientific theory relies on a conscious and deliberate process of prediction, experimentation, observation, pattern-recognition, hypothesising and generalisation (Cohen *et al.* 2000, p.16). The dynamic nature of complexity dictates the necessity for its phenomena to be

studied at this point of emergence. Phenomena may also display coherent collective behaviours which cannot be understood by reductionist analytical methods (Klein 2004, p.4). The notion of unpredictability is linked to the characteristic of structure determinism in which phenomena are inexplicably able to "*adapt themselves to maintain their coherence in the face of changing circumstances"* (Davis & Sumara 2005, p.455). As a consequence, the replicability requirement of traditional experimental methods cannot apply to the study of complex phenomena.

Webb and Lettice (c.2005, p.2) describe the characteristics of complexity theory as six principles associated with certain organisational behaviours (Table 2.6). These principles of complexity science were derived from research conducted in a Europe-wide corporate partnership (Webb & Lettice c.2005, p.2) and are intended to be used to help organisations deal with uncertainty. The principles may be applied equally to schools.

It is not only organisational behaviour to which complexity theory applies. Knowledge construction and the process of learning also manifest principles of complexity theory.

2.6.2 Complexity theory, knowledge and learning

Complexity theory applies to the body of knowledge and to the process of learning. Knowledge itself is no longer divided and compartmentalised in a linear structure but in a network, web or rhizome structure (Klein 2004, p.3) with infinite complex possibilities of interconnection and interaction. Knowledge generation is no longer the domain of venerated experts but of *"affiliations, coalitions and alliances"* through "*dialogue, interaction and negotiation"* (Klein 2004, p.3) at all levels. Knowledge sharing and knowledge construction underlie individual and social construction of knowledge and collaboration is necessary to such construction in schools (Reynolds 2005, p.67).

Complexity theory applies also to learning and thinking as an emergent process in which ideas and concepts are formed within a unique context and outcomes cannot therefore be predicted (Bloom 2001, p.23). Davis and Sumara (2005, p.458) extend Bloom's notion, referring to the *"nested organisation"* of individual and community. They suggest that all complex phenomena are cognitive agents or learners explaining that the brain is continuously evolving as it learns (2005, p.456). However, 'the learner' may refer to not only the physical entity of an individual, but also to the abstract concepts of organisation or community. Davis and Sumara's concept of this nested organisation of knowledge is illustrated in Table 2.7 below.

Table 2.7: The nested organisation of knowledge (after Davis & Sumara 2005 p.458)

Cognitive agent or body	Theory	Evidenced in
individual biological body	constructivism	individual knowing
social corpus	socio-constructionism	collective knowledge
society (body politic)	critical theories	cultural identity

Davis and Sumara suggest (2005, p.458) that each cognitive agent is concerned with a particular body. Each body learns in a different way: the individual through constructing knowledge, a defined group (e.g. a group of teachers) through socially constructed knowledge and a cultural group through power-related critical theory. Davis and Sumara describe these different bodies as nested: the individual within a social corpus, the social corpus within society.

Learning is a dynamic process of accommodation and self-organising adaptation (Doolittle 2001, p.5). Knowledge results from the interaction between the learner and the environment and learning or knowledge acquisition results from the construction of representative models filtered through and influenced by "*one's beliefs, culture, prior experiences, and language, based on interactions with others, direct instruction, and modelling"* (Doolittle 2001, p.5). Knowledge is therefore constructed through interactions

with multiple facets of the complex environment. Complexity increases as learning levels increase (Goodison 2003, p.10). Whereas "*complexity provides a metaphor for myriad phenomena … constructivism provides a metaphor for learning"*. From these metaphors Doolittle derives the concept of complex constructivism, which embraces the *"non-linear, adaptive, and constructive nature of learning"* (Doolittle 2001, p.16). The learning process is dynamic and complex in that at the point when new knowledge is understood it immediately changes the body of knowledge within the brain and forms a changed entity or frame of reference for the acquisition of further understanding. Any new idea that is introduced at any stage may lead to outcomes other than those predicted (Phelps & Hase 2002, p.515). Therefore, introducing innovations into a complex entity such as a school may often result in a differing effect to what is intended because of technical, cultural or political constraints (Mehan 2005, p.353).

The construction of knowledge and the process of learning are the business of schools. It is therefore logical that complexity theory will apply to the acquisition of knowledge through the processes of learning in schools. Schools are also complex entities in themselves.

2.6.3 Complexity and schools

Viewed from a complexity perspective a school or its components cannot be evaluated at a specific point before and after an intervention. Nor can an aspect of that school be fully understood in terms of either teachers as agents, students as agents or the organisation as agent. Instead, it is only possible to understand a school in terms of the *interactions* between agents.

Schools, and secondary schools in particular (Clarke *et al.* 2000, p.160), are recognised as complex systems (Bloom 2000, 2001 unpaged; Clarke *et al.* 2000, p.12; Davis & Sumara 2005, p.453; Doolittle 2001, p.9; Eadie 2003, p.2; Hennessy, Ruthven & Brindley 2005, p.6; Phelps, Hase & Ellis 2005, p.73) in which teachers, as agents of innovation, each contribute new understandings

from their unique perspectives (Clarke *et al.* 2000, p.160). The culture of a school is a "*complex web[s] of traditions and rituals that ha[ve] been built up over time"* (Deal & Peterson 2000, p.182).

The process of understanding how schools as organisations transform is "*both a complex and a messy business"* (Schmidt & White 2004, p.207). Structures and systems for formal learning in secondary schools are so well designed for stability that their systems limit adaptive growth, making transformation difficult (Clarke *et al.* 2000, p.5). The challenge to secondary schools therefore is to simultaneously maintain a balance between stability and change, between a predictable order and the unpredictability that produces new energy (Clarke *et al.* 2000, p.17).

When ICTs are introduced into the stable systems of schools they offer radically different opportunities that challenge these traditional systems in complex ways.

2.6.4 Complexity and ICTs in schools

The integration of rapidly evolving ICTs into school curricula, described by Scrimshaw as *"one of the largest and most complex curriculum innovations ever undertaken in schools"* (2003, p.85) adds a further degree of complexity to an already complex environment (La Grange, Artigue, Laborde & Trouche 2001, p.22) and can increase the rate of interactions with potential instability. Staples, Pugach and Hines (2005, p.307) concluded that the analysis of their study elucidated the complexity of the interactions between curriculum, technology and professional development, while Tearle (2003, p.567) refers to the underestimation of the "*complexity of the processes and culture shift"* required to achieve the potential of ICTs. Tearle refers also (2003, p.267) to the moving goal posts, suggesting that developments in ICTs are moving as fast as adaptation takes place, thereby maintaining the gap between actual and potential use. However, Tearle notes that some individual schools have managed to succeed in integrating ICTs into the curriculum, whilst others

have failed, despite the presence of enabling factors. Tearle argues that "*whole school contexts, goals and interpretations of the need and value of deploying ICT create a much more complex picture"* (Tearle 2003, p.568).

ICTs also provide students with the connectivity to explore an increasingly interconnected and complex world (Hargreaves 2003, p.xi), while paradoxically adding to the complexity of their world (Harada 2001, p.42). Skills that students need, including managing complexity (Dede 2000, p.301) are defined by the workplace; skills that students want are determined by their facility with technology, particularly mobile technology and video games. There is a need therefore to understand the difference between educators' and students' perceptions of what students need as well as to understand the paradox (Harada 2001, p.42) that ICTs present.

According to the literature, complexity theory therefore applies to schools as organisations, to the learning process and to the concept of knowledge itself. In the same way complexity applies to the integration of ICTs and to transformation within and of school environments. Finally, complexity applies to the convergent world in which all schools operate.

Davis and Sumara sum up complexity with eloquence:

> *"... even the most profound knowledge of the subsystems that come together to form a complex system will not help us to predict or to control the behaviors of such systems. The most thorough understandings of hearts, livers, brain stems and skin does not help us much in accounting for the emergence of such complex phenomena as consciousness and identity. Although these 'components' all contribute to such phenomena, their interrelation is too complex to understand through a process of fragmented study. It is the relations among them, not the things themselves, that are productive and, as such, of interest"* (Davis & Sumara 1997, p.114).

To understand complexity is to understand the dynamic interactions that constitute the temporal relationships of school contexts.

2.7 Summary of the literature review

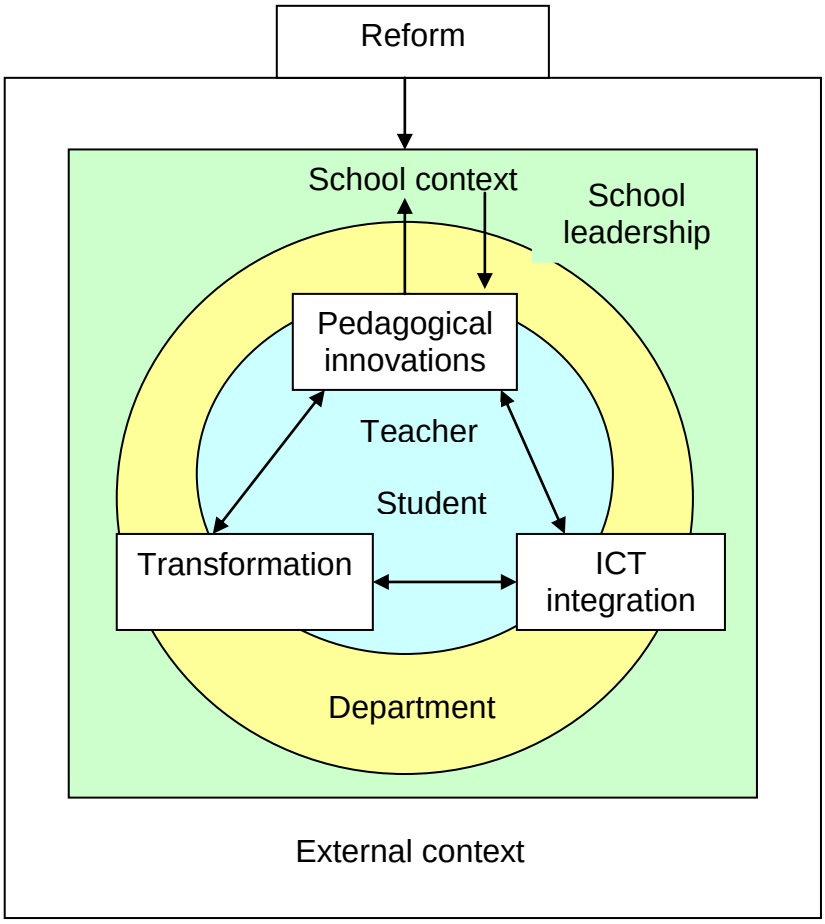
This literature review has described the extent and complexity of the issues of ICT integration. ICT integration needs to be understood in terms of the pedagogical innovations that teachers need to introduce into their practice and such innovations are context-dependent. The review has therefore considered the multiple perspectives that accommodate the complexity of such adjustments that schools and teachers need to make. These perspectives are those of ICT integration; the relationship between innovation reform, transformation and change; and that of complexity theory as well as the relationships between these perspectives. The next section will describe the derivation of the conceptual framework for the study based on these multiple perspectives.

2.8 Towards a conceptual framework

Multiple perspectives of school contexts emerge from the literature. Figure 2.4 is a graphic representation of the inter-relationships between the multiple perspectives that emerge from the literature. The teacher functions within a department within the school context. Reform, conveyed through policy is external and applies to the whole school context. The intention of the reform is transformation within the whole school context. The teacher is central to the context and the transformation process and responds to the reform with innovation in practice. In order to innovate, the teacher may or may not make use of ICTs which are provided in the context for curricular and professional use. Interactions occur between each level of the environment i.e. the external context, the school context and the professional and personal context of the teacher. Interactions also occur between individuals on any level of the environment. For a teacher to innovate in response to either intrinsic or extrinsic motivation involves complex interactions.

These interactions occur between the teacher and the physical entities of the immediate environment or department, of the whole school environment and of the external environment. Similarly, interactions occur within the social environment between teachers and students, between teachers and colleagues within and across departments, and with school leadership as well as external agencies. Interactions also occur with abstract entities such as information and creative ideas or beliefs, attitudes and disposition, personal history or opportunities. These entities form the context that affects each teacher as an individual in a unique way and have a bearing on their ability to innovate.

Figure 2.4: Relationship between perspectives

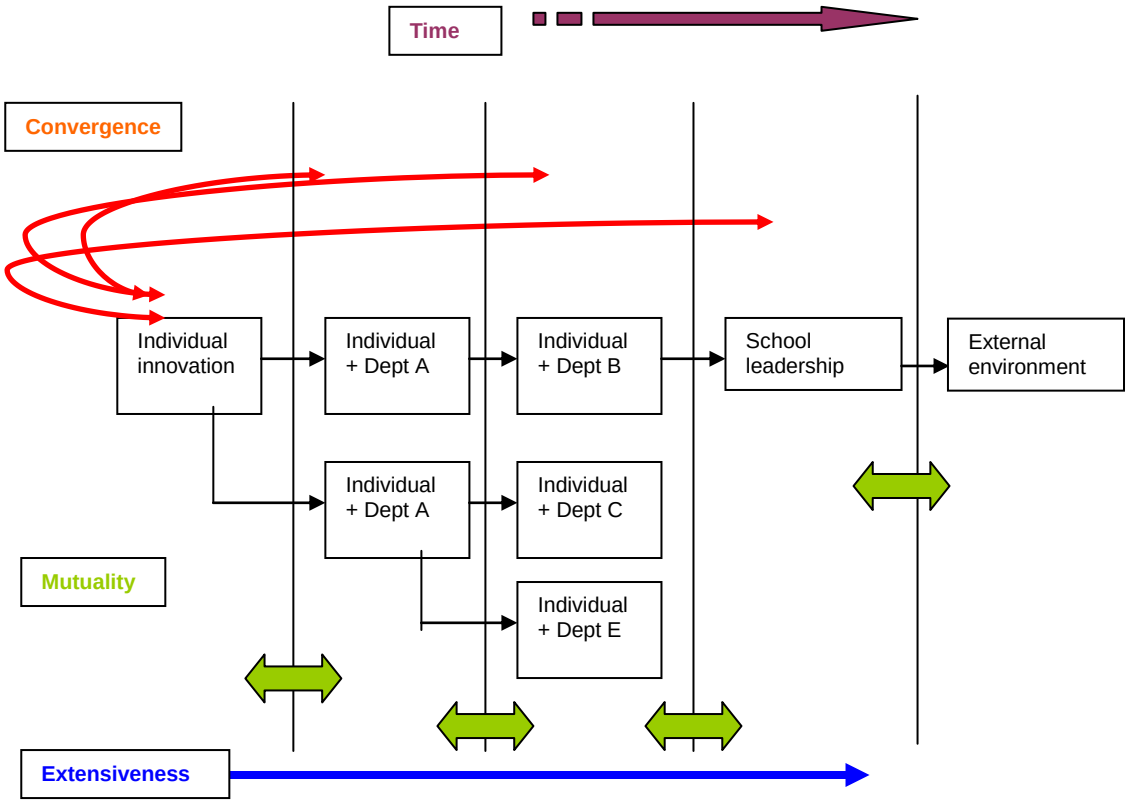


A diagram cannot show the complexity of interactions between each element. To illustrate such interactions would imply the control that complexity repels.

The study draws on the three critical processes of convergence, mutuality and extensiveness which underlie the sustainability of innovations (Sherry & Gibson 2005, p.6; 2002, p.7). These processes are explained in Section 2.5.2 p.86 above and are illustrated in Figure 2.5 (below). The figure shows the three processes which underlie the diffusion of a teacher-generated innovation and how it might become sustainable over time.

In the example in Figure 2.5 convergence occurs enabling an individual innovation in teacher practice. If the benefit of the innovation extends to a further individual with benefit to both parties, then mutuality is recognised. The further the benefit extends over distance and time, the greater the chances of an innovation becoming institutionalised and achieving transformation at whatever levels it targeted.

Figure 2.5: Conceptual framework: Diffusion of innovations within a school system



2.8.1 Applying the conceptual framework

This conceptual framework constitutes my theory about the world that I am researching. It derives from my own experience as a practitioner-researcher and from the literature web that has been described along the pathway of this review. The conceptual framework therefore guided the development of the research instrument and the description and explanation of the phenomena but not the analysis of the data (Rossman & Rallis 2003, p.120). However, the analysis is grounded in the data provided through interviews and observation.

2.9 Summary of Chapter 2

This chapter has reviewed the literature relating to the effect of context on teachers' ability to innovate with ICTs in secondary schools. In order to understand the effect of context it has explored the literature on ICT integration and on innovation and change. Complexity theory was described as the underpinning theory of innovation and change which are integral to ICT integration. The review explained how the construct of ICT integration developed over time and the need to understand it within the context of innovation and transformation. The work of Clarke and Gibson (2000) and the terminology developed by Sherry and Gibson (2002) in response to the findings of Clarke and Gibson were used to develop the conceptual framework which guides the research process. The next chapter will describe and discuss the research methodology, design and process of the study.

Contents

Chapter 3: Research methodology, design and process

3.1 Introduction 101
3.2 The research approach 101
3.3 Research methodology 108
3.4 Research design 112
3.4.1 Unit of analysis 114
3.4.2 Data collection 117
3.4.3 Interviews 118
3.4.4 Observation 122
3.4.5 Document verification 122
3.4.6 Data transcription 123
3.4.7 Data analysis 124
3.4.7.1 Illustration of the data 127
3.5 Trustworthiness 129
3.6 Ethical considerations 133
3.7 Limitations 134
3.8 Summary of Chapter 3 136

Chapter 3

Research methodology, design and process

3.1 Introduction

The previous chapter examined the literature and demonstrated the derivation of the conceptual framework for the study. This chapter will describe how the research design for the study evolved from the conceptual framework and explain how the methodology and process ensued from the research design. It will also address issues of validity, ethical considerations and limitations.

3.2 The research approach

Research is the critical examination of issues (Loughran 2003, p.183). It is concerned with understanding the world and is determined by the understanding of the researcher (Cohen *et al.* 2000, p.3). Educational research provides the opportunity that the workplace rarely provides to understand the lives and work of teachers (Elbaz-Luwisch 2005, p.ix-x). Research in education needs to become relevant to the everyday concerns of teachers (Murray & Lawrence 2000, p.6), offering opportunities to explore issues, tackle problems or test hypotheses (Bassey 1999, p.66). Bassey describes a research problem as a *"difficulty which can often be expressed as a contradiction between what is happening and what someone would like to happen"* (Bassey, 1999, p.66). In order to solve such a problem data is collected, analysed and interpreted systematically and with sensitivity by a researcher using trustworthy procedures (Bassey, 1999, p.40). In systematic inquiry the basis for each decision is explained and documented to enable others to assess its adequacy and trustworthiness (Rossman & Rallis 2003, p.12)

In this study, the research is guided by the over-arching problem of evaluation of effectiveness of ICTs. However, as explained in Chapter 1, the problem was distilled to identify the need to understand the context in which ICTs are

integrated from the point of view of teachers within a particular context and the dynamics that impact such integration. The particular context is characterised by complex, simultaneous and ongoing changes. In order to solve the problem, it needed to be formulated as a question that incorporated these aspects. The resulting research question that guides this study is therefore:

> *How do teachers innovate in the face of complex, simultaneous and ongoing changes and, in particular, how do they innovate with ICTs amidst such changes?*

In order to answer this question the research question was broken down into further sub-questions namely:

- *How do organisational interactions influence teachers' ability to innovate and to sustain innovation in practice?*
- *How do collegial and professional interactions influence teachers' ability to innovate and to sustain innovation in practice?*
- *How do ICTs influence teachers' ability to innovate and to sustain innovation in practice?*
- *How do leadership interactions influence teachers' ability to innovate and to sustain innovation in practice?*

It is in answering these questions that the interactions reveal the extent to which convergence, mutuality and extensiveness occur (Ch.2 Section 2.5.2, p.84). In order to describe and understand these interactions I chose to draw on the experiences of my colleagues who are teachers in the context of the school that is the focus of this study. The understanding of context from a teacher's point of view involves the interaction of policy, practice, individual beliefs and relationships, the organisation and the systems that comprise the school as a complex entity. Policy dictates the broad direction of change, but does not account for how a teacher responds to that change. The teacher's response is at a personal level: what they understand of the expectations of policy, how they grapple with personal innovation and creative ideas to interpret and implement the requirements of policy, how they are individually

enabled or inhibited in their endeavours by systemic contextual factors and how they relate with others to change their practice in order to accommodate policy changes. To understand such teacher responses is to understand human experience within the complexities of context, to look at their social worlds holistically (Rossman & Rallis 2003, p.9). To understand human experience requires a qualitative approach as such experiences cannot be measured and predicted: rather, such experiences require description, analysis and interpretation (Rossman & Rallis 2003, p.11) in which the voice of the participants, rather than that of the researcher should come to the fore (Cohen *et al.* 2000, p.22). Qualitative case studies are appropriate to naturalistic, context-specific settings (Patton 2002, p.39) in which the researcher is involved and immersed (Golafshani 2003, p.600) and becomes an instrument through which the experiences of the participants may be interpreted.

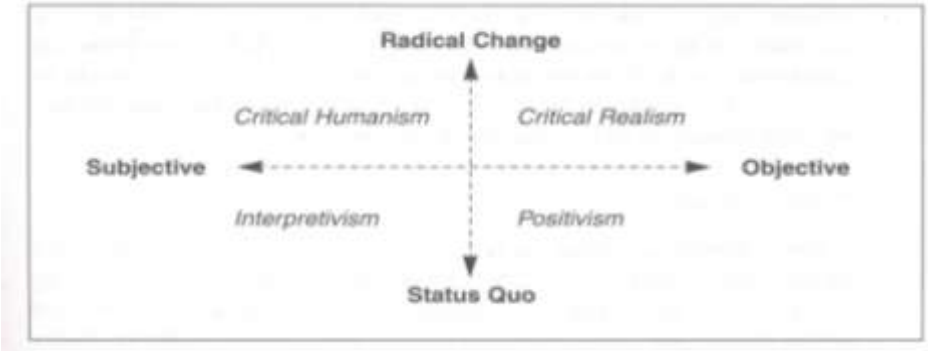
While the voice of the participants may be paramount, the voice of the researcher cannot be discounted in qualitative research. The researcher is an integral part of the process and some form of relationship is always present between the researcher and those being researched (Hammersley & Atkinson 1983, p.15). In this study, there is a dual relationship between myself as the researcher and my colleagues, as the researched, and this duality needs to be expressed and accounted for. As an insider I am an integral part of the school community bringing an emic perspective, whilst at the same time, as a researcher, I am an outsider with a researcher's or etic perspective. In reporting the research the account will be my own account of their stories. However, my participation in the research is overt and my colleagues are fully aware of the research and its intention (Patton 2002, p.127).

What then are the position and assumptions that I bring to this study? As a consequence of my role in the school as described in Chapter 1, I am involved on a daily basis with teachers and their individual needs. In order to provide insight into this context in which I am a participant researcher, a qualitative approach, using naturalistic and interpretive methods of inquiry (Denzin 1994,

p.118) and focused on the experiences of individual teachers, is indicated. In choosing the qualitative approach I acknowledge my post-modern viewpoint (Kvale 2002, p.300) and my belief that human experience needs to be understood from the point of view of the individual rather than that of an objective reality. The positivist approach assumes knowledge to be a mirror of reality, whereas the post-modern approach sees knowledge as a social and linguistic construction of reality (Kvale, 2002, p.306): there is no objective reality against which it can be validated, only a perspectival reality (Kvale, 2002, p.300). The post-modern focus is on "*interpretation and negotiation of meaning of the lived world"* (Kvale 2002, p.306).

In terms of Burrell and Morgan's (1979) diagram of epistemological and social change assumptions, as illustrated in Figure 3.1 below, my viewpoint lies within the subjective/interpretive paradigm.

Figure 3.1: Four paradigms of social research. (Burrell & Morgan 1979, p.22)



My viewpoint is subjective in that I recognise that there is no single or absolute truth, but multiple perspectives and multiple truths (Cohen *et al.* 2000, p.22; Kvale 2002, p.301; Schutz 1972). The subjectivist assumption is that *"humans construct understandings of reality through their perceptual and interpretative faculties"* (Rossman & Rallis 2003, p.41) and each individual's reality is different. The acceptance of multiple perspectives and no single reality foregrounds the role of human agency in *"shaping everyday lives and larger social patterns"* (Rossman & Rallis 2003, p.41). It is through the stories

of individual teachers that the phenomena of this particular social world are described, each contributing from their own perspective.

Interpretive research attempts to understand the process within a given context, and the interactions and relationships between the subjects of the research. The goal is to *"discover the specific ways in which local and non-local forms of social organization and culture relate to the activities of specific persons in making choices and conducting social action together"* and to reveal the *"invisibility of everyday life"* (Erickson 1986, p.121-129). This paradigm resonates directly with the objectives of my research. My approach to this research is interpretive in that I rely on description, analysis and interpretation to describe the processes within the context. Even though the data are gleaned largely from interviews in which teachers tell their stories which represent their reality, this report of their stories is subject to my interpretation. I become the instrument through which their experiences are interpreted and need to be mindful of the perspective that I bring to the collection, analysis and selection of data reported.

Underlying the qualitative approach is the philosophic premise on which the research is built. The choice in this particular study was between ethnography and phenomenology. The ethnographic approach is designed to extract characteristics of the group. Gregory (2005, pp.xx-xxi) describes ethnography as starting with a question and not a hypothesis, working from the question to identify patterns to form an analytic framework or "cultural grammar" of the cultural group targeted by the research.

The phenomenological approach has been described in two conflicting ways. Maykut and Morehouse (1994, p.3) describe it as "*an overarching perspective that includes qualitative research*" while Merriam and Simpson (1984, p.89) describe phenomenology as "*an orientation that falls within qualitative research*". Ehrich (2003, p.44) notes the lack of specific definition that calls phenomenology a philosophy, a paradigm and a methodology. Phenomenology is about describing and interpreting phenomena as they are

experienced by individuals. Ehrich (2003, pp.44-69) uses the metaphor of a web to explain phenomenology. The hub of the web represents the underlying philosophy, the threads or spokes represent differing approaches, while the silk coils represent the four themes or key qualities that hold the coils in place. The spider represents the phenomenological researcher who spins the web in order to understand the underlying structures of human experiences. The key qualities are description, reduction, essences and intentionality. Reduction (Husserl 1931 cited in Griffiths 1985, p.200) requires that taken-for-granted assumptions and pre-suppositions about the phenomena be temporarily suspended in order to not influence their description (Merleau-Ponty 1962 cited in Ehrich 2003 p.45). Essences refer to the core meaning that an individual experiences of a phenomena: the researcher would need to determine what is essential or necessary and what is accidental or contingent. Intentionality is the conscious experience of a phenomenon. Phenomenology therefore gives credence to ordinary conscious experience and does not separate experience from reality (Ehrich 2003, p.48)

The second element of phenomenology is hermeneutic interpretation. As the researcher I need to understand and interpret the experiences of the teachers as though it were text in order to more fully comprehend the situations and the people (Ehrich 2003, p.51; van Manen 1990, p.26). While description is "*investigating experience as we live it"*, interpretation is *"making sense of the investigation"* (van Manen, p.2). To do this, personal interactions through, for instance, interviews and observations are indicated.

Naturalistic inquiry embraces the ethnographic approach which is characterised by *"thick description"* (Geertz 1973, p.6). Thick description catches the diversity, variability, creativity, individuality, uniqueness and spontaneity of social interactions (Cohen *et al.* 2000, p.139). Detailed description of the group facilitates generalisability. In this case, the stories of the teachers as revealed though the interview, place the study within the realm of ethnographic inquiry. However, the purpose of this study is not

intended to distil salient cultural characteristics of that group, but rather to describe and interpret the social interactions of the group from the perspective of specific phenomena. The focus is on the phenomena and not the individuals (Ehrich 2003, p.58). This study therefore falls within the phenomenological ambit.

My philosophical standpoint is from a constructivist perspective. Constructivism, essentially a philosophy of how people learn (Clements 1997, para.2), has two central ideas. Firstly, learning is not a passive, but an active process in which the individual is in control of what they learn and how they learn it (Schuman & Ritchie 1996). Secondly, constructing knowledge is based on the premise that individuals all construct their own reality or perspective of the world, using reflection of their individual experience or interpretation as a starting point. Individuals all have different perceptions, learning styles and attitudes and do not all understand things in the same way. Individual understanding changes as new situations that do not fit their current idea of reality are confronted (Hoover 2003, para.7). Time is therefore required to build on new knowledge and reflect on it. Group interactions ensure that individuals can form and measure their understanding in relation to their peers (Hoover 2003, para.7) and learning therefore becomes a social process (Vygotsky 1978, p.24).

Constructivist learning is not limited to students per se, but is equally applicable to teachers' professional learning and to the process of research as a learning activity (Rossman & Rallis 2003, p.5) in which the report becomes the construction of the researcher's reality as an interpretation of the reality of the researched. This study recognises that, given the complex environment of multiple simultaneous changes, teachers are as much learners as are their students and that on-the-job professional learning is a process of each teacher constructing their own individual realities, either in isolation or through collaboration. At the same time, the collective entity, the school as an organisation, is constructing its own reality.

In this study, what is reported is my interpretation of my colleagues' reality. As a participant researcher, whilst my intention is to be as objective or detached as possible in the selection and interpretation of the data for analysis, the likelihood of subjectivity is acknowledged. However, as the value of the study is dependent on its ability to tell the story using others' voices as accurately as possible such accuracy is the prime endeavour.

3.3 Research methodology

To describe the interactions that impact teacher innovations I needed to understand and describe their experiences. Such experiences are not objective facts that could be quantified and aggregated by statistical methods, hence the choice of a qualitative approach. The choices of empirical research types included case studies, experiments, surveys and action research. The rationale excluded an intervention or experimental approach and action research was not an option for me as I was aware of pressures that my colleagues were under with the new curriculum. As methodology is influenced by epistemological and ontological assumptions (Rossman & Rallis 2003, p.42), I needed to choose a methodology appropriate to subjective description and interpretation of human experiences. Given the above assumptions, my background in the research context and the conceptual framework as derived from the literature and described in Chapter 1, the choice of methodology fell naturally to a case study. A case study deals with first hand knowledge of the social world and interpretive analysis of data (Rossman & Rallis 2003, p.42). Stake (2000, p.435) notes that *"[c]ase study is not a methodological choice but a choice of what is to be studied. By whatever methods we choose, we choose the case".* In the case of this study, 'the case' was a given. The study of ICT-related issues cannot be separated from their contexts (Ch.2, Section 2.3.5, p.49) and qualitative case studies are appropriate to naturalistic, context-specific settings (Patton 2002, p.39) in which the researcher is involved and immersed (Golafshani 2003, p.600) and becomes an instrument through which the experiences of the participants may be interpreted.

Case studies have been described by various authors in different ways. Whilst there is agreement that case studies refer to bounded systems (Smith

1974, cited in Bassey 1999, p.27) it is difficult to put boundaries around case studies as a genre. Case studies are a *"natural way of reporting"* (Lincoln & Guba 1985, p.43) in that they produce "*thick descriptions"* (1985, p.214) or richly detailed accounts of participants' experiences. Adelman, Kemmis and Jenkins (1980, p.59) capture the sense of an instant in time and the dynamic nature of social conditions in their definition of a case study as *"the study of an instance in action"*. In describing case studies, Nisbet and Watt (1984, p.78) draw a parallel with complexity in that they refer to a case study as *"more than the sum of its parts"*. Similarly, Sturman (1999, p.103) argues that contexts are unique and dynamic and that case studies are able to "*investigate and report the dynamic interaction of events, human relationships and other factors in a unique instance"*. Case study is the generic term for the investigation of individual, group or phenomena (Sturman 1999, p.61). Case studies are *"a style of research that lead to the perfection of observation"* (Skilbeck 1983, p.18), an overall strategy for studying the case rather than a genre (Stake 2000, p.435). Yin and Stake are amongst the most commonly cited authors of texts on case studies. Yin defines a case study as:

- *"an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when*
- *the boundaries between phenomenon and context are not clearly evident"* (Yin 1994, p.13)

Case studies rely on multiple sources of evidence. Data from such sources needs to converge and triangulate and will do so, particularly if guided by theory (Yin 1994, p.13). On the other hand, Stake (1995, p.xi) defines case study research as *"the study of the particularity and complexity of a single case, coming to understand its activity within important circumstances"*. In other words, as pointed out by Bassey (1999, p.27), while Yin takes a theoretical standpoint, Stake's definition arises from the case itself. A case study is "*a bounded system … an object rather than a process … an integrated system"* in which the *"parts do not have to be working well, the purposes may be irrational, but it is a system. Thus people and programs clearly are prospective cases"* (Stake 1995, p.2).

Whilst there is little agreement on what defines a case study, there is some overlap on the characteristics of case studies and what they do. These overlapping characteristics are detailed in Table 3.1. This study accepts the broader definition of case study as a methodology and endeavours to demonstrate the consensual characteristics of case studies as indicated in Table 3.1. However, case studies also occur in various types according to different authors. These types are tabulated in Table 3.2, Types of case studies and their purposes.

Table 3.1: Case study characteristics

Author	Case study characteristics
Adelman, Jenkins & Kemmis (1980, p.3) Rossman & Rallis (1999, p.92-94, 103-104); Bassey (1999, p.5); MacDonald & Walker (1975, p.1)	• *in-depth and detailed explorations of single examples that are 'instances drawn from a class' of similar phenomena.* • *seek to understand the larger phenomena through close examination of specific instances or cases and therefore focus on the particular* • *strength is their detail, complexity and use of multiple sources* • *studies of singularities* • *the examination of an instance in action*
Sturman (1994, p.61)	• *belief in wholeness of human systems* • *requires an in-depth investigation of the interdependencies of parts and of the patterns that emerge*
Adelman, Jenkins & Kemmis (1980, p.3) Rossman & Rallis (1999, p.104); Yin (1994, p.25)	• *focus on events, processes, individuals, groups, organisations or programmes to understand their perception of events* • *provide a chronological narrative of events relevant to the case* • *describe or explain events, processes and perspectives as they unfold i.e. real life contexts, and build an explanation for those events or outcomes*
Rossman & Rallis (1999, p.104)	• *descriptive, holistic, heuristic and inductive* *complex and multi-layered*
Merriam (1998), p.11	• good for dealing with practical problems.
Hitchcock & Hughes 1995, p.317)	• richness is reflected in how the case is written up or reported.
Rossman & Rallis (1999, p.104)	• researcher is integrally involved in the case.
Nisbet & Watt 1984, p.78)	• commence with a wide field of focus and narrow down.

Author	Case study characteristics
Rossman & Rallis (1999, p.105) Bassey (1999, p.58)	• methodologically eclectic, relying on a variety of techniques for data gathering • are conducted over a period of time.
Rossman & Rallis (1999, p.104)	• give insight into other similar settings • the reader judges the applicability of the case
Skilbeck (1983, p.18; Burgess (1985, p.177)	• lead to the perfection of observation and documentation • they illuminate the process of schooling • open it up to evaluation by all those concerned with education.
Adelman *et al.* (1980, p.59-60)	• strong in reality but difficult to organise • pay attention to the subtlety and complexity of the case in its own right.
Adelman *et al.* (1980, p.59-60)	• complexity and embeddedness of social truth • 'a step to action': they begin in a world of action and contribute to it. Their insights may be directly interpreted and put to use …
Adelman *et al.* (1980, p.59-60)	• present research or evaluation data in accessible form
Adelman *et al.* (1980, p.119)	• 'preserves indeterminacy' • intertwined processes of conceptualisation of the research problem, investigation, interpretation of findings and their application
Bassey (1999, p.44)	• essentially interpretative

In terms of Stenhouse's definition (Table 3.2), this study is an educational case study in that it is concerned with understanding educational action. In part, this study uses theory testing in that the angle from which the teachers' experiences are viewed is theoretical (seeking convergence, mutuality and extensiveness), but it also draws on the story-telling aspect in that the interview method was loosely structured in order to capture the teachers' experiences as stories. In terms of Bassey's types (Table 3.2), the approach is therefore theoretical and in terms of Stake (Table 3.2), it is intrinsic. Whilst the study will serve the institution that it investigates, the intention is that it will resonate with similar case studies.

Having established the intrinsic or educational case study as a methodology within the interpretivist paradigm, the design of the research began to take shape. The research design is described in the following section.

Table 3.2: Types of case studies and their purposes

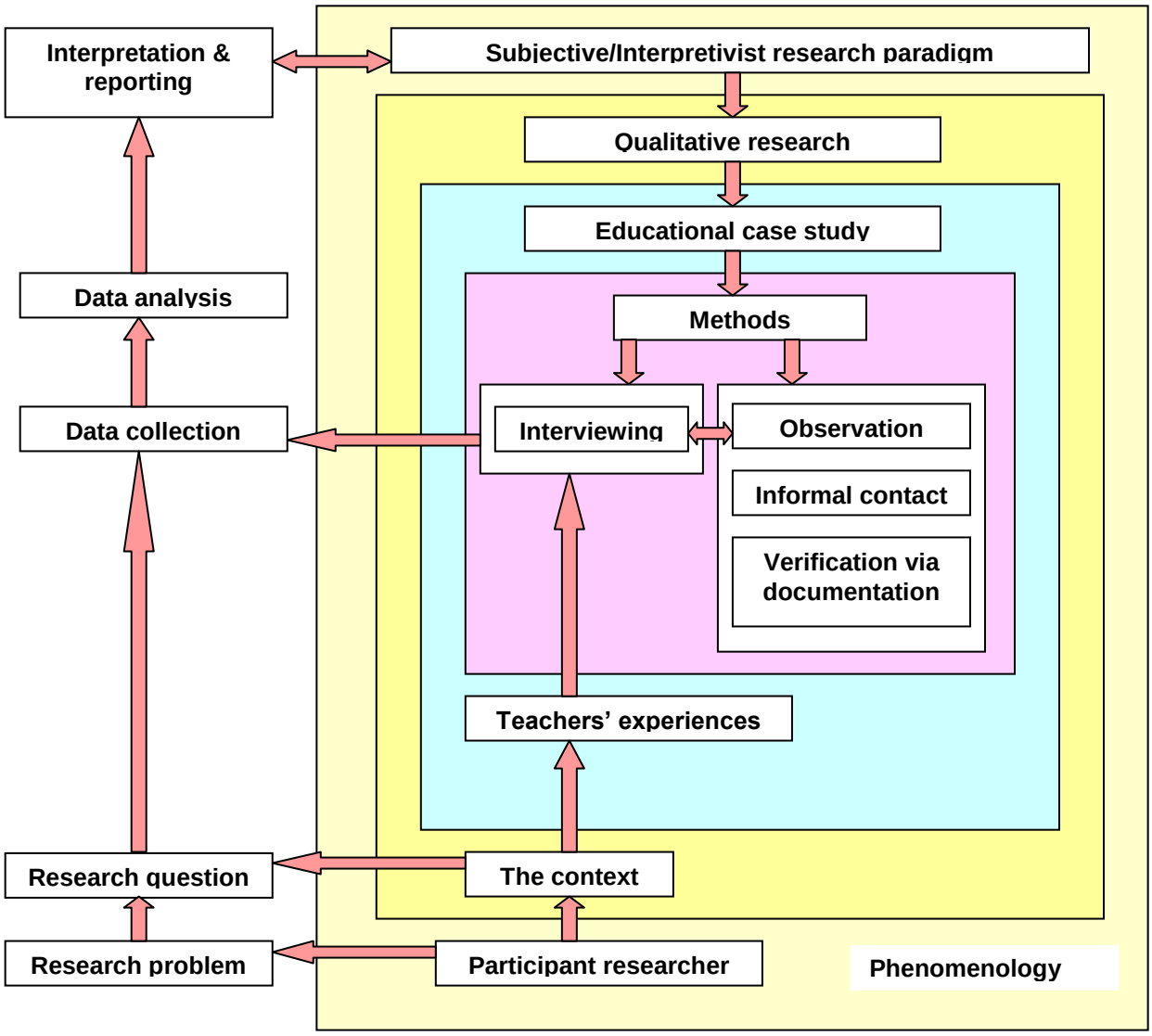
Author	Type	Characteristic/s
Bassey (1999, p.3, 40)	theory-seeking and theory-testing;	purpose: to understand; to portray the topic as it is; includes story-telling and picture-drawing;
	evaluative	purpose: to understand and evaluate
	action research	purpose: to understand, evaluate and change
Yin (1993, p.5)	an exploratory case study	"*[aims] at defining the questions and hypotheses of a subsequent […] study"*
	a descriptive case study	*"presents a complete description of a phenomenon within its context"*
	an explanatory case study	presents data bearing on cause-effect relationships – explaining which causes produced which effects
Stenhouse (1985, p.50)	evaluative case studies	intended to judge *"the merit and worth of policies, programmes or institutions"*
	action research case studies	*"contribut[es] to the development of the case or cases"*
	educational case studies	concerned with the understanding of educational action; to enrich the discourse and to systematically reflect evidence
Stake (1995, p.3)	intrinsic	Research into particular situation for its own sake and irrespective of outside concerns.
	instrumental	*"Research into one or more particular situations in order to try to understand an outside concern. Issues dominate the case".*

3.4 Research design

This section will illustrate how the research design emanates from the research approach and chosen methodology. The design is summarised graphically in Figure 3.2, (p 113) to show the iterative nature of the research process. As described in Section 3.1 p.104 above, the research approach, based on Burrell & Morgan (1979, p.22) is a subjective interpretivist approach. The methodology selected is a qualitative educational case study in which the methods employed are largely interviews, supported by observation and

informal contacts and the use of documents where necessary to verify data. Methods consistent with case studies include observation, semi-structured interviews and document analysis, whilst the researcher becomes a human instrument in the research.

Figure 3.2: Research design



Incumbent on the researcher is adaptability, responsiveness, knowledge, ability to handle sensitive matters, ability to see the whole picture, ability to clarify and summarise and to explore, analyse and examine atypical or idiosyncratic responses (Lincoln & Guba 1985, p.193-194).

The research took place over the following timeframe:

Table 3.3: Research timeframe

Research process	Time span
Leadership interviews	November 2006, July 2007
Teacher interviews	June 2007 – March 2008
Transcription	August 2007 – July 2008
Analysis & reporting	October 2008 – August 2009

The methods used will now be described in detail.

3.4.1 Unit of analysis

The educational setting in which this research was conducted is an independent secondary school for boys that draws most but not all of its students from a relatively high socio-economic suburban area in South Africa. The choice of school arose from my full-time involvement in the school rather than as a result of a quest for a research topic or the selection of the best school for the purpose. The school does not typify a South African school; rather it stands close to one extreme of a continuum that spans the full spectrum of the digital divide, thereby limiting local generalisability. However, it is typical of schools worldwide in which there is a high-end provision of ICT resources; in which physical access to ICT is theoretically not limited; in which teachers are expected to be competent ICT users; and appropriate use is made of ICTs in the curriculum. The study of innovation also requires that a school has the capacity to innovate although this does not imply that only high end schools have this capacity. Such conditions are necessary to the particular focus of this study.

Although I am an employee in the school, the research is a personal undertaking that I have conducted as an independent researcher, with the full support of the school and in terms of its research policy. No sponsorships have been involved. Whilst the research product is mine, the data also belongs to the school in terms of its policy and given my position within the school community. The research is intended to be of benefit to the school.

In this study the unit of analysis consists of ten teachers and three teacher-leaders from the school. The primary form of data collection was interviews.

Teachers were interviewed as participants in the study in order to establish the interactions that affected their ability to innovate in their practices, including innovating with ICTs.

Research in which people are targeted needs to pay close attention to the attributes of those people, why they are of interest and their degree of representativeness (Murray & Lawrence 2000, p.40). My initial approach was to introduce the fact that I would be conducting research in a weekly briefing (May 2007) for all staff, in which I invited all colleagues to participate. This was followed up by an email providing further details of the purpose of the research and including a letter of consent that could be signed and returned to me. I had intended to interview at least one person or group from each subject department, but I was advised that the volume of data would become unwieldy and require too lengthy a time to process.

Of an academic staff of 70 teachers I received 14 replies from teachers representing a variety of departments. However, I encountered two problems. Firstly, there was a short period between receiving consent and the planned interview time that preceded the month-long August holiday period. Secondly, I found it difficult to arrange the interviews due to the busyness of the teachers and the long hours that I am required to man the library which is my domain within the school. Although I am surrounded by my colleagues for each working day, access to them for private purposes is limited by the demands made on them (as the findings will later reveal). The only time slots I had available were late afternoon (after 16h00) whereas teachers had in many cases left school early as it was an examination period, were marking, or were busy with the myriad of activities that characterise a school with a highly demanding programme. The numbers of teachers/leaders interviewed would have been the same if I had managed to interview all those who had originally agreed to be interviewed, but the range of subject departments and individual patterns would have been different. The themes that emerged would likely have been similar due to the presence of dominating factors.

Table 3.4: Table of representativeness of 2007 teachers/leaders by department in which they teach

Department	Teacher cohort	Number interviewed	% interviewed	Working relationship with the library
2nd languages	10	0.5	20%	10
Academic/psychological support	4	0	0	3
Accounting	2	1	50%	2
Art	2	1	50%	2
D&T	1.5	0	0	1.5
Drama	2	0	0	2
EMS	1.5	0	0	1.5
English	6	0	0	2
French	1	0	0	1
Geography	4	1	25%	3
History	4	0	0	4
IT/CAT	2.5	0	0	2.5
Life Sciences	4	3	75%	4
LO	2	0.5	25%	1
Maths & Maths lit	8.5	2	24%	4
Music	3	0	0	1
Physical Sciences	7	4	57%	7
	65	13	20%	47.5 (73%)

While some interviews were completed as planned, I eventually resorted to convenience sampling (Cohen *et al.* 2000, p.103), approaching colleagues on the off-chance that they might be available, usually when they came to the library for whatever purpose. Convenience sampling is a matter of choosing individuals to whom the researcher has access and continuing the process until the required sample is reached. The only way convenience sampling might have influenced the data is that the teachers may be more representative of those that make more use of the library and by default excludes the teachers who almost never use the library. Table 3.4 indicates the representativeness of the participants within the full staff complement across departments.

This process spanned a longer time period and although most interviews were completed in 2007, the last one took place in March 2008. Apart from this fact, the participants represent a relatively even sample of the school's teachers with regard to subject discipline, gender, length of service, age, home language and ethnic origin (see also Table 4.1, p.142).

My original intention was also to interview teachers in small groups, but for the same reason as outlined above, this proved impossible. However, three pairs of teachers, each from the same subject department, were interviewed together and the rest were interviewed as individuals.

Apart from the teachers, I also interviewed three members of the school leadership, all of whom were teachers as well (i.e. not purely administrators). In referring collectively to 'the teachers' in this study, I include these members of the leadership unless otherwise indicated. I use the term 'the management' or 'the leadership' to refer specifically to this latter group.

Of those interviewed, two members of management and one teacher have subsequently left the school.

3.4.2 Data collection

Qualitative research studies people in their natural settings employing multiple methods such as interviewing, observing and gathering documents. Collecting data is a "*deliberate, conscious, systematic process*" (Rossman & Rallis 2003, p.179). Interviews were the primary format used to collect data. Interview data was supported by informal observation in my day-to-day experiences within the context and by verification of factual data through the interrogation of documents where necessary. The interviews were a culminating rather than a starting point in that they provided the unique opportunity for me to obtain a detailed understanding of so much that is taken for granted in the school as a working environment.

One challenge that I faced in data collection was contextual data. To be useful, data need to provide thick rich descriptions, especially the details about the context (Rossman & Rallis 2003, p.68). Given that my focus is specifically on the context, the question arose of how much data collected sub-consciously through my experience was 'data' and how much was background. Gregory (2005, p.ix-xvii.) sheds some light on this dilemma in her introduction to her book in describing how deeply her family history was situated in her particular ethnographic context and how this influenced the path of her research. Taking this example as a precedent, I consider all the knowledge accumulated through my professional experience of this context as data.

3.4.3 Interviews

Interviews are conducted between the researcher and the participant in order for the researcher to achieve three purposes. These are: to access and measure the knowledge that resides *"inside a person's head"*; what that person values or prefers; and the attitudes or beliefs that the person holds (Tuckman 1972, p.213). The phenomenological interview (van Manen 1990, p.6) is a means of gathering narrative material from which a rich and deep understanding of a human phenomenon may be acquired. It may also serve to explore the meaning of human experiences.

The researcher needs to be aware of potential problems in the interview situation. Cohen *et al.* (2000, p.121) indicate possible bias might include the attitudes, opinions and expectations of the researcher; for the researcher to view the participant in their own image; a tendency to seek answers that support preconceived notions; misperceptions on the part of the interviewer of what the participant is saying and; on the part of the participant, of what the researcher is asking. In order to avoid these pitfalls, I needed to plan my medium of recording the interview, carefully follow an interview protocol, listen attentively and actively and ask for clarification where necessary. Using the chosen method of videoing the interview, meant that I could follow the conversation without having to take down more than the odd observational

note. Interviewing colleagues with whom I had worked for between six and twenty years meant that a relationship already existed and did not need to be established although my role changed for the purpose of the research.

The power relationship (Platt 1981, p.76) between the researcher and the participant is not a one-to-one correspondence in that the researcher who has designed the interview remains in control of the process (Smith 1975, p.190) and needs to be aware of any bias that they may bring in guiding the course of the interview. In interviewing peers the researcher does not have the advantage of superior knowledge (Platt 1981, p.118). Nevertheless, the participant holds the knowledge that the researcher wishes to tap into and the researcher needs to craft a way of extracting that knowledge whilst remaining within ethical boundaries and keeping the interchange at the conversational level.

Interviews have been variously described as *"a conversation with a purpose"* (Burgess 1984, p.102); as *"a conversational partnership"* (Rubin & Rubin 1995, p.11); as a social *"encounter"* (Gubrium & Holstein 2002, p.3) and as the *"ultimate context within which knowledge is to be understood"* (Rorty 1979, p.389). To balance the comfort of conversation with the purpose of the interview required that power relations be consciously addressed.

The power of the conversation worked on two planes in this study. Firstly, the conversations, in both formal interviews and informal interactions with the participants as colleagues in our everyday lives, revealed the interplay of contextual factors for which I was searching. On a different plane, the teachers as participants often referred to their conversations with each other and with their students as evidence of contextual factors. The fact that they could tie their insights to specific conversations was significant. Examples of these were in the interviews with Richard, Henry, Bronwyn and Ineke. It struck me that the interview conversations appeared to provide opportunities for the teachers to voice ideas that they may not otherwise have had the opportunity to express. In this sense the interviews, from my perspective,

became a reflective learning experience for the teachers and an example of socially constructed learning taking place that time pressures otherwise mostly preclude.

I used a standardised open-ended interview approach (Patton 2002, p.342-347) in which I asked of the teachers a series of pre-defined, but open-ended questions (Appendix 3.1) that derived from the research sub-questions and the conceptual framework. These open-ended questions allowed the teachers to develop and express their own point of view, and allowed me to further question their answers when necessary (Murray & Lawrence 2000, p.117). The set of teacher-questions were then adapted for the leadership interviews (Appendix 3.2) to account for their differing perspective. The questions were sequenced from the more general questions on the context to the more specific questions on ICTs. Each interview took approximately an hour except for one in which, I felt, the teacher needed to talk more and, in fact, carried on doing so for a further half-hour. The result was a set of interview transcripts that yielded in-depth data that could not have resulted from any other form of research. At the start of each interview I again explained to each colleague what the purpose of my research was without going into too much detail of the terminology but rather relied on them to ask me questions where necessary. The intention was to diminish any possible gap between their perceptions of my expertise and their own and to keep the interaction at a conversational level. I believe that I was able to achieve the necessary comfort levels and realise that I was privy to information on negative as well as positive issues that my colleagues were comfortable in sharing. In only one instance was I requested to keep a teacher's opinion on a certain matter confidential, but this did not deter the teacher from sharing their point of view. This matter is dealt with in an undisclosed Appendix.

Each interview was based on the subject discipline of the individual or pairs of teachers. Interviews were recorded on video tape for firstly, a purely pragmatic reason, in that the facility which is under my control was always available when interviews had to be scheduled at short notice. Secondly, I

had previously used video tape to record lessons at the request of teachers as well as for my own short research assignments in their classrooms, and colleagues accepted video as part of my tools of the trade. The interviews took place in a staff study facility attached to the library and with which teachers are familiar.

Possible disadvantages of interviews (Murray & Lawrence 200, p.119) include participants providing what they deem to be the answer that will most please the researcher; the interview descending into argument; language levels and wording; providing leading questions or having participants rephrase the question. I needed to be careful of these pitfalls and on the whole managed to avoid them, although, due to my participant-researcher role and the conversational atmosphere, I once or twice found myself using a leading question and needed to account for this in the analysis. Although four of the teachers have a language other than English as their home language, language did not prove to be a barrier as all are fluent in English. Another disadvantage is that my colleagues in a few instances, assumed my knowledge of a particular issue (Platt 1981, p.79). I left these assumptions largely unchallenged in order to not interrupt their train of thought, as either I knew about the issue or it did not appear to warrant interrogation at the time. Where necessary I asked them to explain further. One linguistic anomaly that struck me during transcription was the tendency for teachers to use the casual expression 'you know': in one interview it was generously interspersed no less than 78 times. This is a lax South African mannerism, and does not necessarily imply that the speaker is assuming knowledge on the part of the listener. On the other hand it may indicate a degree of familiarity or informality, or simply be a part of the teacher's natural thinking process, inferring 'I know' rather than 'you know'.

One observation that emerged during the interviews was how both my confidence levels and my objectivity changed. After the first interview I noted feeling quite strongly about certain points that had been made. These points countered what I believed to be 'the truth'. Despite theoretical warnings, it

took some time for me to register what was happening in my mind before the realisation of experiencing different realities, of not taking my views for granted, fell into place and gave me a benchmark from which to proceed in later interviews. It also confirmed for me the dissonance between one viewpoint and another. Also, I realised that, after a series of interviews in a short period of time, a degree of indifference on my part might have crept in. I therefore needed to pause to clear my brain before proceeding with the last few interviews. Griffiths (1985, p.200) recognises such difficulties for practitioners in conducting research alongside one's normal role and how tiredness can become a significant factor.

3.4.4 Observation

Whilst the interviews provided the majority of the data, personal observation was used to add to it. The personal observations consist of what I have observed in my day to day dealings with my colleagues whom I interviewed. Such observations include informal conversations, instances of co-teaching, and discussions around learning design, resource acquisition or ICT support. These observations have not been formally recorded but exist in my cumulative memory archive. These are drawn on to provide background and elucidation to the data contained in the interviews.

3.4.5 Document verification

I use the term document verification rather than document analysis in that I did not seek out documents in order to obtain primary data. In the same way that the interviews were supplemented by personal observation, I drew on documents to verify policy details and implementation dates, school events or other occurrences relevant to the context. External documents include Department of Education (DoE) and Independent Examinations Board (IEB) circulars. Internal documents include minutes of meetings, organisational charts, timetables, analyses of facility use and in-house research reports. The documents are referenced in text to the extent, where necessary, that they do not identify the school. Data verification by this means was part of my dealing

with assumptions which I had to consciously suspend (Merleau-Ponty cited in Ehrich 2003, p.46), particularly given my familiarity with the context as well as to counteract the vagaries of long term memory.

3.4.6 Data transcription

The use of video for recording the interviews proved to be a beneficial medium in the transcription phase as it made explicit not only the voices but also the body language and facial expressions as well as the subtle interactions and visual focus of the teachers. In the few instances where voices faded or words were indistinct the visual image assisted in identifying words or phrases and, when voices overlapped, it assisted in extricating one voice from the other. The transcription was done personally in order for me to derive the greatest benefit from the process as well as to preserve confidentiality.

I encountered one technical problem in transcription which was that, in one interview, the sound level on the camera had been turned down by the previous user and I had inadvertently forgotten to check the levels before the interview began. I tried various means to boost the sound signal but to no avail. I eventually managed to transcribe all but a few phrases of the data, but it took an inordinately long time.

Each interview was transcribed into a separate word document with the dates of recording, transcribing and analysis. Each segment was separated and numbered using a table format to facilitate the analysis phase. I developed my own system of notation to indicate speaker, pauses, body language and changes of tone. I retained the original names of the teachers until the final report stage in order for me to 'hear' the real voices and not those of the avatar that anonymity would create. The transcripts were emailed to the teachers involved in each interview for verification and each came back with their sanction.

3.4.7 Data analysis

The challenge of interpretive data analysis from interview transcripts is to maintain the integrity of the story rather than fragment it into meaningless data (Cohen *et al.* 2000, p.282). To borrow from Ehrlich's analogy of phenomenology as a web, I needed to understand and describe the cohesion of the web, not just the strands or the coils. In keeping with complexity theory I needed to be mindful of the importance of the whole, rather than the parts and the extracts from Chapter 3 in particular. These extracts are included in Table 3.5 below:

Table 3.5: Complexity characteristics

Author	Characteristic of complexity
Phelps & Hase 2002, p.510	*Complexity theory does not try to understand the whole by understanding its parts; but rather aims to understand the interaction of its parts*.
Klein 2004, p.4	*Phenomena may also display coherent collective behaviours which cannot be understood by reductionist analytical methods.*
Klein 2004, p.3	*Knowledge itself is no longer divided and compartmentalized in a linear structure but in a network, web or rhizome structure* (with infinite complex possibilities of interconnection and interaction.
Davis & Sumara 1997, p.114	*… a thorough understanding of each human organ will not help account for complex phenomena such as consciousness and identity, although each organ contributes to such phenomena. Each part is integral to the whole*.

However, to understand the whole, I needed to understand what constituted the whole and I therefore employed inductive reasoning (Cohen *et al.* 2000, p.4) and descriptive coding to identify each theme within each segment of text. Coding is the translation of the text generated from the responses to the questions posed in the interview into specific categories (Kerlinger 1970 cited in Cohen *et al*, p.283). The codes were developed on the principle of inductive logic, reasoning from the particular to the more general (Rossman & Rallis 2003, p.11), in which inherent relationships emerge from the data itself without the application of preconceived ideas or structures (Mouly 1978, p.9). A sample of the coded data is included below in Table 3.6.

The codes were derived systematically from each interview in turn. Some extracts had multiple codes as shown in the data sample in Table 3.6. I used highlighting as a guide to separate the various elements of the extract although there is not a direct correlation between the code and the highlight in every instance.

Table 3.6: Sample of coded data

Extract from transcript	Codes	Memo
XX: I think we've been given quite a free hand and been given a great deal of trust. They trust us to do the job and to do it well and that's good because it shifts the responsibility and we try to pass that on to the rest of the department. Um … [long pause] … I think they have tried to shield some of the blows that comes from official government declarations every now and again which are silly and then get reversed six weeks later and there you know a lot of people are very apt to … to … they under-react. I don't think they have with … with this new LO. They've over-reacted a bit. That's my opinion. [wry smile, laughter]. I think generally they've been fairly supportive in an indirect fashion. Just provided the background and some of the resources, but not all of the resources we need. But the main resource we need actually is time … and that's the one that's got the most stretch on … [chuckles]	headmaster professionalism communicating down mandated change LO accessibility of resources lack of time constraint	

To manage the coding process, codes were recorded in a spreadsheet at the point of first use (Table 3.7: Sample of coding spreadsheet) with an explanatory note to each to clarify in my own mind why I was using it. I also noted in which interview each code occurred. As the coding progressed further codes developed and I was able to return to earlier interviews to adjust or add new codes. Codes were assigned to categories as the patterns within the data emerged, and in turn, each category was identified within a broad area. The codes, categories and broad areas were refined throughout the coding process. Using spreadsheets enabled me to sort codes by code,

category or broad area as well as "Used in" which sorted on occurrences by groups of interviews using the initials column. In analysing the coded data, there were many codes that I did not eventually use, because they did not appear to have a specific bearing on the phenomena for which I was searching i.e. convergence, mutuality and extensiveness.

Table 3.7: Sample of coding spreadsheet

Code no.	Teacher initials	Code	Category	Broad area	Explanation of code
124	ZZ	ICTs - power of PCs	T belief	teachers	acknowledgement/recognition of potential of ICTs - see also ICTs - impact
125	PP, QQ, RR, XXNN, ZZ,	ICTs - projectors	hardware	tools	generic comment on projectors
126	DD, LL, PP, QQ, RR, XXNN, ZZ,	ICTs - provision	ICTs	principles	providing ICT resources (see also equity)
127	AA, CC, LL, PP, QQ, VVTT, XXNN,	ICTs - research	ICTs	practices	using ICTs for research based learning

These categories and broad themes underlie the description of the findings. Data from different interviews was compared code by code within each category and broad area. Similarities and comparisons were drawn using the themes derived from the codes. However, as described above, the complexity of the interactions for each individual teacher or pair of teachers resulted in the findings being described systematically by interview in order to retain the cohesion of each teacher's story. This was particularly important in looking for convergence, as that refers to the *common* occurrence of the interactions.

In analysing the data the temptation was to let the data speak for themselves as the eloquence and honesty of my colleagues' accounts as well as the depth and detail of their responses did precisely that. However, as Rossman and Rallis point out (2003, p.11) data requires interpretation and needs to be

my story about their stories. My dilemma was to retain the cohesiveness of each story. Although I attempted to report on the findings by category or broad theme, referring to each interview in turn, I eventually became so bogged down that I abandoned this and reverted to an interview by interview report and referred to the categories and themes within those. A further challenge was whether to include the incidental mentions of ICTs that teachers raised in response to questions on context with that response, or whether to combine the response mentioning ICTs with their answers to specific ICT-related questions. In the end I placed each response where it related best to the individual context.

There are three approaches to identifying analytic or thematic statements (Bassey 1999, p.66; Ehrich 2003, p.57). These approaches have been described as holistic (or what phrase captures the meaning of the text), selective (what seems essential or revealing in the text) or detailed (line by line) by van Manen (1990, p.79). As I was searching for data that supported particular phenomena I relied largely on the selective approach. The analytical statements that arose from each interview were illustrated with graphics to show the interplay between convergent and disconvergent factors and my interpretations of the data were consolidated and added to the extracts that I chose to use quite liberally in order for the teachers stories to also 'speak for themselves'. In this way I attempted to get a balance between the sense that my colleagues made of what was going on and the sense that I made of it (Rossman & Rallis 2003, p.50), but based on the data itself.

3.4.7.1 Illustration of the data

The findings relating to the first three sub-questions were described sequentially by interview and illustrated in each chapter by figures that showed the interplay of convergent and disconvergent factors for each teacher or each pair of teachers.

In certain cases the relationship between convergent and disconvergent factors was found to have a direct one-to-one correspondence. These factors

were illustrated in the figures by a pair of arrows as shown below in Figure 3.3. An example of this was in Francois' practice in which curriculum requirements and ICT policy met head-on with spiralling effects (Ch.6 Section 6.4.6.2, p.333).

Figure 3.3: Example of direct interplay of factors

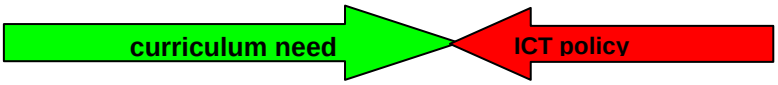
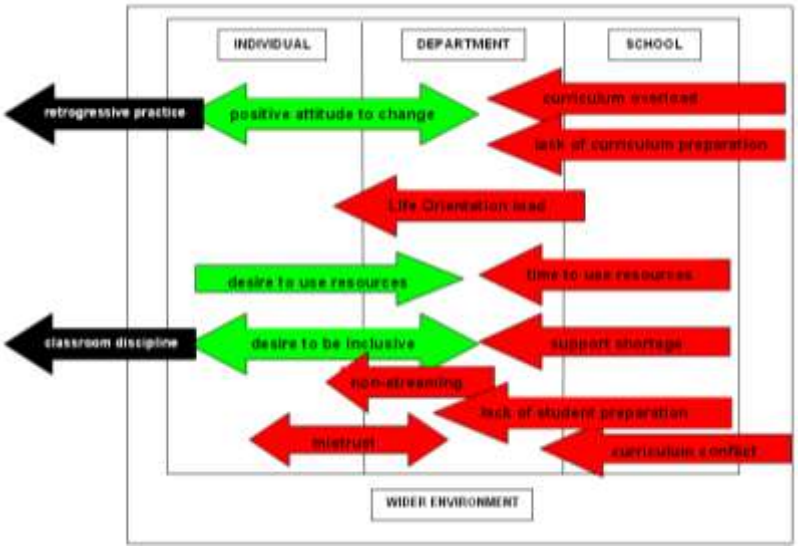


Figure 3.4: Example of indirect interplay of factors



In other instances the factors co-exist without a direct impact, but the overall effect is limiting as in the example in Figure 3.4. In this example, the desire to change is visible in the positive attitude and extends from the individual to the department, but curriculum overload and lack of curriculum preparation meet that attitude head on and retrogressive practice results.

A double headed arrow was used to indicate a mutual effect as in Figure 3.4: the positive attitude to change has a positive effect on both the individual and the department. Black arrows indicated retrogression and yellow arrows indicated the presence of a factor that appeared to have a neutral effect.

3.5 Trustworthiness

Positivist theory portrays validity as the understanding of knowledge as a map of an objective reality (Kvale 2002, p.300). Post-modern theory has discarded this concept against which to measure validity (Lincoln & Guba 1985, p.218; LeCompte & Preissle 1993, p.326; Bassey 1999, p.75) and replaced it with "*the social and linguistic construction of a perspectival reality where knowledge is validated through practice"* (Kvale 2002, p.300). Criticisms of this post-modern approach centre on the research interview. They challenge the possibility of leading questions, the number of interview subjects and the real meaning of what the interview subjects are saying (Kvale 2002, p.301). Kitwood's counter argument (1977 in Cohen *et al.*, p.125) suggests that the greater the degree of control in the interview, the more reliability increases but at the expense of validity. The easier the degree of control, the more human the response is likely to be, thereby increasing validity.

Validity asks the question: *"Are we investigating what we think we are investigating?"* (Bassey 1999, p.75; Kerlinger 1973, p.457; Murray & Lawrence 2000, p.135). It is incumbent upon the researcher to record the details of the data collection and the process of analysis to the extent that others are able to judge whether the boundary between truth and non-truth (Kvale 2002, p.301) has been appropriately demarcated (Patton 2002, p.402). What is at issue is not the data themselves, but the inferences drawn from the words and actions of the participants (Hammersley & Atkinson 1983, p.191). Validity occurs at two levels: internal validity and external validity. Internal validity is the extent to which the research observes or measures what it is intended to observe or measure and external validity is the extent to which the findings can be generalised to other groups (LeCompte & Preissle 1993, p.348; Bassey 1999, p.75). The singular nature of case studies, in which the group is chosen for the uniqueness of its context (LeCompte & Preissle 1993, p.332), means that external validity in this sense cannot apply. Instead, the applicability comes with the use of a study when it is compared to other similar studies.

Traditionally, reliability is understood to be the extent to which a claim or finding can be repeated given the same circumstances (Bassey 1999, p.75) whereas the qualitative concept of reliability focuses on "*the fit between what researchers record as data and what actually occurs in the natural setting that is being researched*" (Bogdan & Biklen 1992, p.48).

Alternatives to the traditional concepts of reliability and validity are trustworthiness (Bassey 1999, p.129; Lincoln & Guba 1985, p.218; Kvale 2002, p.301); understanding (Maxwell 1992, p.280; Mishler 1990, p.129); fidelity (Blumenfeld-Jones 1995, p.25); dependability (Kvale 2002, p.301; Lincoln & Guba 1985, p.108-109; Miles & Huberman 1994, p.278); auditability, credibility and authenticity (Miles & Huberman 1994, p.278); comparability and translatability (Vidovich 2003, p.77). These terms rely on the integrity of the researcher to ensure the integrity of the procedures and therefore cannot be separated from ethical considerations (Kvale 2002, p.308). The qualities that constitute integrity are honesty, wholeness, coherence and a sense of moral principle (Rossman & Rallis 2003, p.63). Such trustworthiness is assessed by how well the study conforms to standards for acceptable and competent practice and whether it meets standards for ethical conduct with sensitivity. What are important are considerations of accuracy, balance and appropriateness at the research design stage (Cohen *et al.* 2000, p.115). Similarly, at the data-gathering stage, steps should be taken to minimise bias and at the analysis stage to minimize subjectivity, the halo effect, coding errors and selective use of data. As a participant researcher I need to be aware of fidelity, context and situation specific issues, authenticity, comprehensiveness, detail, honesty and depth of response. Actions such as respondent checks, prolonged engagement, audit trails and triangulation contribute to the trustworthiness of the study and enhance dependability. Comparability is facilitated by the use of standard terminology and clear delineation of the group studied. Translatability relies on explicit description of the methods, analytical categories and characteristics of the phenomena.

For this qualitative study to be trustworthy, the onus was on me as researcher to be reflexive and to make all my purposes explicit. In keeping with the expectation of trustworthiness I used the criteria in Table 3.8 amalgamated from those of Bassey (1999, p.76); Miles and Hubermann (1994, p.278); Richardson (1994, p.52); Wildy (2003, p.120-121); Kvale (2002, p.301) and Cohen *et al.* (2000 pp.108, 185).

Table 3.8: Criteria for trustworthiness

Criteria	Actions
Is there evidence of prolonged engagement with the data sources?	I have been involved with the context for 20 years and work with the participants on a daily basis.
Is there persistent observation of emerging issues?	The observation has been ongoing – both prior to and during the research phase
Has the raw data been adequately checked with their sources?	Transcripts were sent to participants for approval.
Have emergent findings been shared with participants?	I met with the teachers and discussed the draft findings.
Has there been sufficient triangulation (multiple perspectives) of raw data leading to analytical statements?	I used data from different sources (management and teachers) to gain different perspectives. Documents were used to verify data where necessary. Informal observation was indicated when referred to. I used multiple theoretical perspectives i.e. complexity, innovation, ICT and teacher-librarian point of view.
Has the working hypothesis, evaluation or emerging story been systematically tested against the analytical statements?	The conditions of convergence, mutuality and extensiveness as well as disconvergence have been identified and described and evaluated against the literature.
Has a critical friend thoroughly tried to challenge the findings?	The final drafts have been evaluated by a critical friend.
Is the account of the research sufficiently detailed to give the reader confidence in the findings?	This chapter summarises the actions taken and the reasons for those actions. The case has been comprehensively reported in this full document.
Does the case record provide an adequate audit trail?	The case record has accumulated systematically and been preserved in paper, electronic and audio-visual formats.
Is the account authentic in reporting the situation from the participants'	I endeavoured to be fair, to balance each account and to provide a fresh view of the situation.

Criteria	Actions
point of view?	
Comparability: is standard terminology used? Is the group clearly defined?	The group and the setting have been described in as much detail as ethical considerations will allow.
Are the methods and analytical categories explicitly identified?	The methods and categories are described in this chapter. The case record provides further details.
Is the data accurate?	Interview data was recorded and transcribed personally. Documents were used to verify factual data where necessary.
Language issues	All respondents were fluent in English, the language medium of the interviews and there were therefore no language issues.
Check for representativeness and for researcher effects.	The teachers interviewed are representative of the whole staff in terms of gender, age, ethnic background, home language and years of service. The researcher's perspective is described in detail.
Are extreme cases and surprises accounted for?	By reporting per interview each case retained its integrity and relevance to the phenomena.
Is the selection of data representative?	I have tried to include as much raw data as possible in support of my interpretations.
Look for negative evidence	The evidence for the three conditions spans a continuum from positive to negative.
Does the study focus on exploration and creative generation of new knowledge.	The study responds to various calls in the literature for research into contextual studies.
Ethical considerations	Described in the next section

One particular condition that I had to be conscious of was the halo effect[1]. As a participant researcher my colleagues are well known to me and I needed to address the conflict between knowledge of the teachers arising from familiar day-to-day interaction and knowledge arising from the data. In order to address this I separated my observations from the transcripts and acknowledged them as such when used.

[1] Halo effect: the tendency to make specific evaluations based on a general impression (from: Rosenzweig, P. (2007) *The halo effect*. New York: Free Press.)

3.6 Ethical considerations

This study has been conducted in terms of the school research policy, the university's ethic's policy and individual rights to privacy as reflected in the ethical clearance certificate (Appendix 1.2). Access to the school was given in principle and in writing and permission was granted for me to access whatever documentation I needed to access for the purpose. Potential participants agreed to participation in terms of the informed consent principle (Rossman & Rallis 2003, p.73) and signed written acknowledgement of their willingness to participate in the study. Whilst most of the documentation is in the public domain within the school, it was appropriate to seek this permission nevertheless. The terms of publication of this final report have been negotiated with the principal. The purpose of a study affects its sensitivity: a study that is for one's own enlightenment or for professional development purposes holds less threat than that which might be commissioned (Griffiths 1985, p.210). On the contrary, the participant researcher, as an integral part of the context, has more at stake than the outside researcher (Griffiths 1985, p.211).

The formalities of securing ethical clearance and permissions do not address the dilemmas that one faces as a participant researcher. Whilst this study is a private undertaking, it will be of benefit to the school and I consequently needed to be sensitive to any issues that might arise, at the same time ensuring that I did not compromise the trustworthiness of the report. Hargreaves suggests that such sensitivity issues are *"incapable of simple resolution"* (1967, p.199). In a similar vein to what Griffiths found (1985, p.203) the analysis of contextual considerations began to show a complex web of issues that needed to be unravelled. At the outset I planned to interview a sample of teachers and committed myself to securing their anonymity as well as the anonymity of the school. However, when the time came to report the findings it was nigh impossible to separate each individual from their specific context in terms of subject specialisation or rank (leadership, Head of Department or rank and file teacher) yet maintain contextual integrity. These aspects were crucial to what they had to say.

These factors also influenced decisions I had to make about sequencing the findings, whether by topic or by interview, and how this affected the so-called anonymity. Anonymity can often be a "*non-solution*" because if it is impenetrable the research does not provide feedback to those interviewed (Adelman *et al.* 1980, p.57). Given that within any context those that are familiar with the context may be able to identify individuals should they so wish (Rossman & Rallis 2003, p.191), I negotiated with my colleagues that they would not be named, but that the subject-relevant data would be used as such. For pseudonyms I used names linked to their gender, cultural background or both.

The issue of trust and betrayal (Rossman & Rallis 2003, p.77) is a sensitive matter. Rossman and Rallis state that *"people often tell more than they know they are telling"* and that the researcher often "*learns more than she wishes*". I believe that there were instances when both these situations occurred. One section of one interview contained sensitive material which will be confined to an undisclosed Appendix. Reference to certain strategies employed by teachers that might also have directly identified them thereby heightening sensitivity was either referred to in generic terms or left out. However, such instances were few and far between and given the more public nature of the topic that I was investigating did not impact the study significantly. In one sense I was quite surprised by the overall frankness of my colleagues, yet it is in keeping with an atmosphere of open dialogue that I sense from experience does permeate the school.

In terms of procedural requirements, the transcriptions of interview data were emailed to the teachers for checking for accuracy and approved. Member checks and negotiations regarding the identification of subject specific data were discussed and agreed face-to-face.

3.7 Limitations

Limitations set the boundaries of what this study is and what it is not. The conceptual framework defines what this study is about: the interactions that affect teachers at they try to innovate and the role that ICTs play in these

interactions. However, there are certain limitations to this study. These limitations relate to generalisation; the sampling method; the predominance of the curriculum change factor; rapidly occurring changes; comprehensiveness; and the socio-economic status of the school.

- General limitations of case studies are that results may not be generalisable, it is difficult to cross-check data for selectivity or bias and that as a participant-researcher I become a human instrument in the research and my interpretations will always be subjective (Nisbet & Watt 1984, p.76). The question here is how the study may be generalised within the context. This study does not claim generalisation to the full context, rather it shows how the combination of factors affects each individual in a unique way.
- The fact that I used convenience sampling may be a limitation, albeit the sample of teachers as described above, and that were eventually interviewed was representative in a general sense.
- The study is not a longitudinal study conducted over a lengthy period of time although the period in which I have been involved in the school, as well as my role in the school, have influenced my thinking. The data collection was also a moment in time and not necessarily representative of what might be happening at the present juncture. While some more recent events are accounted for in that they have a bearing on the findings, there needs to be a limit and that limit is as much a practical limit as any other.
- The data collection occurred at a time when the teachers were pre-occupied with curriculum change which may have had a bearing on the focus on curriculum as the findings reveal. However, the new curriculum had been introduced informally in 2002 and then formally in 2004 in secondary schools and had not yet stabilised. In other words, curriculum change is an ongoing condition that schools have to contend with.
- The study may have benefited from further interviews that counter-balanced the data collected from the interviews that did take place.

- A potential limitation of this case-study may relate to the position of the school at the 'high end' of the scale of schools within South Africa. Nonetheless, it is a typical school in that it grapples with transformation issues as much as any other school. It is also a school that grapples with ICT integration as any other school in that it is not privileged by any benefaction or commercial support of its ICT infrastructure and endeavours. The demands made on the school are also relative to the socio-economic status of its client base and the 'value-for-money' expectations cannot be ignored. All these factors add to the complexity of the context. At the same time it is acknowledged that less privileged schools in South Africa are just as complex and deal with just as many demands, albeit different ones. However, privilege does not imply irrelevancy; on the contrary it is often from the privileged schools, particularly in South Africa, that education expects creative leadership and innovation. It is towards this effort that this study documents my experiences in such an environment through the stories of my colleagues in the belief that it may contribute to the larger picture.

3.8 Summary of Chapter 3

This chapter has described the approach to the study and my position as participant researcher. The development of the research design based on this approach and on the conceptual framework has also been illustrated and described. Details have been provided of how each stage of the research process unfolded and reference made to issues of trustworthiness, ethical issues and the limitations of the study. The following chapter/s will describe the data based on the interviews that formed the main source of data for the study and provide my interpretations thereof.

Contents

Chapter 4: Findings: Organisational interactions and their effect on teachers' practice

4.1. Introduction 139
4.2. The relationship between innovation and context 140
4.3. The school: Wilding College 140
4.3.1. The teachers 142
4.4. Main themes identified in the analysis 143
4.4.1. Curriculum change 143
4.4.2. Inclusive education 144
4.4.3. Professional learning 147
4.4.4. The nature of the subject 148
4.4.5. Systemic factors 149
4.4.6. Teacher beliefs 150
4.4.7. Student beliefs and attitudes 151
4.4.8. Societal and parent factors 153
4.5. How organisational interactions affect teachers' practice 153
4.5.1. Organisational interactions: Bronwyn & Ineke 154
4.5.2. Organisational interactions: Magriet *et al.* 162
4.5.3. Organisational interactions: Henry 176
4.5.4. Organisational interactions: Richard 185
4.5.5. Organisational interactions: Maria 194
4.5.6. Organisational interactions: Francois 201
4.5.7. Preliminary findings: organisational interactions and their effect on teachers' practice 206
4.6. Summary of Chapter 4 208

Chapter 4

Findings: organisational interactions and their effect on teachers' practice

4.1 Introduction

The previous chapter described how the research design for the study evolved from the conceptual framework and explained how the methodology and process ensued from the research design. The research problem that this study addresses is to understand the effect of context on teacher innovation in secondary schools and on ICTs in particular. The study therefore explores the contextual interactions that affect teachers' ability to innovate and, in particular, to innovate using ICTs. This chapter will present an analysis and discussion of the findings on the first sub-question:

> *How do organisational interactions influence teachers' ability to innovate and to sustain innovation in practice?*

The Chapter will look specifically at interactions between mandated changes and teachers' ability to innovate in practice in the face of such changes, seeking evidence of convergence or disconvergence. Whilst the term 'convergence' is used as defined in Chapter 1 for the convergence of positive factors, the term 'disconvergence' is coined to refer to the convergence of factors which were found to have a constraining effect on teachers ability to innovate. In order to describe these interactions, the chapter will briefly recount the argument for the relationship between innovation and context, introduce the school and the teachers that form the sample of participants for the study, introduce the main themes identified in the analysis of data, and then describe the effect of mandated changes on teachers' ability to innovate.

4.2 The relationship between innovation and context

In order to establish the influence of context on the teachers' ability to innovate with ICTs it is necessary to understand and describe the context in which they practice. According to the literature, understanding teacher responses to change requires understanding human experience within the complexities of context, to look at their social worlds holistically (Rossman & Rallis 2003, p.9). To understand context is therefore to understand the interactions and relationships between the teachers and their context, how they make choices, interact together and adapt to each others presence (Erickson 1986, p.121-129; Clarke 2000, p.55). Schools need to identify and understand their own contexts in order to identify curricular goals, evolve a common sense of direction and consider how ICTs might help them achieve their purpose (Beetham & Sharpe 2007, p.7-8). ICTs therefore need to be studied against their contextual backgrounds.

Innovations are context-dependent: what is new in one context may not be so in another. To be effective, an innovation needs to have a purpose and to have been implemented in practice to a certain extent, while its success will depend on how it is perceived. Change occurs in very small steps, evolving gradually, therefore innovations do not have to be on a large scale, but the *"continual flux and change"* of organisational complexity plays a role (Glatter et al 2005, p.386). Fullan and Hargreaves (1992, p.4) point out that schools not only implement one single innovation at a time but are typically required to manage "*multiple innovations simultaneously"* and that little is known or understood about the *"teacher's sense of purpose, the teacher as a person, or the context or conditions under which they work"*. The broader context in which a teacher functions therefore needs to be described and understood before their ability or inability to innovate with ICTs can be understood.

4.3 The school: Wilding College

Secondary schools are highly complex environments (Bloom 2000, unpaged, 2001, unpaged; Clarke et al 2000, p.160; Davis & Sumara 2005, p.453; Doolittle 2001, p.9; Eadie 2003, p.2; Hennessy, Ruthven & Brindley 2005, p.6;

Phelps *et al.* 2005, p.73). As a South African school, Wilding College is no exception. It has faced a range of political and societal changes, education policy changes, school driven changes, technology-driven changes and practice-driven changes (Appendix 4.1). Every individual has felt the effects, beneficial or adverse, of the political and societal changes that have occurred in South Africa over the past fifteen years. As a consequence of the political and societal changes, major educational policy changes had to be made to racially integrated schools, to an inclusive human rights culture and to an outcome-based curriculum. These affect every teacher and student at a fundamental level and determine changes in curriculum and practice. School driven changes add further complexity to the adaptations that teachers and students alike need to make. Environmental factors as well as systemic factors further determine teachers' need and ability to change their practice. Global technology changes, some of which impact via the socio-economic sector that Wilding College serves, place further demands on teachers. Such changes are more subtle and interplay with mandated changes in different ways for each teacher or department. All these factors interact dynamically at organisational, departmental and individual teacher and student levels. Hennie's opening comment on changes that might impact a teacher's classroom practice epitomises the dynamic nature of change in the school:

> ***HJ5:*** *'It's forever changing … as we go along.'*

Wilding College is particularly complex, having also entered into a partnership with a group of schools and embarked on a programme of governance and internal policy specifications (e.g. Employment Equity Policy) over the past decade. It is a typical school in that teachers are required to deal with multiple innovations simultaneously (Fullan & Hargreaves 1992, p.4). In order to describe the context it was therefore necessary to gain an understanding of how the teachers had managed these multiple top-down simultaneous or overlapping changes and how the changes had impacted their classroom practice. As a participant researcher I am familiar with many of these

changes having experienced them myself over two decades (Appendix 4.1: Table of changes).

Of the teachers on the academic staff at Wilding College, thirteen were interviewed for this study. A description of the staff and the teachers follows.

4.3.1 The teachers

At the time of the interviews (2007) there was an academic staff cohort of 66 teachers. Of these 34 were male and 32 female. Ten teachers and three members of the leadership team were interviewed. The sample data is illustrated in Table 4.1.

Table 4.1: Table of teachers interviewed

Age bracket	Gender	Home language
20-30	Female	Afrikaans
30-39	Male	English
30-39	Male	English
30-39	Male	Afrikaans
30-39	Male	Sotho
40-49	Female	English
40-49	Female	Afrikaans
40-49	Male	English
40-49	Male	English
50+	Male	English
50+	Female	English
50+	Male	English
50+	Male	English

The table indicates that most teachers are experienced. All teach through the medium of English although the incidence of home language varies. In the findings the teachers are given pseudonyms in order to preserve anonymity. For the same reason the colleagues which they refer to in interviews are also given pseudonyms.

The following section will describe the main themes identified from the analysis after which the findings of the data analysis from the interviews with the teachers will be described.

4.4 Main themes identified in the analysis

It was found that dynamic interactions that support or inhibit changes in practice as a response to mandated changes occur in nine broad areas: curriculum; inclusive education; professional learning; the nature of the subject; systemic factors; teacher beliefs; student beliefs and attitudes and societal factors (including parental beliefs). The final area is collegial and professional relationships.

This section will briefly introduce these eight broad areas and then take each interview in turn to describe how convergence or disconvergence results from these interactions that support or inhibit innovative practice. Collegial and professional relationships are dealt with separately in Chapter 5 and interactions involving ICTs in Chapter 6. The references to these broad areas are not separated out in the interpretations as it is the *interaction* between all factors that are described and in each case these interactions occur in differing and complex ways.

4.4.1 Curriculum change

Curriculum change is nationally mandated top-down change. The change to an outcome-based (OBE) curriculum was implemented in secondary schools over a period of five years between 2004 and 2008, preceded at Wilding College by two years of preparatory experimentation. The data for this study was gathered at the time that curriculum change reached Grade 11 and the first Grade 12 final examination of the new curriculum occurred in December 2008. The OBE curriculum requires teachers to redesign not only the content they teach, but how they teach it and how they support the learning process. This requirement is described in the IEB handbook, noting the essential need for teacher support, as follows:

> *"The development of more appropriate curricula, forms of assessment, and teaching methodology for our school system is a central task of the IEB. The means of achieving this development is through ongoing exploration of improved ways of setting and administering examinations, as well as creatively developing school based assessment practices. User support is essential in this context as part of the national effort required to address changing needs in education*" (IEB 2006, p.4).

The requirements of OBE include mandated changes to assessment practices. The first assessors course[1] for teachers at the school was underway as this study began and it would be another two years before all teachers had attended this practical course in which they were trained to design for formative as well as summative assessment of each individual learner. To become a certified assessor, which is compulsory, each teacher was required to complete a comprehensive assessment portfolio. Although almost all teachers have now completed the course, only three have managed to complete their portfolios. From a curriculum perspective alone, teachers were thus required to work with different and applied content; change from assessment *of* learning to assessment *for* learning (Black 2004, p.9); accommodate individual needs; and accommodate knowledge, skills and values simultaneously. Curriculum change has thus dominated the context of this school for an extensive period, including the full period of this study. All interviewees therefore referred to curriculum change although it affects each teacher's practice to varying degrees and in various different ways as the analysis shows.

4.4.2 Inclusive education

The principle of inclusion (Ainscow 2005, p.118) is accepted internationally as a reform that supports and welcomes diversity amongst all learners (UNESCO 2001, p.3). Inclusion is a natural consequence of the democratic dispensation in South Africa and is nationally mandated as part of the change to the OBE curriculum. The *White Paper 6: Special Needs Education* (DoE 2001) provides a framework for systemic change for the development of inclusive

[1] Wilding College contracted consultants through the IEB to run this 5-day professional development course during term time for teachers in batches of 10-15 at a time. Each teacher has had to complete the course in order to become a certified assessor.

education. Independently of these developments, the school desired to implement the practice, consciously moving away from its previous practice of selection for admission on academic merit. The initial impetus arose from a conference at Harvard University (USA) attended by the principal in 1999. From the start, the focus of inclusion was not only the small number of students with special educational needs, but the range of individual needs manifested by all students (Ainscow 2005, p.118; Baggott la Velle 2003, p.196; Mioduser et al 2003, p.26; Clarke et al 2000, p.7), requiring a differentiated approach to learning (George 2005, p.185). Whilst student-centred learning does not necessarily imply individual support, student-centred learning is at the heart of inclusion and individual support because it focuses on how students learn rather than how teachers teach.

This change has significantly influenced teaching and learning practices over the past decade at Wilding College. Inclusion has resulted in certain systemic changes. Where classes were previously streamed, streaming in most subject areas was dropped in favour of mixed ability classes and the exclusive connotations of being superior 'in the top set' or inferior 'in the bottom set' fell away[2]. One adaptation that the school has made is offering Business Studies for boys who cannot cope with Physical Science which previously was compulsory. Another is the opportunity for boys with specific difficulties to follow an independent learning programme (ILP). An Academic Support department was established and initially two academic support specialists were appointed to work with the teachers and assist individuals with specific needs in some or all of their classes as well as through afternoon tutorials. However, although the number of students requiring support for specific difficulties was small[3], their numbers were not necessarily evenly distributed across the classes, either before or after streaming was abandoned. Thabo and Magriet describe the impact on their classes:

[2] With a cohort of 140-160 students per grade there could be up to seven sets per grade in some subject areas.
[3] The school theoretically accepts 6-8 students with identified learning difficulties per grade but further cases requiring support are often identified within the cohort group after admission to Grade 8.

***TL18**: I think it has changed, because if like you had to look way back then, we had sort of smaller classes, especially if you were taking inclusion. Your class will be generally small: you'll find that you've got maybe fifteen boys – maximum. And there you could like … do the one on one, try to OK push them like that, show them how things are done. But now its twenty five, and, you know, things have really changed … since then.*

***TL20:** Ja[4], I think that the inclusion boys … OK, inclusion is fine, but the class … that class should not be as big. You know, if maybe I've got a class of fifteen and I've got three inclusion boys, then its fine, I can take care of them. But if I've got a class of 25 and some inclusion boys inside, so it's …*

***MD21:** So, it's for example in my class that's got the most inclusion boys, the biggest problem boys, it's a class of 28. You can't … you can't … it doesn't work.*

Apart from changes in practice that inclusion requires, teachers have also to adjust to the presence of a second teacher in their classrooms and learn to work collaboratively with these academic support teachers.

In line with inclusive practice, but not necessarily as a direct result of it, there has been an increased focus on the pastoral needs of each individual student. The house system, which was previously only manifest in inter-house sporting or cultural events, evolved over the past ten years into a rigorous system of pastoral support through tutors and house directors. Over and above their other duties, every teacher in the school tutors approximately fifteen students, monitoring and supporting their progress from Grade 8 to Grade 12. Tutor groups operate within houses of 70-80 students under the leadership of a house director. Tutors and house directors oversee the academic, sporting, cultural, community service, leadership and disciplinary aspects of each individual student's school life and communicate with parents on their progress or lack of it.

[4] Ja (Afrikaans) = Yes.

4.4.3 Professional learning

With curriculum change, teacher professional learning occurs on different levels. Firstly, teachers at Wilding College are provided with print materials and electronic access to resources that inform them about the content and the mechanics of the OBE curriculum. Secondly they are learning about the realities of implementation in practice. Thirdly, and most significantly, they are learning on a personal level about themselves and what they are capable of achieving. Personal development is encouraged in the form of courses (such as *Investment in Excellence*[5]). Mandatory in house workshops conducted by outside consultants are offered during the one or two professional development days preceding the start of each term. Content of the workshops is determined by the school leadership and deals with broad policy issues at a strategic level rather than a practical level (e.g. transformation and diversity, professionalism). One recent presentation dealt with classroom discipline. Lastly, two voluntary one-hour sessions are held each term to workshop ideas around the Jim Collins concept of *"good to great"*[6] with the intention of dispelling complacency about how good the school might be and stimulating and extending teachers to strive for excellence over and above current levels. These workshops do not cover curriculum issues nor do they provide opportunities to develop pedagogical approaches (Beetham & Sharpe 2007, p1; Dede 2000, p.282; Looi et al 2004, p.92; Rowan et al 2005, p.22; Fogelman et al 2006, p.186). A mid-year planning day for the following year provides the single opportunity for teachers to share curriculum direction and practice. This day was held in 2007 and 2008, but in 2009 the day was given over to a general workshop with a consultant. From observation, although the teachers enjoy the workshops, comments on general workshops include *'I could have been doing …'* or *'Not at this stage of the term'*, indicating the time pressure that teachers are under and where their priorities lie.

Apart from the above, there are no further in-school opportunities for professional development that cover practice-related topics e.g. cognitive

[5] The Pacific Institute's *'Investment in Excellence'* professional development course is offered to all teachers. It includes refresher courses and is also offered in an adapted format to Grade 10 students.
[6] Collins, J. *Good to great: Why Some Companies Make the Leap ... And Others Don't* Random House 2001

development, constructivist methodologies, ICT integration, differentiated learning or learning design.

The nature of the subject was also identified as a factor that affects practice.

4.4.4 The nature of the subject

The nature of each subject area differs significantly according to different factors. These include the balance between practical and theoretical (content) components, the degree to which the subject area is established within the school, whether it is a compulsory or optional subject, the demand for the subject if it is optional and the relative size of the staff complement. A further influence on practice is the reason why a particular subject is chosen, sometimes linked to student learning factors and at other times to socio-economic pressures or both. In this example Richard explains how student learning factors affect his attempts to introduce an innovation:

> ***RL76:*** *Because we do allow [students] to choose from Grade 10. They can then choose. I introduced that because of this high level. There's always some kids that are just … never going to get it. And I think that opens up the … particularly the kids with sort of special needs. So what I did, I started with them. That was the way I tried to cope … Ok, this is a tool now that these students are really struggling with … its giving them pain. So I would then have Alena now teach them something else during that time. So it opened this little door. So now we took our special needs students and put them with Alena. Now she was meant to give them extra art lessons because they were struggling with that, as well. So they need this extra time, I felt. And I felt this is a good way. But it opens this little door and this is where … now what we have is they choose. As they feel that they can't cope with the computers, those ones filter off and go up to Alena in grade 10 [laughs]. That's the technique that's used at the moment.*

The implication for an optional subject is that there needs to be a minimum number of students choosing that option to make it viable. As a previous Head of Department (HOD) who has since left the school commented to me in an attempted discussion on potential changes to the approach in his subject:

"It's a matter of bums on seats."

In this particular case the HOD was not prepared to take the risk of losing students from his option by trying out new ideas and was reticent to enter into a discussion on the matter.

Balancing class numbers according to options adds a further complication. As soon as a class size reaches a certain number (ideally 28, but often 30 students) a second class is required which doubles either teaching time or teacher numbers. In either case, larger or smaller classes impact class sizes in other options. This balancing of choices and numbers creates tension between departments and lessens co-operation:

> ***AS193:*** *[It did not continue …] it was time-table and personal[ity] … mainly time-table. The person involved was very keen to continue. Also, we were slightly over-resourced in [our subject], so that was the main reason. So that was a real thing.*

Each of these aspects of the subject area affects individual teachers in different ways. Apart from these factors, systemic factors also play a part.

4.4.5 Systemic factors

Systemic factors or the *"grammar of schooling"* factors (Tyack & Tobin 1995, p.453) include the systems on which the school operates: classes within grades, annual and term calendars, daily and weekly timetabling of subjects and teacher time, the broader curriculum, the provision and allocation of physical and human resources, hierarchical structures, relations with the partner schools and the underlying administrative system.

The school runs according to a traditional '*grammar of schooling'* model:

- The school day runs from 07h30 until 14h35 and sports run from 15h00 until 16h30. There are between 9 and 11 30-minute periods per day, most of which are doubled to provide a one-hour slot.
- Each teacher is time-tabled for a minimum of 32-36 30-minute periods per week and an HOD or House Director for 28-32 periods.

Over and above this, each teacher is expected to be involved in at least one sporting or cultural extramural activity, act as tutor to a group of boys, teach either Life Orientation (LO) or in the leadership programme, attend school religious services and attend all compulsory school functions such as parent evenings and some optional ones.

- Students are divided by grade and within grades by classes according to their optional subjects. Students have no free periods and are expected to partake in at least one sport each season after school hours. They are also encouraged to be involved in cultural activities and community service.
- Structures are hierarchical from the partnership through the principal to deputies, HODs and teachers. Separate departments run the maintenance and financial operations of the school. Communication routes are formalised through line management although a few cross-hierarchical committees (e.g. the Footprint environmental committee and Staff Forum) exist.

The structure of the school is therefore traditional and rigid, with almost no leeway to accommodate other extra-curricular events without disruption to the rest of the school.

The next section will outline the effect of teacher beliefs on context.

4.4.6 Teacher beliefs

Teacher beliefs around a range of factors significantly influence both their thinking and their practice. In some cases teacher beliefs are contextualised within areas such as curriculum change, inclusion or ICTs; in other cases they are broader. Self-belief emerges as a strong factor in the teachers' predominantly positive attitude towards change and innovation. It is sometimes expressed as self-belief and sometimes as self-doubt as the following examples show:

BK2: *We were talking about that today because Ineke was saying, because Ineke set up the Grade, the change in the Grade 10 last year. I wasn't teaching Grade 10. So I said to Ineke, "you're doing the most amazing work". "No, terrible." We had the most terrible time in Grade 10 last year. Even in a public announcement Darryl said in Grade10 we never got it right. Now, we're going through the same work, the same way, and I keep saying to Ineke, this is the most amazing work. So, there's no benchmark for us.*

IG3: *Yes … it's hard …*

BK4*: The same is happening to us in Grade 11. I keep saying to Ineke, I said "Ineke, I don't feel like we're on the same track or on the right track" but Ineke said "remember how we felt about Grade 10 last year. It's the first year. Give it a year". We're like first year teachers, Mary.*

IG5: *So you just have to give yourself time to …*

BK6*: … hard on ourselves …*

IG7*: … work through things, iron through things and then when you run them the second time you make little changes here and there …*

*****

MW6: *because you feel, or I sometimes feel that I'm not doing all the children justice in my classroom. I have an hour … and I'm picking that up especially in Afrikaans. So, I have an hour where I see them, but you don't, I just feel I don't get to all the kids who need the individual help*

Self-belief is also a critical tenet of the *Investment in Excellence* course which most teachers have completed. Self belief has a strong positive effect on teachers' ability to cope with change. In addition to teacher beliefs, student beliefs and attitudes were identified as contextual factors that affect teachers' practice.

4.4.7 Student beliefs and attitudes

The majority of students at Wilding College are drawn from the highest socio-economic level and residential areas in the country as described in Chapter 3

Section 3.4.1, p.114. As such they bring specific demands and attitudes that have a bearing on classroom practice as illustrated in the following extract:

> ***HN15:*** *It's just exposure to the negatives of a technological society. The amount of time and energy that goes into computer games and into Mxit and into I-Pods. You know, I mean, I find it scary as a runner that most runners now run with I-Pods in their ears. So they don't talk to anyone around them. You know, they're all cyclists at heart. That kind of thing. And this is all part of our society. We've become much more isolated as human beings. So, with all the pastoral care and trying to make them react with each other and work with each other in so-called group work we do, they're actually pulling apart.*

Generally, the students aspire to high academic, sporting and cultural standards of achievement. They have ready access to digital technologies. South African teenagers have the highest incidence of mobile-technology ownership in the world[7] and Wilding students are no exception. Their expectations of digital resources are therefore high. Student beliefs as they enter secondary school are also influenced by their exposure to learning principles and processes at preparatory school as described by Henry:

> ***HN27:*** *Now, if you take that into the classroom, if you start saying "Well, now you do group work" when you're 9 years old, they don't begin to understand the concept. Whereas, you say to a team of Grade 10s and this is where the prep school is going now with Roger's thing. Have you seen it? It is very clever.*
>
> ***HN29:*** *It's a real world … um … Sims, basically.*
>
> ***HN31:*** *And that involves group activities, individual activities. How does society work? And it's pitched at exactly the right level. They [???]. They're exactly the right age to learn the rules of the game. So that's the kind of thing that works well, but on the other hand, they're doing a lot of content at too high a level*

Although the school serves a high socio-economic sector generally, not all students come from the same socio-economic background and, while it is possible to generalise about the student population and their beliefs, it is

[7] Sunday Times 13 June 2009

recognised that the exceptions are very real and that each individual student is unique. Societal and parental factors are closely linked with student factors.

4.4.8 Societal and parental factors

Societal and parental factors are closely interlinked with student factors. As a fee-paying independent school parents expect good returns on their investment in their children's education. Parental demands for excellence and their beliefs regarding the value of tests and examinations can be in conflict with curriculum intentions and marks still predominate as their singular measure of achievement. However, what is evident from the data are teacher perceptions of parental perceptions, although experience confirms that this parental perception might be common:

> ***HN11**: I think it's actually because OBE is being subverted by marks. That, you know, the reaction in the education community and I include parents in that, was that we're now just getting fuzzy reports that don't define my child in terms of marks. That's why I use the phrase dinner table. I think the kids are picking that up from the parents.*

All of the above factors interplay in different ways within the context of Wilding College and each combination of factors has a different bearing on each individual teacher as the findings that follow show.

4.5 How organisational interactions affect teachers' practice

Interactions within and across these broad areas differ from one department to the next and between individuals. Hence, to establish the effect of these interactions and to determine not only where convergence occurs but how it influences innovation, the following section will describe the dynamic interactions within and between these broad areas discussing each interview within the context of the individual or pairs of teachers. The section will describe how the interaction of factors relating to mandated changes have converged with and impacted on the requirement for teachers to change their practice as well as how the convergence of negative factors interplays with

positive factors. The first pair of teachers who were interviewed together is Bronwyn and Ineke.

4.5.1 Organisational interactions and their effect on Bronwyn's and Ineke's practice

Curriculum change, professional learning and the nature of the subject are the predominant factors affecting Bronwyn and Ineke.

4.5.1.1 Curriculum change

Curriculum change is the most significant factor for Bronwyn and Ineke. They ascribe the development of their innovative practice to a number of factors: their willingness to change; the need for Ineke as a new member of staff (returning to teaching after a career change period) to create new materials from scratch; the suitability of the new curriculum to boys learning needs; and their mindset. The new curriculum has, for them, been like starting again as '*first year teachers'*, and forced them to rethink their practice from ground upwards. The following extracts show how Bronwyn and Ineke have coped with curriculum change:

> ***BK2/4****: We were talking about that today because Ineke was saying, because Ineke set up the Grade, the change in the Grade 10 last year. […] So I said to Ineke, "you're doing the most amazing work". "No, terrible." We had the most terrible time in Grade 10 last year. […] We never got it right. Now, we're going through the same work, the same way, and I keep saying to Ineke, this is the most amazing work. So, there's no benchmark for us. […] The same is happening to us in Grade 11. I keep saying to Ineke, I said "Ineke, I don't feel like we're on the same track or on the right track" but Ineke said "remember how we felt about Grade 10 last year. It's the first year. Give it a year". We're like first year teachers, Mary*

> ***IG5/7/9:*** *So you just have to give yourself time to […] work through things, iron through things and then when you run them the second time you make little changes here and there … and it's fine.*

***BK10**: And I kept saying to Ineke "But, look what we've done". […] We've done lovely stuff, but it's just because you get so bogged down you don't see the big picture.*

*****

***BK12/14/16**: I think we were prepared to change. You see, a lot of the schools […] and the secret is not re-hashing old material. It's developing new material. The other schools […] they're re-hashing old notes, so they're not getting it right. So we've definitely thrown everything out … I mean that's also thanks to Ineke. […] and Ineke kept saying, "look at the date in the book. This is a 1975 book. That's absolute nonsense. Get the latest book."*

***IG17/19**: I've been very strict on that. We have … to be up to date with current trends. We have to go onto the Internet. We have to get the latest and greatest information. You can't rely on the stuff.*

*****

***BK23/25**: So it was a change of mindset. It was a mindset change […]*

*****

***BK62**: But that you see … I think that's where our strength comes from. We don't allow anybody else to pull us down.*

***IG63:** Yes. We set high standards for ourselves and we, we work together … as a team.*

*****

***BK27**: […] We like the new syllabus. That's … I think that's why we made the changes. Because it suits the boys, the activities, little bits of information suit the boys.*

***IG28**: And lots of it also is about the human body and diseases and medical things which is very interesting … for us to teach and for the boys to learn. Because it's giving them … it's empowering them. That's what it's doing. They can't ever walk out of our classroom and say "but we didn't know about HIV. We didn't know," because they do know.*

***BK30/32:** For their future. […] But they even verbalised it. I had one of my Grade 11 boys who said "Ma'am, you know. Thank you for being so concerned that we must never contract HIV." So they also feel our urgency that they must be empowered.*

> ***BK34:*** *So that was quite interesting. I've never had that before. So it wasn't just, "Ag, you're just the teacher", but "thank you for caring and thank you for letting us know and how … all the stats that we give them. Because, you know, they do it, I think, in LO, they're thrown … but it's not personalised. And I think that's what Ineke said. The boys, they like the diseases, they like to know about themselves.*

> ***IG35:*** *And I go and find all pictures on the Internet for them, of all vrot[8] limbs and whatever, whatever and they say "Why do you show us such detail?" and I say, "Because then you can't say you didn't know".*

A striking point about the conversation between Bronwyn and Ineke is how they recount their conversations. The impression is that they are not only two people working in the same department, but two people working *together* in the same department. The alignment of their thinking is evident in the way in which the discussion switches between them, sentence by sentence and in the way in which they make use of the first person plural 'we'. To have an ally, to have someone to affirm what one is doing, is a positive factor in their ability to deal with curriculum change.

The process of innovation as adaptation and self-organising growth (Clarke et al 2000, p.157; Doolittle 2001, p.5) is illustrated in this response:

> ***IG133****: We haven't thought of something and not gone … we've tried everything we've thought of.*

> ***IG137:*** *We can only really talk about Grade 10s, because that's the only one we've done for the second year running and we've done the same, but also added things to it like the model. We didn't do a model last year but we did one this year. But, everything else we did last year we've done this year again.*

> ***BK138/140****: But, you know, like in Grade 11, I said in the meeting today, we will teach it very differently; because we will […] we'll cut down. So, we're already planning what we're going to take out already.*

> ***IG142****: Because we've maybe gone into a little bit too much detail this year.*

[8] Vrot = rotten (Afrikaans; used colloquially in South African English)

For a unit of work on the HIV virus Bronwyn and Ineke describe how they would, under the old curriculum, have transmitted information about the virus to the students. With the new curriculum, their students had to use the Internet to investigate how the virus attacks the human body, build a model of the virus from the located information and explain the model to demonstrate their understanding. To accommodate the knowledge, skills and values requirements of the curriculum, Bronwyn and Ineke's practice changed to a student-centred constructivist, resource-based approach.

In order to cope with curriculum change, Bronwyn and Ineke both experienced a sharp professional learning curve, the result of a number of interacting factors.

4.5.1.2 Professional learning

Bronwyn and Ineke admit that they were open to change and prepared to develop new material. For Ineke, her return to teaching forced her to begin again by creating her own resources. She also had a strong influence in her department regarding the importance of working with current resources. Bronwyn's use of the word *'secret'* has a magical connotation about it. Finding the *'secret'* has allowed them both to make the breakthrough. The repetition and contrast between *'not hashing old material'* and *'developing new material'* reveals Bronwyn's confidence in being on the right track. Both are also realistic and prepared to admit when they do not get it right.

The intensity of their professional learning is summed up in the comment: '*We're like first year teachers'*. This admission is significant in that it is in reflecting on their practice that their success with the new curriculum appears to lie. In a separate undocumented informal conversation, a few weeks prior to this interview Bronwyn had commented in almost identical words. However, she had added that it was only once she '*started again from the beginning'* that she had really learnt to understand not only the new curriculum, but what could be done with it. Bronwyn had further commented that the context of student learning was *'everything'*. A paradigm shift had

occurred in her thinking and enabled her to make the necessary changes in her practice. Reflexive practice combined with their collegiality characterise these two teachers and enable their professional growth.

Bronwyn and Ineke realise that it is a matter of working through the material and making adjustments each year to improve their practice. This is clearly expressed in her acknowledgement that it is difficult to keep sight of '*the big picture'*. The effect of working with a new curriculum has resulted in the teachers doubting their ability at times. However, their lack of success is identified, acknowledged and addressed as shown in the statement '*we never got it right'*. Acknowledgement of their shortcomings opens the way for them to improve their practice.

The nature of the subject also contributed to their ability to change.

4.5.1.3 Nature of the subject

The nature of the subject matter has different effects in different departments on teachers' ability to bring about change in their practice. The Life Sciences teachers were positive about the changes in content in the new curriculum, recognised it as appropriate to boys and welcomed the opportunities it provided. Their efforts to empower their students by personalising the work is reciprocated in that the boys have provided positive feedback on the issues covered.

Bronwyn and Ineke draw two comparisons: the first with other schools' materials and the second with LO. They are sufficiently confident in their own innovative ability to be able to pass judgement on other schools attempts to implement reform by rehashing old notes. They also criticise LO for *'throwing'* impersonal material to the students (BK34).

There were few disconvergent factors that constrain their ability to innovate.

4.5.1.4 Constraints

One difficulty for Bronwyn and Ineke in implementing the new curriculum is that they started without a benchmark[9] or established personal norm against which to evaluate their practice. However, after the first year a baseline or norm had been established, they are able to see the wider picture and they find it easier to progress with enhancing their units of work. Working through units for the second time thus enables their reflective practice (Baggott la Velle 2003, p.197; Beetham & Sharpe 2007, p.7-8). Despite the drawbacks they face, most teachers anticipate that each year will bring further improvements. Bronwyn and Ineke are confident in what they are doing, yet see room for improvement, anticipating further adaptations in the following year.

However, there is one serious threat to their ability to implement the new curriculum and that is the curriculum itself. Further proposed changes and the reasons behind the changes emanate from government school teachers and are perceived to be regressive:

> ***BK310:*** *[big sigh] You know why [they want to go back to the old syllabus]? […]*
>
> ***IG313:*** *Because they're worried that there isn't enough Botany in these things.*
>
> ***BK314:*** *And also they're not comfortable with this new curriculum. […]*
>
> ***IG316/318:*** *Government teachers … […] Ja, that's where it's come from. And we're not sure yet whether the IEB is actually going to go with that.*
>
> ***BK319/321/328:*** *Because we might say that we're going to stick to the changes we made, because in the User Group we're all so excited about this change and there's … the last comment in the User Group was "We're having fun; we're having fun with our Grade 10s". […] Why change and go back to the old-fashioned … go through all*

[9] Benchmark: a point of reference from which measurements may be made; something that serves as a standard by which others may be measured or judged; a standardized problem or test that serves as a basis for evaluation or comparison (as of computer system performance) (Merriam-Webster online dictionary http://www.merriam-webster.com/dictionary/benchmark. Standard, or a set of standards, used as a point of reference for evaluating performance or level of quality. Benchmarks may be drawn from a firm's own experience, from the experience of other firms in the industry, or from legal requirements such as environmental regulations.
http://www.businessdictionary.com/definition/benchmark.html

the plants and go through all the animals again? Where you're putting more content back in. […] [T]here's been a lot of opposition to going back in 2009. Books are being written, Mary. The authors have written all the new syllabus that we're using. They've done 10, 11 and 12. Next year Grade 12 is finished.

IG329: *And they're saying that from 2009 they're wanting to change from Grade 10 again.*

BK330/332: *So they'll have to rewrite all the textbooks again. […] Ja, because, you know, you know it's a lot of work to change.*
IG333: *Ja. So they want to move away now with this new suggested … the new, new one that they suggested for 2009 … move away from all the stuff on the human body that we're doing, cut down on that and bring in more plants and more of the old stuff from the old, old syllabus.*

BK335: *So we're all opposing it …*

IG336: *So we've just changed Grade 10 last year, 11 this year, 12 next year. Now they're saying the year after that we'll have to do 10 again and the year after that 11 again and the year after that 12 again.*

BK344: *So its … we don't … we don't want to go back … because we feel this has been the best …*

IG345: *We've done all this work …*

BK346: *… and it's been … I think it's been the best thing that has happened to Biology [Life Science] for years and years and years.*

The reversion to familiar content has implications for teachers and authors alike. Apart from the additional load for teachers, textbooks will have to be rewritten at substantial cost. Schools such as Wilding that are less dependent on textbooks and more reliant on electronic resources will still need to redesign all units of work around the different content. Instead of being able to expend energy and time in developing and refining units for the new curriculum in Grade 12, teachers will have to be fighting a political battle to retain the current curriculum. In this case it is contradiction and vacillation in mandated changes that add significantly to teachers' workloads, destroy

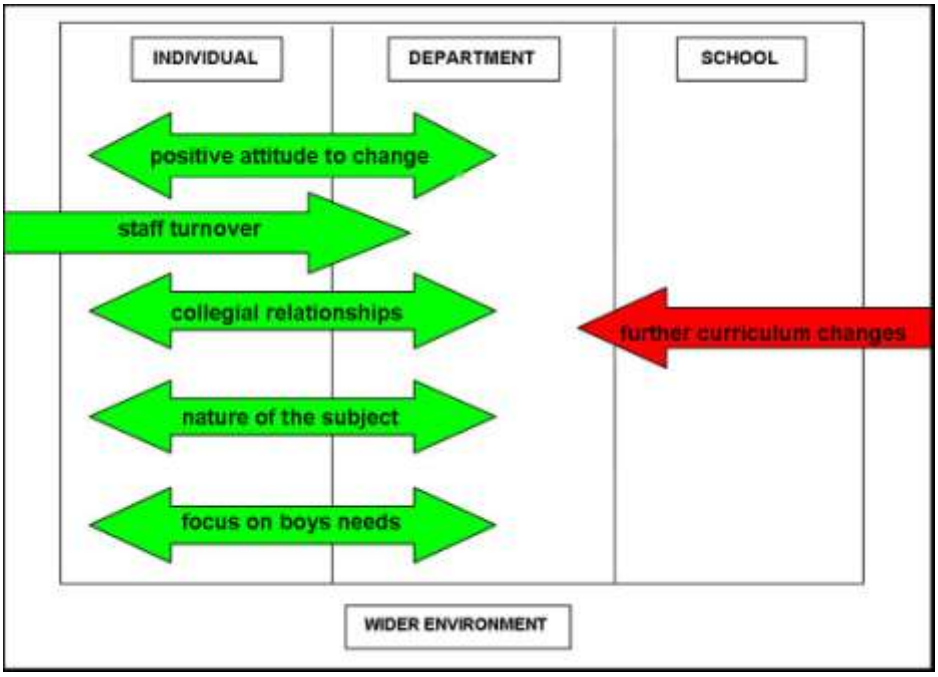
innovation and curb its sustainability. At the time of the interview a decision regarding the change had not been made, but was subsequently confirmed. This is an example of political push-back factors that can inhibit innovation (Mehan et al 2005, p.315).

4.5.1.5 Summary and preliminary findings: Bronwyn and Ineke

For Bronwyn and Ineke convergence is evident from the way in which they describe their experiences as well as the positive reaction that they report from their students. Factors that interact positively or converge are the opportunities that the curriculum provides; the focus on the individual needs of the students; their acknowledgment of their own learning; palpably harmonious and effective collegial relations; the nature of the subject in its ability to attract the interests of the boys; an alignment between teacher and student beliefs and attitudes; and the emergence of benchmarking through repetition and adjustment over time; access to resources and active pursuit of currency in such resources. The nature of the subject, their understanding of boys learning needs, access to resources and pursuit of currency in such resources have converged to enable a socio-constructivist pedagogical approach (Hokanson & Hooper 2000, p.543; Baggott la Velle et al 2003, p.190). Potentially negative factors are their initial self-doubt and getting bogged down, but these are acknowledged, addressed over time and consciously set aside. The workload is implied by their reference to the changes in different grades and to their getting bogged down but at no stage do Bronwyn and Ineke indicate an insurmountable load or an inability to cope with these factors. However, recent reversals in curriculum content threaten to undo much of what has been achieved.

Although complexity cannot be illustrated, the result of the complex interactions, i.e. the effect of context can be illustrated as convergent and disconvergent factors as in Figure 4.1 and in the similar figures that follow for each of the next sections. Figure 4.1 illustrates the pattern of organisational factors that affect Bronwyn's and Ineke's practice.

Figure 4.1 Organisational effects: Bronwyn & Ineke



Convergent factors enable individual innovation and positive collegial relationships ensure mutual benefit across the department (double headed arrows). Positive outside influences are those which Ineke brought from her previous corporate environment and which have pervaded the department. The single disconvergent factor, in this case a contradictory direction change in the curriculum, is represented by the red arrow.

In the next section two pairs of teachers will provide differing perspectives from within the same subject area.

4.5.2 Organisational interactions and their effect on Magriet's Thabo's, Hennie's and Arthur's practice

Two interviews, each involving two teachers, were held with the Physical Science department. The interviews included the HODs responsible for the two different secondary school phases (Grades 8 and 9 and Grades 10-12) and two regular teachers. As a result it was possible to contrast two differing perspectives within one subject department. Whilst there was agreement on the presence of certain factors, there was contrast in the responses to these

factors. The data from these two interviews is therefore analysed together. Curriculum change and inclusive practice were the predominant factors for the Physical Science teachers, with convergent and disconvergent factors intertwined in complex, but differing ways for each pair of teachers.

4.5.2.1 Curriculum change

The interviews revealed the differences in perspective on mandated changes and the varying effects on practice between the pairs of teachers. The effect of experience as well as overload became evident as these extracts show:

> ***MD11/25**: […] and the fact that there is so much demand on our time. I mean, like, I used to mark their books every day. I can't anymore because I've got this to do, this to do, this to do. You don't have time for that extra bit you want to put in. So it's … it's getting a lot, especially with LO also coming into this [...] Entering marks. Now they want … […] where it took you a day to moderate something … it now takes you two or three days. Its … I mean I moderated a Grade 11 paper with this LO[10] nonsense. It's not nonsense, but it takes for ever. It takes forever. And now, when you make notes you have to specify what LO it is. When you set up a test, next to the test, the question, it should say LO this, LO this, LO this. It …* [sigh] … [throws up arms].
>
> ***TL26:** Ja, I think, we're maybe not that prepared for the new curriculum, especially in Grade 11. I mean, I … I find it sort of difficult for me to prepare even though I know the content, but to prepare and to present the matter in the way you're supposed to present. I find it to be very difficult. You know, there's so little time to do everything … to prepare here, to do that.*
>
> *****
>
> ***MD40:** I understand what they want to do and it makes sense. You know, implementing it into nature and our daily life. That makes perfect sense. But what they expect is unrealistic. And that's … that's why we don't get time to do or to be with the kid anymore, because your time for prepping triples and your time for admin triples. Your hours in the day stays* [sic] *the same.*
>
> *****

[10] In this case Magriet is referring to LO as 'Learning Outcome', not the subject 'Life orientation'

> ***TL28:*** *Now I think its more of application … and we're expected to explain … and OK … of course to show also the boys 'how does this affect us in every day life and how do we solve problems with these kinds of things?' It is no longer sort of those calculations where you get a formula, you plug in the values and then you calculate. No, that's gone. Now, now, it's more application.*
>
> *****
>
> ***AS11b****: The new curriculum has had quite an impact because that's had the opposite effect [to inclusion], because the new curriculum is not well understood. The temptation is to withdraw and fall back on the old…. a very directed style, so that we can sort of figure out what the syllabus is <u>really</u> saying as we go along. I think that's quite a common phenomenon because the [test ???] don't really understand the curriculum either even though they've written the curriculum.*
>
> *****
>
> ***MD71:*** *Um … and … no matter how hard … for example this Multi-media Science School on the computers. Excellent. But I can't remember when last I had time to go and physically work through it, make notes from it for my kids … or something. I don't have time. And to find new things or a new way of doing it or going through the books, for example, to find a new experiment, I don't have time. That's unfair.*

In Physical Science, the HODs appear to take the change to the OBE curriculum in their stride and show less frustration with its shortcomings than their departmental colleagues for whom the expectations of the curriculum are *'unrealistic'* (MD33&35). Magriet and Thabo identify a lack of time to implement the administrative requirements of the OBE curriculum and the extra load of having to teach LO as negative factors (Ch.5, Section 5.9, p.252). Specifically, Magriet is frustrated that Multi-Media Science School (MMSS), although available, cannot be incorporated in her practice because the constraints of extended preparation time prevent her from using it. To her, this is *'unfair'*. However, as much as she would like to make use of this resource, Magriet refers to MMSS as a source from which to make teaching notes. It is not referred to for its interactive potential as a *learning* tool i.e. she does not express the wish to take the students to a venue where they can benefit directly from its interactive potential. She is still the intermediary between the students and the content.

Magriet expresses frustration with the administrative aspects of the new assessment process, but also recognises its shortcomings, while Thabo concedes that the underlying problem is likely the lack of preparation for the OBE curriculum. His understands that OBE requires him to prepare and present in different ways, but whilst he accepts this mandated change in principle, he is unsure of how to implement it in terms of his classroom strategies and consequently, has not been able to change his practice. Magriet also acknowledges that with the OBE curriculum, the context or application of knowledge is essential, but this requires more preparation time. Together with the increased administration load, preparation is therefore a further factor in her inability to reach the individual student, as much as she desires to do so. The simultaneous introduction of the new curriculum and inclusive principles contradict each other. It would appear that whilst these teachers desire to change their practice from a teacher-centred to a learner-centred focus, systemic factors and lack of preparation for the OBE curriculum prevent them from making the necessary shift, resulting in overload, stress and regression rather than progress in the development of their pedagogic practice. Fullan and Hargreaves (1992, p.4) recognise this problem of multiple innovations being introduced simultaneously as a feature of complex environments.

Although Wilding College writes the Grade 12 IEB examinations, the OBE curriculum originates in the national Department of Education (DoE). At the time of the interviews there was general concern across the school as the curriculum reached the penultimate year of schooling (Grade 11):

> ***AS11c:*** *[Those who have written the curriculum] certainly don't know what the final [???] product is going to look like, so that's created quite a bit of tension within me and within the classroom in Grade 11, less so in Grade 10 where [???] able to do.*
>
> *****
>
> ***MD29:*** *[…] But if you want to bring the concept of momentum over and help them to understand it, its momentum. It doesn't matter if it's Grade 11 or 12, its momentum [shrugs]. And a Grade 11 kid isn't ready for it. I'm sorry. We've seen it in our marks.*

They are not ready for it, which means we stress ourselves up even more because we can't get through to them. They, they can't, they can't do it.

TL30: *Ja. It doesn't show really where we should stop when we are busy teaching. Remember now, that the Grade 12s, next year are going to write only the work that should be done in Grade 12. Now, when we are teaching Grade 11, we can see it overlaps but when we are busy teaching, we say "no, we shall stop here, we shall not go forward, we will do this next year". You know, and it just sort of leaves some gaps here and there and I also end up being confused as well. […] I don't know, maybe we are not that well prepared to …*

MD31, 33 & 35: *[…] But it's what they expect of you – the kids – and of us. It's too much. I mean the amount of work we have to get over, to get done, it's … it's … it's unrealistic, because it's too much. […] the curriculum we get says what? Just touch this, touch this. But when we get an exam from the government or the IEB now, they go into depth. […] So we don't know … what they are up to actually. […] It is [a contradiction]. Because they just do this, just touch it. And then they go into so much detail. Neither of us knows …*

Thabo is concerned about the conflict within the curriculum itself, particularly in Physical Science, as identified in both interviews. Students' developmental levels appear to be in conflict with conceptual demands. The division of concepts over the two final grades as separate years rather than as two integrated years has negative implications for students and teachers alike. The volume of work to be covered is perceived to be too great. Lastly, there are contradictions between expectations as described in the curriculum documentation and the expectations manifest in the formal external assessments. As a result, teachers are confused and frustrated about the intentions of the curriculum. Arthur predicts that further changes will occur in the curriculum. The fact that the IEB examiners themselves do not know what the final curriculum will look like is an inhibitor to his confidence. All the teachers agree on the shortcomings of the Physical Science curriculum.

Apart from curriculum change, inclusive practice has had a predominant effect on the Science teachers.

4.5.2.2 Inclusive practice

Arthur compares the impact of inclusion with the impact of the OBE curriculum on his teaching practices, acknowledging that inclusion has had a bigger direct impact in that he has moved from teacher-centred to group facilitation approaches. However, his ability to implement such strategies is inhibited by the greater demands of coming to terms with implementing the new curriculum. As with Magriet and Thabo, the immensity of the mandated curriculum inhibits the personal desire to fully realise inclusive practices:

> ***AS9/11a:*** *I think [inclusion and OBE] have impacted in different ways. The emphasis on inclusion … on teaching for every child … has probably had the biggest impact I think. But … it's made me go from … fairly teacher centred to very group centred … peer mediation teaching.*
>
> *****
>
> ***MD5/7:*** *[???] It makes it hard. I see with my Grade 8s now. I've got so many inclusion kids and it's hard hey. 'Cause as soon as you've got the one, you lose the other one and then you have to restart and then you have to pull them all and as soon as you have them one kid falls off his chair and then they just laugh for half an hour. And it takes you forever to get them back. […] No, [the Academic Support teacher] can't. She can't be in every class. She can't be in every class. She's only one person. And we've got [six] Grade 8 classes.*
>
> *****
>
> ***TL12/18/20:*** *Ja. There's just no time to do … to do everything all at once. And, you know, that one on one sort of taking care of this particular boy or boys has gone. We just teach generally. And in my Grade 9s for example, I don't even know whether I've got inclusion boys. I'm just teaching continuously and I find that some of the boys … they might be inclusion boys, but I just continue teaching. […] I think it has changed, because if like you had to look way back then, we had sort of smaller classes, especially if you were taking inclusion. Your class will be generally small: you'll find that you've got maybe fifteen boys - maximum. And there you could like … do the one-on-one, try to OK push them like that, show them how things are done. But now it's twenty five and, you know, things have really changed … since then. […] OK, inclusion is fine, but the class … that class should not be as big. You know, if maybe I've got a class of fifteen and I've got three inclusion boys, then its fine, I can take care of them. But if I've got a class of 25 and some inclusion boys inside, so its …*

> ***MD21:*** *So, it's for example in my class that's got the most inclusion boys, the biggest problem boys, it's a class of 28. You can't … you can't … it doesn't work.*
>
> ***TL36:*** *And I think with those G11s. Their committed level is not the same as what the curriculum wants them to do.*

Together with curriculum change, the inclusion policy dominates the responses from Thabo and Magriet. They struggle with the presence in their classes of students with learning difficulties. Although academic support is offered, the academic support department is short-staffed and a support teacher is unable to get to all classes, particularly in Grade 8 and 9 Natural Science, where all six classes in a grade are taught concurrently. Magriet and Thabo are willing to implement the inclusive practices and desire to provide the individual attention that is required, but they are frustrated by two factors: limited time and class size. These systemic or grammar of schooling factors have not changed, whilst complex changes have occurred around them. Both Thabo and Magriet refer to not only a lack of positive change, but also acknowledge retrogression in their practice of supporting individual needs arising from factors which are beyond their control. With streaming, classes at the lower end were smaller, facilitating more individual attention. Without streaming, and with inclusion, class sizes have evened out and teachers have to cope with larger classes as well as wider ability ranges. The combination of these factors has had the opposite effect to what the school desires and one-on-one attention to the individual has thus diminished.

The emphasis on the teaching process (TL12/18/20: *'We just teach generally … And in my Grade 9s for example, I don't even know whether I've got inclusion boys. I'm just teaching continuously …')* rather than the learning process is evidence that the pedagogical changes espoused by the IEB, i.e. "*the development of more appropriate curricula, forms of assessment, and teaching methodology for our school system"* (IEB 2006, p.4) have not been realised. Magriet's statement *'if you've got the one, [then] you lose the other one'* (MD5/7), indicates that she is not equipped with the necessary strategies or provided with the support necessary to accommodate attention-related

difficulties, hence the resultant breakdown in classroom discipline. Apart from the lack of preparedness on the teachers' part, Thabo reveals an apparent lack of preparedness for the expectations of the OBE curriculum on the part of the students as well.

As a consequence of these conflicting mandated changes Thabo and Magriet have been forced to abandon certain innovations that they have tried to implement:

> ***MR139:*** *Is there anything new that you've tried that you've had to discontinue?*
> ***MD140:*** *A lot. A lot. What I tried was … putting them into groups and then giving each group a little thing to do. That doesn't work, because the bright kid in that group will do everything and the rest will just slop along and mess around. So then I said, "All right, I'm gonna [sic] give you time in class to do this work, so if you battle then ask, [???] to mess around [shrugs]. […] But group work, I'm not a big fan of. I'm sorry, because I don't find it always working, especially with Grade 8s. They're too immature. They are too immature to work in groups. They can't. Pracs for example: I can't let them do that. For example, I light the Bunsen burner. I can't let them do it. They set each other alight. [Chuckles] No, seriously. They throw each other with a match [sic]. I can't. There are things which it's essential for them to learn which I can't do, because they're too stupid … not stupid, but acting stupid [shrugs]*
>
> ***TL141:*** *Ja. Ja. It's true. But when they're doing pracs, I think its better. I know with my Grade 9s, I mean, I give them a circuit board and the prac will tell them what to do. You know, boys will connect the batteries and they'll light the bulb and everything, you know. Which is fine, but by the time I tell them to do what we are supposed to do, those batteries are gone. Ja. [laughter] "No, it's not working" or "The bulb has gone". This and that.*
>
> ***MD142:*** *Or, they've disconnected. There's the bulb, there's the other piece of the bulb!*
>
> ***TL143:*** *I think … but I think its best if maybe we can try to … to see that actually boys learn by playing, you know. When they are playing, they are sort of learning.*
>
> ***MD144:*** *Yes, I don't mind them playing, but I don't want to get sued for kids being set alight. That's different. I enjoy the playing thing, the whole idea, but no, <u>no</u> …*

Their difficulties in implementing inclusive practice, attributed to the move away from streaming and larger class sizes, have already been described (Section 4.4.2, p.144). Magriet has also experimented with group work in an attempt to become more student-centred, but abandoned the efforts because of unproductive group dynamics. Although she does not rationalise the problem in the same way, her experience is similar to Henry's (HN15b, Section 4.5.3, p.179). Disciplinary issues arise from either her lack of experience or lack of understanding of co-operative techniques with the result that she abandons the practice. Magriet concedes that she also has classroom discipline issues in practical work. Thabo, a more experienced teacher, admits that difficulties encountered in practicals has much to do with the playful nature of boys and it can be deduced that he is able to turn boys' playfulness into an advantage in the classroom. Although Magriet subsequently concedes the advantages that Thabo highlights, she ends yet again on a negative note *'no, no'*, indicating her frustration. Mentoring, exposure to model classrooms, the repetition of a collaborative workshop[11] for staff, or classroom-based support for Magriet during this transitional phase could have helped sustain her willingness to experiment with new practices rather than write them off as unsuccessful, to the advantage of the students and teacher alike.

4.5.2.3 Professional learning

The nature of the subject has both a positive and a negative effect on the Physical Science teachers' ability to change their practice. In describing how they try to innovate, Hennie and Arthur refer to material in the curriculum that is not new. In contrast to Richard, whose creative subject appears to invite innovation (RL4a, Section 4.5.4, p.185) Physical Science appears to do the opposite as the following extracts show:

[11] A workshop for all teachers on co-operative learning and collaborative practices was facilitated by the first academic support director and myself in c.2001. In this workshop teachers were carefully assigned to mixed-subject groups in order to take advantage of their strengths and weaknesses. They were provided with a box containing straws, sand, stone, plastic containers etc. They had to construct a functioning wetland. Library resources were made available. It was a highly successful socio-constructivist learning venture in which collaboration was understood to involve questioning and listening.

> ***HJ41:*** *Having said that, you know the current curriculum, from last year … I think we're doing a good job because it's been done for so many years … so it's OK if I just set the test and say "There's your standardised paper". Nobody fears or … it's because we've been around it so many times. So the system does work even if it's in place.*

Arthur and Hennie had faith in the old curriculum and believe that it was well-taught. They admit that it is therefore easy for teachers to fall back on old materials and, by inference, old ways. In their view it is preferable to teach the old ways well, than new ways badly. There may be any number of reasons for this lack of innovative practice, but clearly it is harder for teachers to change their strategies in a subject with more rigid content specifications. It would appear that with familiar material teachers continue to teach 'to the test' and that the process of formative assessment that underlies the new curriculum has not yet been integrated into their thinking and practice. Whilst it is incumbent on teachers to now implement new assessment practices, the reality is that within the classroom, this may not always be happening. Although teachers believe in what can be achieved by an innovation, their expectations are not always matched by reality (Rodrigo 2003, p.120).

There is cautious optimism that the situation will improve as the curriculum becomes more familiar in future years:

> ***TL68/70****: Ja … ja. But I think, as time goes on, all of these things will unpack. […] We'll have, we'll sort of have a better picture of what we are supposed to do. I remember, when we were in Grade 8 or 9 … when we all started … with all changing curricula and stuff like that, it was scary. You know, we really didn't believe that we'll … you know … we'd make it. But now we are sailing, sailing through and we know exactly what is expected.*

> ***MD71****: But next year it will be easier for Grade 11, because we've done Grade 11, but the problem will be with Grade 12s. Same as it was last year with the Grade 10s. Now, I'm fine with my Grade 10s because I've done it. But, as soon as you think you've done with something, that hassle's away, something else comes. That's the thing. It doesn't stop. […] And to find new things or a new way of doing it or going*

through the books, for example, to find a new experiment, I don't have time. That's unfair.

*****

***AS15/17**: A [the second year is a] huge improvement. Huge! […] But it's not where it should be.*

***HJ16/18:** Definitely! But compared to last year its just miles and miles … because us as facilitators are much more aware of what is required … how to handle this thing and we've got more confidence and it spills over as well. You can plan it better and you know that this is not as important and that this works very well; this does not work, so the second time round we've made a huge improvement.*

***AS19:** We also know what the boys struggle with … conceptually. We've got a much better idea of where they are conceptually. In terms of the demands … so that's enables you to focus on fundamental issues and then … then you address the problem [???] quite quickly, quite quickly.*

Thabo is optimistic that the situation will improve and believes that curriculum innovation in the senior grades will become easier each year as happened in the lower grades. Magriet, however, is more circumspect about the future. *'It doesn't stop'* indicates that she might feel she is on a relentless treadmill. With her last two words '*that's unfair'* she summarises her frustrations. Her comment epitomises the dilemma between her willingness and desire to develop and move forward but also her frustration at her inability to progress. Like their colleagues, Arthur's and Hennie's confidence in their own ability to implement the new curriculum increases year-on-year and they believe that their practice improves as they become more familiar with the OBE curriculum material and its demands. They also have a better idea of how their students handle the concepts. However, their practice is still not what they would like to be.

Arthur summarises their approach to the new curriculum in almost identical terms to his colleague in Life Sciences. This indicates an essential mindset characteristic: the willingness to learn:

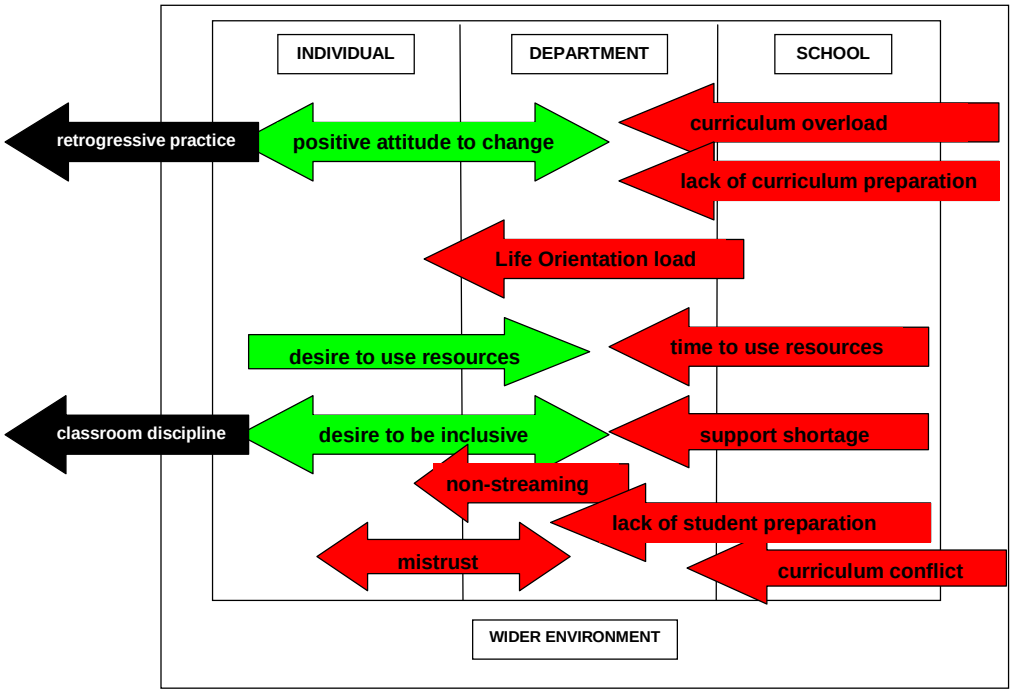
AS38: *So it's a bit like being first year teachers again. We know what's going on, but we don't <u>really</u> know what's going on! [laughter]*

4.5.2.4 Summary and preliminary findings: Arthur and Hennie, Thabo and Magriet

In Physical Science, from Magriet's perspective, disconvergence overwhelms convergence. Although she and Thabo have a positive attitude towards change and towards being inclusive in their practice, their reality is that they are constrained by the host of negative interactions. Conflict between mandated policy and pedagogical practice occurs and Magriet's ability to support individual students has retrogressed (black arrows). Although Thabo is not as stressed, his situation is similar. Systemic factors such as concurrent classes, mixed ability classes, class size and a shortage of academic support staff impact on their practice and, at times, result in student discipline issues. Inadequate preparation for inclusive practice and for the OBE curriculum (and in particular assessment practices) constrains both teachers. Time, or rather the lack of time and its corollary, teacher overload, emerge as significant factors. Magriet and Thabo identify lack of balance and clarity in the OBE curriculum as well as contradictions between curriculum and external assessments as further constraints.

For Magriet and Thabo, as illustrated in Figure 4.2, student-related factors include lack of preparation of students for OBE and conflict between curriculum expectations and student developmental levels. The administrative aspects of OBE assessment together with compulsory teaching of an extra subject (LO) add to the overload of these teachers and subvert their morale. There is conflict between their personal desires to meet expectations and the reality of what they achieve: mandated changes demand practice that the teachers are willing and wanting to implement, but the interaction of the changes constrain Magriet in particular to a no mans land from which she appears unable to escape. Thabo and Magriet clearly want to do things the right way, but no matter the effort that they put in, they feel they are not achieving as they would want to in the classroom. The result is high stress levels and frustration which stifles their ability to innovate.

Figure 4.2: Organisational effects: Magriet and Thabo



The issue of self-evaluation was raised in a recent meeting with the school principal[12]. He felt that teachers often rated themselves higher than what he believed (and knew) them to functioning. In pointing out the time pressure that these findings were revealing, but which is also common knowledge amongst staff, I suggested that teachers may be mistaking busyness for effectiveness. Teachers are not only kept busy with conflicting demands; rather they are *so* busy that they are not able to function effectively which is counter-productive.

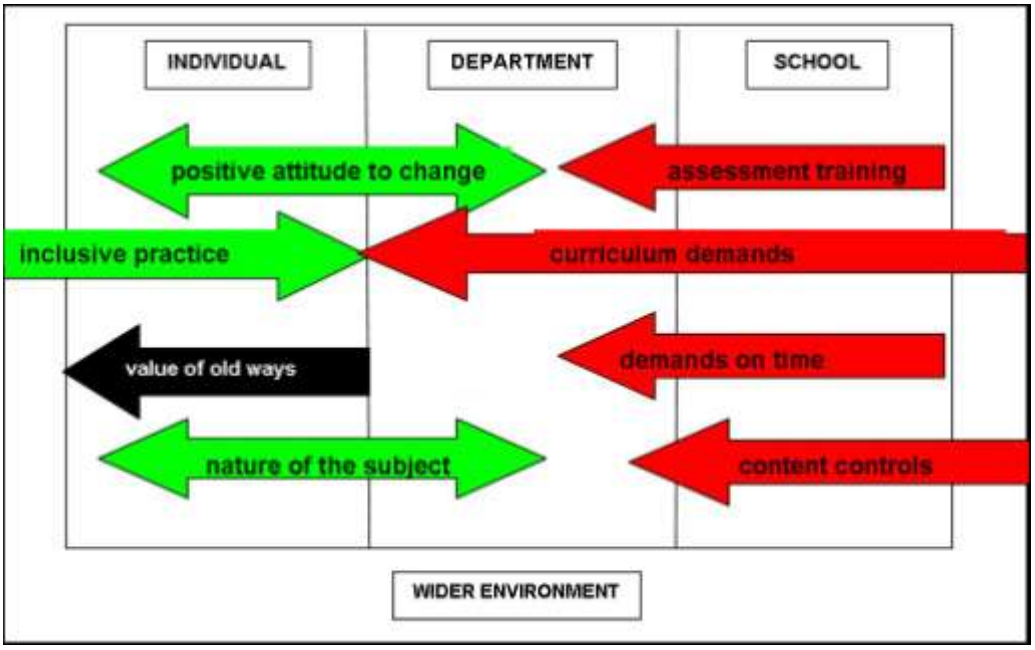
Abandoned innovations in practice inhibit teachers' ability to meet their own desire for and the schools expectations of inclusive practice. Student characteristics, in this case boys' behaviour, in combination with the dangers inherent in the practical aspects of the subject, limit teachers' ability to innovate.

In contrast to the Life Sciences department in which positive relationships emerge as a convergent factor and are clearly evident from the interaction

[12] Diary entry – meeting 25th June 2009

and from the tone in the interview, in Physical Sciences good relationships were evident between each pair of teachers interviewed, but relationships were not raised as a factor affecting practice.

Figure 4.3: Organisational effects: Arthur and Hennie



Arthur and Hennie, as illustrated in Figure 4.3, are less overwhelmed by the challenges that curriculum change and inclusion present than their colleagues, which may be attributable to their role and their experience. However, the immensity of the simultaneous challenges of the changes inhibits even experienced teachers' ability to succeed to their own rigorous standards, although their confidence in their ability to implement the changes is growing. The instability of the curriculum is a significant constraint to their progress. There is a more even balance between convergent and disconvergent factors, but the disconvergent factors need to be addressed if Arthur's and Hennie's desires to meet curriculum and student needs are to be met. In particular, the head-on contradiction between curriculum demands and the tenets of inclusive practice need to be addressed.

The difference in experience has been illustrated as a factor in the case of Arthur *et al.* Experience also plays a role in Henry's case.

4.5.3 Organisational interactions and their effect on Henry's practice

In response to the question of how his innovations came about Henry draws on his considerable history in teaching. It was his nature as a divergent thinker, as a product of the sixties, that initially brought him into the profession and that has remained as a strong factor throughout his career. He is comfortable with innovation and shares instances of innovative practice. Henry's philosophy from the start was '*there's got to be a better* way'. He describes some of the innovations that he initiated at his previous school in which the influence of a 'like-mind' sparked their joint creative efforts. However, on arriving at Wilding College, he could not find a similar like minded teacher with whom to explore his creative ideas.

> ***HN33c**: […] And when I came here I thought there would be … I tried, but nobody was interested. [The school] at that point had a good work ethic, but … um … no imagination at all.*

As a result, although remaining at Wilding College, he explored creative opportunities in partnership with corporate organisation. These projects also introduced him to ICT-based innovations, to constructivist methodology, interactive materials and the development of simulation games as early as the 1980s. These opportunities had a significant influence on Henry's thinking. He joined up with an American project which was the precursor of interactive ICT-based learning materials and also attended an American conference which exposed him to further ICT influences, particularly educational simulation games.

Henry worked with a local project to develop curriculum-based simulation games at a time when ICTs were, relatively speaking, not ubiquitous in schools. A lack of funding limited the continuation of the project. The withdrawal of funding related to the political situation in the country at the time, resulting in the demise of the project although Henry believes that the materials may still exist.

Henry served on the Computers in Education working committee of the National Education Commission[13] in the 1980s. More recently he has served on standards generating body, which has exposed him to disparities between *'university professors and industry people'* driving the project and the thinking of practicing teachers. Henry comments:

> ***HN41b**: [...] so there was a lot of discussion there. That was an interesting time because I was the only practising teacher on the [...] And … um … I was the only practicing teacher on that group … and I've been in that situation numerous times where the people driving all that stuff are university professors and industry people. And they just don't get to understand [...] And again, I'm the only practicing teacher. There are university teachers, but I'm the only practicing classroom teacher. And the consequences of that are scary as to what gets set as a standard, what level. They've got no concept as to what is appropriate to each level, thinking level and so on.*

Curriculum change, for Henry, is relatively insignificant, whereas student, parental and societal factors, as well as systemic factors, predominate.

4.5.3.1 Curriculum change

Henry has no self-doubt in adapting to the new curriculum; on the contrary he is entirely confident in his own ability, attributing his practice to a natural affinity with OBE. He is dismissive of the *'ridiculous administration'* aspects of OBE assessment, but relishes the fact that the OBE curriculum focuses on application of knowledge rather than memorisation of content. Henry is comfortable focusing on individual student needs:

> ***HN9:** Then the pastoral care system, in terms of my classroom practice has helped because you're far more aware of the kids' individual needs [...]*

[13] Human Sciences Research Council (1981) The de Lange Report. The commission was set up to investigate education across all sectors of South African society. The report was the first official investigation into the potential of a new educational dispensation in South Africa.

However, despite his confidence in the new curriculum and comfort with student-centred learning and individual needs, Henry struggles with student, parental and societal attitudes towards the changes.

4.5.3.2 Student, societal and parent factors

Henry's ability to implement the requirements of the new curriculum is affected by the interaction between student, parent and societal factors. Henry believes that Wilding students have lost their curiosity for the world (HN11b) which conflicts with the applied knowledge focus of the OBE curriculum. Further, he believes that the swing of the innovation pattern at Wilding is currently retrogressive. His concern is that the momentum of the transition from a marks-driven curriculum to an outcome-based student-centred curriculum is not only slowing, but is in fact reversing. The evidence of this comes from the students themselves:

> ***HN9a:*** *[…] Ten years ago I was out on a limb. Vanessa and I … and then when you came in ... we were the only people who were doing anything remotely different, child-centred … um … self-paced learning and all of that stuff. Everyone else was in marks and curriculum. And that pendulum swung strongly in favour about three or four years ago where I got a sense that there were far more people on board. But now I get a sense that we are going the other way. Because now I get far more of a reaction from kids when I do something slightly different: "But, is this for marks?" So that the marks … I think we are still horribly marks driven and I think it's got stronger in the last two years or so.*

> ***HN9b/11a:*** *[…] And this is … you know, I think this is a reaction to dinner-table conversations that the kids hear … how terrible our education system is. And it didn't use to be like that in the old days. […] I think it's actually because OBE is being subverted by marks. That, you know, the reaction in the education community and I include parents in that was that we're now just getting fuzzy reports that don't define my child in terms of marks. That's why I use the phrase dinner table. I think the kids are picking that up from the parents.*

> ***HN11b:*** *But, because there's a curios … a curious …a curiosity … a curiosity there now in the kids' attitude to learning. They definitely - the Grade 8s and 9s – know less coming into the College now than the kids used to know. Definitely. There's*

absolutely no doubt about it. And I think that's a function of the sort of fuzzy OBE stuff that they got because people didn't understand OBE. I think it's a function of more time spent … um … on computer games and that kind of thing and not enough time being interested in the world. I think the kids are much less interested in the world around them than what they used to be. Um … and I think it's … we live in a canned society.

The fact that the students remain marks driven, Henry attributes largely to home influences and parents' negative attitude towards the OBE curriculum which in turn results from public perceptions at large of the failure of the current national education system. Henry's reference to *'a canned society'* implies the high level of consumerism that predominates today and particular amongst the relatively wealthy, such as the Wilding community.

Henry teaches concurrently in the corporate responsibility programme (CRP) provided on Saturdays by Wilding College to some 600 students from less privileged backgrounds and is able to compare the attitudes of the two different student bodies. He also runs a co-educational extension group which provides an opportunity for gender comparisons:

***HN15b**: […] I got a sense this year that the boys would far rather just do their own little project and not have anyone else involved. […] I think that is a reaction to group work which is not group work in primary schools. You know, group work which is sitting around a table and if you want to work some other guys disrupting you instead of genuine group work, you know involvement of co-operative group work.*

***HN17a:** […] and they don't, they don't refer to their classmates, which is interesting. Um … the [CRP] school kids – which I think is … it's an amazing situation I'm in at the moment to be able to compare directly – are much more willing to talk to each other about their [work]. And one of them actually said to me "This is the best thing" … just voluntarily, I didn't … I wasn't talking to him about it, voluntarily said to me just while we were driving. He said "You know the <u>good</u> thing about South Africa is Ubuntu. But," he said "You know what? We're losing it". I said "What do you mean?" and he said "No, people are becoming isolated".*

***HN17b:** Well, it's interesting the … the extension […] lessons I'm giving. The girls do talk amongst themselves […] more. Whereas … you know, you'll see them talking*

> *and then they'll ask the question, whereas the boys will just ask the question straight out. And they don't, they don't refer to their classmates, which is interesting. […] You know, the whole process of course is that they do peer review … what they've done in it. Peer review is absolutely critical to the success of that model and they're very unwilling to do it, partly because they on the one hand because they don't want to have their thinking critiqued and on the other hand because they don't want to have their thinking polluted by some lesser being. Their arrogance is huge in terms of the bright guys won't help the other guys and they won't listen to the other guys who are weaker. And there are rare exceptions.*

Similar to Bronwyn and Ineke, Henry recalls and recounts conversations with his students, indicating that he uses discursive methodologies aimed at the social construction of knowledge. From observation and co-teaching with Henry, this approach is confirmed. However, Henry's account differs from that of Bronwyn's in that whereas she uses examples of positive student comments, Henry's interpretations of student attitudes are mostly negative. Bronwyn recounts student comments at face value, whereas Henry interprets student comments to self-evaluate his practice. Where Henry disagrees with students, the student view is negated. This point alone illustrates the diversity of contextual subtleties through interpretations of interpretations.

Henry believes that Wilding students with their high socio-economic status have become disinterested in pursuing knowledge: they appear to take it for granted, whereas the CRP school students actively seek knowledge. He suggests that a further socio economic factor is students' ready access to technologies such as computer games, i-Pods and social networking through mobile phones which corrupt student attitudes towards learning. Henry also believes that with the influences of the technological society and despite the power of social networking, a more isolated individualism has emerged that influences student attitudes towards learning. This developing isolation of individuals contradicts the assumption of a collaborative, networked society that characterises the 21st Century (Lewis & Romiszowski 1996; Steiner 2004, p.4).

The isolation of students also combines with their inability to work in groups. Henry's expectations of students' co-operative skills are similar to those of Magriet: he expects them to work in co-operative groups towards a common goal. However, he has reservations about the students' ability to work in this manner and suggests that it is lack of understanding of techniques of co-operation in primary schools that undermines group work in secondary schools. A second factor that Henry recognises as inhibiting co-operative learning strategies is the arrogant and self-centred nature of some boys, and 'bright' boys in particular, as opposed to that of the girls whom he also teaches. These characteristics combine with the isolation factor to retard the social construction of knowledge.

4.5.3.3 Systemic factors

Henry is one of the few teachers to raise the school partnership as a contextual factor. He comments on its potential to provide opportunities for innovative practice:

> ***HN9d:*** *[…] [T]he [partnership] model had a potential for huge impact in the early days. […] The co-ed classes were so far ahead of the other two it was scary given what everyone says about co-ed. […] So that side of it I'm totally in favour of … of a much closer [partnership] model than we've ended up with. […]*

At its inception, the partnership allowed for some co-educational classes in Grades 10, 11 and 12, but this was later dropped for logistical reasons based on systemic factors. Secondly, extra-curricular events in each school led to perceived disruptions of curriculum delivery and the decision was made to drop co-educational classes, rather than pursuing alternatives. In order to maintain the benefits of this practice, Henry now offers co-educational extension classes after hours.

When asked for evidence of personal innovations that might have been discontinued, Henry points to organisational discontinuation rather than discontinuation by his own choice. He draws on the history of the school,

describing how organisational decisions have affected his ability to sustain personal innovation. However, it was his considered decision to not specialise in ICTs, but to remain in his original discipline.

> ***HN73:*** *Ja, um … the way computers are being used in the school has gone backwards. You know, when we bought our first Apple computers we had a Computer Club that was building wind tunnels doing a whole lot of that […] measurement and control … something like that. So we had a computer club that did that and then when the IBM came out IBM was far less flexible than the Apple, so you weren't able to plug things into it as easy or you bought the … you know, you bought the kit and plugged it in which didn't go down well with me. So that … so that died a quiet death. […] We were teaching computer literacy …*
>
> ***HN77a:*** *[…] Then the … we did some integrated stuff with the History department when OBE first came out. And then when the revised curriculum came out and pulled History and Geography apart, we lost that. But the … in fact, that is the biggest loss in the last ten years. […]*
>
> ***HN79:*** *And then [my methodology] and the Great Zimbabwe … again, you know, separated History and Geography was destructive to that. They still sort of do it, but they don't do it [my way]. They just do it: "Go and research Great Zimbabwe"[14]. So, ja, those things fizzled because this is where I … why I say the pendulum's swung back from some really exciting stuff we did ten years ago.*
>
> ***HN77b:*** *[…] the integrated day … what do you call it? The Subject Focus Day was my idea to get all the departments not wasting time on excursions. "So let's have a day when we go on excursions and then, you know, if the Geographers are going to Soweto and they include History in the worksheets, then we take everybody in that grade and we make sure that the Soweto trip includes History, Geography, English, Geology … whatever". And it worked brilliantly for one year and then the Afrikaans department said they couldn't cope with a whole day. So I said to them "What about doing Fiela se kind[15] from scratch?" "Oh no, no, we don't do that kind of stuff". Then the Maths department hijacked Matric and Grade 11s because they needed more time and it died an ugly death. Um … and that was very sad […]*

[14] This statement is partially inaccurate. The module is now designed to use a different method to Henry's. However, the design does not guarantee appropriate implementation. [informal observation]
[15] Translation: Fiela's child – a former Afrikaans set work by Dalene Matthee (1990)

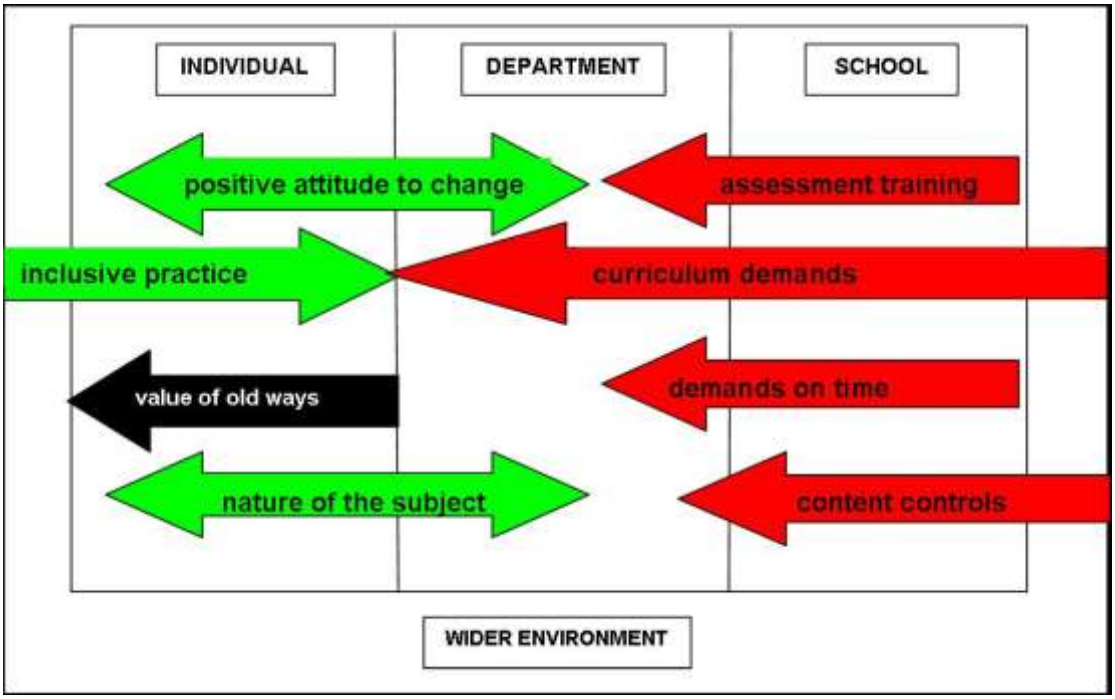
Henry describes the origin of the idea for one of the biggest school-wide systemic innovations: the subject focus or time-table free day. The concept arose out of seeming disruptions caused by curricular excursions. Groups of students in one subject being away from other classes limiting that teacher's ability to continue with their programme i.e. it impacted on the grammar of schooling. The subject focus day continued for a period of three years prior to the new curriculum reaching Grade 10 before being abandoned. It would appear from the evidence provided by Henry that content subjects fared better than Mathematics or second languages in subject focus days as they adapted better to integration of disciplines. Pressures from these areas forced the discontinuation of this innovation. Prior to focus days, individual teachers and their classes were adversely affected; during focus days overall teaching time was adversely affected. Eventually, negative impact of the focus days held sway over the positive benefits and the days disappeared from the programme without resolving the conflict which still continues. It appears that the integrated day was a contradiction: it remained essentially subject-focused rather than providing a broad cross-curricular opportunity, hence the clashes in priorities. The very name 'subject-focus day' indicates this fundamental flaw, whereas the original intention was an *integrated* day. The underlying issues are the reliance on the grammar of schooling and the leeway given to HODs to implement an organisation-wide innovation or not.

4.5.3.4 Summary and preliminary findings: Henry

First and foremost Henry, a product of the sixties, is a divergent thinker, an example of Hargreaves and Goodson's view (2006, p.24) on the creative thinking abilities of the baby-boomer generation as *'formidable forces of change'*. Most important to Henry was the presence of a like mind in joint creative efforts at a previous school, which he found significantly lacking on arrival at Wilding. However, the lack of a like-minded colleague worked initially as a positive factor in that he was forced into seeking a like mind elsewhere. In Henry's case, these long-lasting factors pre-dominate and have had a strong influence on his ability to innovate.

On the other hand Henry's attitude towards OBE, his positive frame of mind about its aims (if not about its assessment processes) and absence of any self-doubt strongly influence his ability to implement changes in his practice. The experience and multiple perspectives of this particular teacher appear to have a significant influence on his or her reading and interpretation of the change situation and he reflects comfortably on his practice. Convergence between the pastoral care system and the inclusion policy enable him to become more aware of individual student needs and support these in his practice. The effect of organisational factors on Henry's practice is illustrated in Figure 4.4.

Figure 4.4: Organisational effects: Henry



Disconvergent student factors impact on his classroom practice and counter his pedagogical intentions. These student factors include lack of curiosity; arrogance and the self-centred nature of 'bright' boys in particular; and a lack of real understanding of the purpose of new assessment processes resulting in the students becoming even more marks focused. The student factors that emanate from the home environment include parental negativity arising from public perceptions of the national education system; parents own experience of mark-driven systems; consumerist results-based demands; access to

technology that corrupts student attitudes and leads to disinterest in the pursuit of knowledge; an inability to work co-operatively and individual isolation despite the present social networking climate. Whilst it is common knowledge that teenagers with access to social networking tools such as mobile phones and the Internet are connected socially, this does not, in Henry's view, converge with their attitudes to learning.

Simultaneous exposure to two contrasting groups of students raises issues in Henry's mind. According to Henry, whereas the Wilding parents' perceptions of what might be right for their children is based on their own experiences and conflicts with teacher intentions, it does not appear to affect the CRP school students in the same way. Henry attributes the Wilding students' attitude to the influence of the technological society and poor group practices in primary schools. Although collaborative and co-operative learning is a conscious intention of the school, according to Henry, the opposite is happening.

Student factors played a predominant role in Henry's case. Whilst they also play a role in Richard's case, it is the nature of the subject that is a predominat factor for him.

4.5.4 Organisational interactions and their effect on Richard's practice

In Richard's case, the nature of the subject has both a positive and a negative effect on curriculum change, his professional learning is strongly influenced by external factors and contributes to extensiveness, whilst student factors have a disconvergent effect on his ability to innovate.

4.5.4.1 Curriculum change

In answer to the question regarding the effect of mandated changes on his practice, Richard, an Art teacher, states that there is little mandated change either dictated by the school or that he needs to be concerned with. However, he concedes that at the moment he is trying to come to terms with the formalisation of curriculum changes and still needs to be inventive within

those changes. As explained in this extract, he believes that Art lends itself readily to creative practice and innovation:

> ***RL4a:*** *Um … well I think art, in terms of the subject and the way its taught, and that its not content driven, I think its always been a bit in front of a subject that has content that drives the subject. […] Um … and the universities tried to limit it in a way, I suppose, on the one hand to make it more content driven and hence the emphasis on history of art. And when I say it's not so content driven I'm thinking particularly more on the practical … side of the course. So there … and that's where I think most of the innovation could take … and I think that's where it was being driven towards a sort of outcomes based education anyway in a way so that's where a lot of the stuff comes in … that's come in … and the changes, the recent changes … I think have already been in art, in place in art already, but it wasn't so formalised. So obviously, I think, in terms of accepting those changes in art, it wasn't … its not been really difficult because a teacher … you know it's like sort of … it's what he can do anyway so let's move along. Seeing maths and science people struggle with it … they get fear in their eye. […]. So, I think that the changes in OBE haven't been really earth-quaking for me or shaking or hasn't put fear into what I do. […] So, I think it applies to all the arts, I think really, that there's been that flexibility and that there has been this emphasis on 'we're not just marking a product which is an exam, we're marking a process'. And art, since I've been teaching art, I've always found that.*
>
> ***RL4c:*** *Obviously, I'm trying to … at the moment to just come to terms with the new system and the requirements I'm finding now, OK, its been formalised which always is a bad problem, it always is an issue which I believe is a bad thing when a thing gets formalised it sort of kills it. So I'm finding just the changes for me it's just like becoming a little bit … making it a bit boring. But it's not so boring yet because I've still got to invent within those changes to try and understand what's … what's the formalised solutions. […] In terms of changes, I find its … it's not … I haven't found them really so scary or … um … I haven't really had to adapt too much to them because there's already been those processes in place. That's what I'm trying to say.*
>
> *****
>
> ***RL59b:*** *[…] So, that's that part. We're not talking about theory again. Because then the content comes back again and I would get nervous again. Because I know that I've got to get through a certain content that's been given to me and now I've got to do it that way.*

For Richard, the transition to OBE has been a gradual transition over the decade or more that he has been teaching owing to the nature of the subject and the natural approach to its practical side in particular. The nature of the subject also aligns well with OBE-based assessment and the changes in assessment requirements have not had much impact. On the other hand, the Art History or theoretical component of his subject, owing to its prescribed content, is less conducive to innovation than the practical component and he is much more limited in his options. Richard provides insight into the way in which he encourages students to meet the critical outcomes of the new curriculum in the practical component of the subject. However, for the more content-driven theory, the picture changes and Richard admits that his approaches are more traditional.

4.5.4.2 Professional learning

Richard's admission that he still teaches the theory traditionally reveals that even for a creative person who is comfortable with practical innovations he faces the same dilemma as teachers in other subjects in changing his practice in the theory component. Apart from the theory component, the challenge for Richard has been that of teaching creativity. He describes his approach as one that encourages dialogue and reflection. In recounting how he approaches the challenge of teaching creativity, Richard reveals the importance of the social construction of knowledge in this aspect of his subject: learning occurs through dialogue between teacher and student. This is illustrated in the following extracts:

> ***RL18a**: Well, I think that's always been the change, I mean the challenge in art … is how do you teach creativity? And there is no solution, as far as I know, how to teach it. Basically its through challenge … um … the way, I think, well through challenge-posing problems, the way problems are posed … um … and trying different techniques almost um … that are like spontaneously. For me, it's like making an art work, you come to a problem and you try and solve it creatively. So it's like doing … making an artwork. That's sort of how I see it.*
>
> *****

> ***RL40b:*** *I also believe in … that the process is a dialogue in teaching and that the dialogue is with the students … um … so, ja … I try and … how can I say it … the student can … we can give them advice and they can ignore it, do something else. And if they don't succeed then it's a case of like saying "Well, OK, try the way I suggested in the beginning". If they do succeed, then I believe in like really acknowledging them. "Hey, wow, you've really done something different." And I think that encourages them as well. I think that's how I try and emphasise their creativity as well. It encourages them then to challenge, not just accept what one says. So I think sometimes … um … in a more formal arrangement, people would think the student is being rude or arguing back. They think the student should just accept. I come from that kind of teaching and I didn't like it. So that's why I don't teach like that. So they are allowed to say and do and they can take their risk and I'm allowed to … to advise them. […]*

Richard's innovations derive from his experience and from his deep involvement in the creative process as a practising artist. He lives what he teaches. He illustrates his point by describing in detail the example of how he introduced and used computer art not only to the benefit of his own students, but to eventually have it accepted by the IEB as an optional sub-discipline:

> ***RL20a:*** *Ja, well, I think if you … I think if you're living what you're doing as a teacher then you're going to teach better. That's my basic ... what I put down to … as a basic rule. So I mean I'm working making stuff and often the stuff I'm learning then I'm passing on to the children. […] So when I decided at some point I was going to start working in computer art in my work I went and started investigating, learning through searching. And then I thought "Well, now I've got all this knowledge now I'll pass it on to the children". So then you start passing it and then I thought "How can you introduce that?" And then obviously at that stage there wasn't - when I started doing it – there wasn't much opportunity. Well, it wasn't part of the syllabus, it wasn't part of anything. Then I introduced it … um … and um approached … eventually it was the IEB … […] um … and said to them "This is what we need in the syllabus" and then, you know, they put it in and then I designed a teachers' course on how to teach it and that so, ja if you're living what you're teaching I think you're obviously going to be in a better …*

With this example Richard demonstrates the principle of extensiveness in which an innovation has extended to the IEB as the highest possible level. It has also extended to other schools through his development of a teacher's

course in computer art. Richard's natural affinity for ICTs and his personal experimentation has led to the introduction and use of ICTs as a formal option within Art. In this case, personal experimentation and the availability ICTs converged to spark a curricular innovation with widespread implications. Richard's personal motivation is driven by the need for ongoing change and he embraces change as an integral aspect of his professional life. He describes this interaction of change and innovation with humour:

> ***RL22:*** *And also, I think, you know teaching can be quite boring, so you've got to change all the time. So, I also like to have fun …um … changing teaching approaches. So, throughout teaching I've tried lots of different approaches just to see … you know, until I get bored of it, just to see how it works and then I get bored, I get tired of it. Then I change to another one. So I think, you know, it comes from oneself, just to keep oneself occupied. [Laughs]*

A further example of extensiveness or how innovations are diffused is indicated by Richard. Although he refers back to his previous post, he describes how he collaborated with a colleague who later also moved to Wilding, to develop a cross-curricular unit of general content combining Art and Science. This initiative, although undertaken willingly and successfully, was mandated by the school leadership. Richard perceived this experiment to be a precursor to LO and an integrated approach. He suspected that, because the innovation was mandated by the principal, principals are in league regarding new ideas. This concurs with the views expressed in the literature on the influence of school leadership (Breuleux 2002, p.10; Otto & Albion 2002, p.1; Sharma 2005, p.53; Staples *et al.* 2005, p.306). Innovations are diffused through interaction with colleagues beyond the school and conferences are ideal forums for this purpose. An innovation that is spread by school principals has diffused to the highest level:

> ***RL8b:*** *[…] I find like … and I've worked in two private schools … only, so it's very limited my … I haven't changed many … but I've found that programmes that are in place at this school were also in place at the other private school and I suspected that they all [???] the private schools around the country is what I suspected, because they were also saying its so new and what they're doing is so revolutionary and*

they're cutting edge, but I think it just comes from a general headmasters' conference … is my suspicion … conspiracy theory [chuckles] … because working at [the two places] for quite a long … nearly twelve years and seven years here and, as I say, the same things get said. […] So, at that time, I remember I was designing a curriculum with the science teacher, Roger, and we were combining arts and sciences and in … in a new way to … how can I say it, in a new way trying to teach a new general content, which I think is now called like LO [chuckles]. So, obviously … and we were instructed to do that … as well … but it wasn't called LO. We were calling it something else because there wasn't a name yet, but it came obviously from the management, so I think the management …

4.5.4.3 Student factors

Richard identifies two student related factors that constrain his creativity in practice. These factors are firstly, student indifference to computer art which he ties to their lack of cognitive skills and secondly, the reasons why students choose to do art.

Student indifference to computer art disappoints Richard. He believes that, despite ready access to digital technologies, students have little ability to apply the tools and lack appropriate information literacy skills. Although he is able, in most cases, to influence learner interests by his own enthusiasm for a particular technique at a given time, he has not had the same influence with computer art, despite his pushing it as a technique. (This issue is discussed further in Chapter 6: RL77, Section 6.4.4, p.322.) Generally perceived expectations of the current generation of students are that they have a natural affinity for digital technologies. However, Richard believes that this is not the case: students have the practical skills to manipulate ICTs, but not apply them in a cognitive sense. To succeed with attracting students to computer art, Richard will need to do far more software instruction rather than rely on students' natural abilities which he would prefer not to do.

Students with academic challenges often manifest reading-related difficulties and therefore choose art as an option because of its large practical non-verbal component, rather than because they have a particular talent for the subject.

As a result, there is a disproportionate amount of students who take Art as an optional subject and these students usually avoid computer art.

In response to the question on innovations that have been discontinued Richard explains how he introduces new ideas randomly, related to how he perceives student needs. It is the student need that determines whether a new idea is introduced:

> ***RL59a**: Well, you know, I tend to … I've stopped and started different techniques continually … for different reasons. Sometimes … so now I'm talking very cognitively here [wry smile]. When I say techniques, I'm meaning like physical plastic techniques like sculpture, computer art, certain software etc or printmaking and stuff or ceramics. I've stopped photography. I've stopped doing them … um … almost randomly. Because, when I'm teaching, I try and find the need of the children that I'm teaching and I try and find the technique that'll bring the creativity out of them. So that's where it's very flexible. What I was talking about – it's not content driven. So I can identify … so that's why these things stop and start randomly by themselves … um … as the need … So, for example, if there's a student that I feel that I can really get the creativity out of them [with a] certain technique, fortunately I have the expertise to then take it out of them. And I think maybe that's perhaps what stops people being creative in their teaching … is that most probably might be limited in what they know. So, for example, if I was – because I've trained and studied for a long time so that I can get a broad understanding of the different art forms – so I studied and studied all different things, so I've got a large knowledge which is in different forms which is fairly rare in artists and most probably rarer in teachers. Um … but so I can move from sculpture to screen painting, any technique I can move and I feel comfortable with it. I don't feel scared. And because I'm comfortable in so many, I can move to something I don't even know most probably … and feel comfortable ... because I'm not interested in the content, I'm interested in how its applied, the context that its applied in and how to bring out something … a way of thinking. […]*

In the practical component any discontinuation or resumption of a technique occurs in response to student needs at the time, not for systemic reasons or due to lack of sustainability. Critically important to this adaptability is Richard's personal knowledge and skills with different techniques. He suggests that lack of such wide variety of experience with the different techniques may well inhibit other art teachers' creative abilities.

Whilst many factors converge to enable innovation in Richard's practice, particularly in the practical component of his subject, disconvergent factors affect both the practical and theory components.

4.5.4.4 Constraints

For Richard, time emerges as a significant constraint with only one period per week to accommodate the theory component. Time is also a constraint in the practical component, limiting both the students' as well as the teacher's intentions.

> ***RL32:*** *And what's allowed me to do that is that it's not content driven. But I think also when I talk about art as well, we're talking about practical, not theory. The theory I don't teach like that because it's very content driven. So that's why I like, in the beginning when we started I was talking about prac and now I've suddenly realised the theory … and its not like I'm contradicting myself because its almost like … So now … the theory though I must admit … my techniques have been more traditional-classical in teaching it because the content in the course there that is really driven more than by … most probably I suspect a like the normal … like history. It's most probably equal to history except it's a … a quarter of the time is dedicated to … does that make sense? So history has about as much content but they've got four lessons of doing it, I've got one … a week. To get through the same content they're using four so they can play a bit more there. I think there's a little bit more freedom even though its content driven and even, like I said: if a subject's content driven it is a struggle for them, a whole new approach. New factors … the time factor's become quite difficult in the theory and so my techniques I've experimented there range from like lecturing … to … sort of self discovery, working through workbooks. So it's not as creative, more traditional kind of teaching … um and ultimately … um … at the moment … back to lecturing. So … um … I'm trying to introduce now a little bit more self-work, but not so successfully just yet … not with the Matrics yet.*

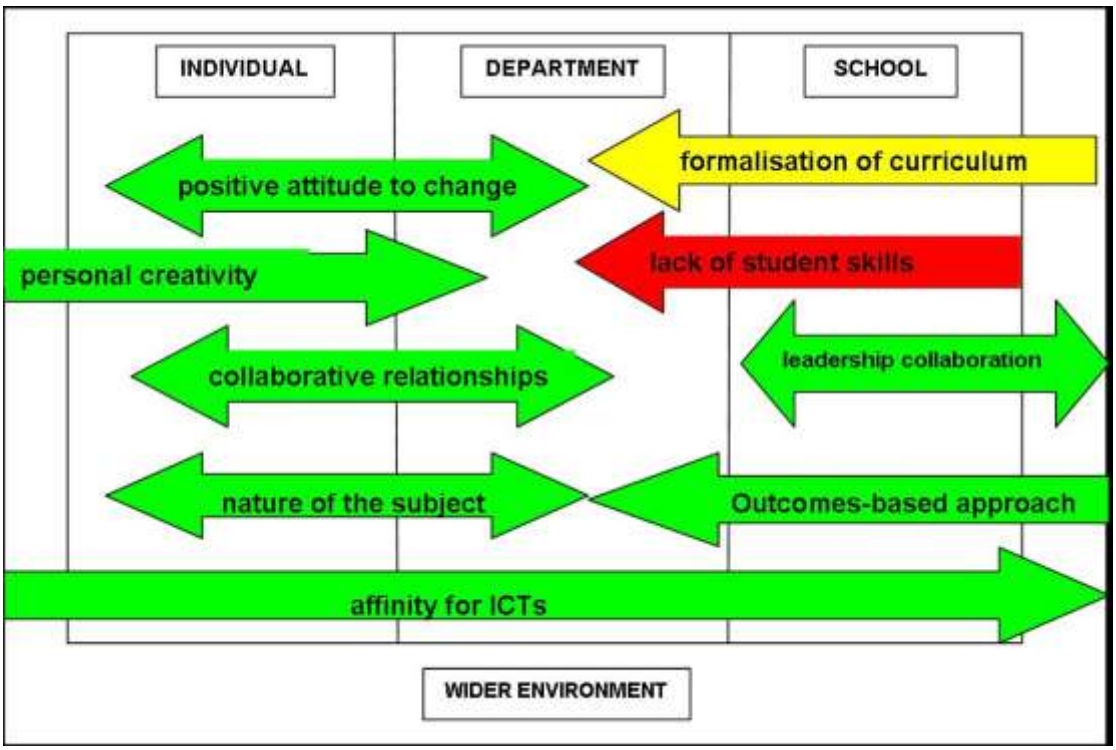
> ***RL34:*** *They can come in a bit more [prepared] … and also they can do stuff … giving them work discussions, group discussions in the class … um … whereas at the moment I find there is just not enough time in Matric particularly. In grade 10 that's where I've started trying it and … actually I suppose that's also one change in … also when I said like outcomes based I was also meaning practical only before. It was never the theory, whereas now I think because it's obviously … that's one change in that the theory is brought more into the practical now. There is a greater mix … um.*

So that … that's where I will most probably start trying to work out ways of covering work in a new way that is not lecturing – theory work. But I haven't got there yet. Does that make sense?

4.5.4.5 Summary and preliminary findings: Richard

The pattern of convergent and disconvergent factors affecting Richard's practice is illustrated in Figure 4.5.

Figure 4.5: Organisational effects: Richard



While Richard admits that he struggles with adapting Art History to OBE practices, he is comfortable that the practical side of his subject aligns closely to OBE expectations. Any transition has been a gradual one over the extent of his experience rather than the paradigm shift that the new curriculum has required of other teachers. An ongoing but not overwhelming challenge that he experiences is teaching creativity, an expectation of all arts subjects. Dialogue with his students is an integral part of the creative process. Richard brings his experience as a practicing artist to bear on his classroom practice. He is also adept with ICTs and thrives on change. These factors have

converged to the highest level in that his influence has extended to the development of the IEB curriculum nationally.

Despite his success in practical art, the theory component constrains his creativity, and he gives the impression that he endures rather than enjoys this aspect of his subject. Students' inability to apply the tools required for computer art is a further constraint. In Prensky's terms the students lack digital wisdom (Prensky 2009, p.2). Richard's misgivings about student ICT skills match my own experience with students' information literacy skills.

Two of the teachers interviewed are from new curriculum areas. These are Maria in LO and Francois in Accounting.

4.5.5 Organisational interactions and their effect on Maria's practice

The OBE curriculum introduced four completely new subject areas. These areas are Economic and Management Sciences (EMS) and Arts and Culture (A&C), both of which are compulsory in Grades 8 and 9; Mathematical Literacy which provides an option to the more theoretical Maths Core in Grades 10-12 and Life Orientation, commonly known as LO, which is compulsory for all students up to Grade 12 and is Maria's responsibility. In her case, systemic factors and inclusive practice predominate.

4.5.5.1 Systemic factors

One serious systemic challenge that the school faced was to introduce LO as a nationally mandated subject area across all grades without significantly increasing staffing costs or reducing other optional subjects. At the same time, optional subjects such as Latin, which Wilding College previously offered, have disappeared[16], although the subject can still be taken privately. With the demise of Latin as an optional subject, the decision was made by the school to redeploy rather than retrench the Latin teacher. Maria was thus appointed to oversee the development of the LO curriculum as well as

[16] The demise of Latin relates to its no longer being a required subject for tertiary Law studies.

continue with a class of second-language teaching. The impact of these changes on Maria and her practice was therefore significant and multi-faceted. She describes the impact on her as follows:

> ***MW12:*** *It was a combination of … of many things. Look, the Latin was … I don't want to say dying out, but the numbers were very, very small. And they called me in and said, "You know, at least 15 boys otherwise it's not viable". So, in the light of that, I realised that I had to pick up something else. I was already busy with [the second language], but then they asked me about the Life Orientation and I'm really enjoying it far more than I thought I would. It's a big change [chuckles] but I'm really enjoying it as well. Hopefully, next year we'll move … we'll get the senior level … I don't think we'll get it sorted out in one year, but we'll move in the right direction to do that.*

As an entirely new subject the school had difficulty ensuring that all the necessary information was received, understood and channelled appropriately. It was believed initially that what the school offered in its leadership programme would cover the required outcomes for LO, but in mid-2006 Maria discovered, through attending a Cluster meeting (Ch.5 Section 5.3, p.214), that this was not the case. Although Maria was appointed to co-ordinate LO, she could not manage all 30 classes across five grade levels on her own. As a result, the whole staff had to be yoked in to teach LO in order to meet requirements. Each teacher had therefore to take on the responsibility for either one LO or one leadership class per term. Maria describes how she found out about the challenge she faced:

> ***MW59/63:*** *[…] So it, I think it was more structured than well, definitely than what I anticipated. I was … I was amazed at what I heard at that Cluster meeting. They are so on track, it's unbelievable, Life Orientation. […] Some of the schools have really been doing fantastically in Life Orientation.*

In contrast to teachers of established subjects, Maria was reliant on her Cluster Group for resources and ideas. Some colleagues in the LO group had apparently fared better and Maria was able to tap into their relative expertise, whilst others were similarly struggling to find their way. This transitional phase

was acknowledged and accommodated by the IEB although the challenges still remained.

> ***MW65**: Yes, yes. That was really … I think that was one of the best conferences that I attended. It was very, very good. Maybe because I learnt so much. […] And people had some fantastic, some fantastic ideas. And what was a relief was that I wasn't the only one [laughs] feeling that I didn't know enough or that I wasn't doing the right thing. At the same time, you know, schools were on track, but not everybody, not everybody was on track. But the understanding from the IEB … you know, they said in as many words "Do not panic too much. If you do not have enough … if [you] do not have everything we require we understand. We are in that transitional phase. That doesn't mean that you don't do anything now." But there is an understanding from the IEB side as well.*

Maria has had to make considerable changes to her classroom practice to accommodate the change from a language to a content subject as well as to adjust to the newness of the subject and the situation. She is comfortable with the discussion approach but this in turn is impacted by discipline issues resulting from the larger class sizes that she is unused to.

> ***MW36:** I think to a certain degree … yes [I have changed my practices]. I think so. But look, the Life Orientation. I don't know. We have … I don't think we've always have … if I say structured … we don't have the chalk and … whatever … for Life Orientation. Its very much discussion, throw out ideas … talk about religion and having responses from the boys. So, to a certain extent, unless they have some formal work to do… no, I think basically things stay the same. To a certain degree it has. I've just got more boys in the class now. I find it difficult at times because the boys are not um… they don't respect each other. You know, so … we battle to get back to basics, be quiet when someone else is talking [???] etc. but we'll get there eventually.*

4.5.5.2 Inclusive practice

Apart from the change of direction in her subject area, for Maria, inclusion has had the biggest impact. Providing individual attention is of concern to her particularly in teaching Afrikaans, but with classroom assistance, she is able to meet some expectations for providing individual support.

MW6: *[…] I think, for me, the biggest impact was the inclusion programme, because you feel, or I sometimes feel that I'm not doing all the children justice in my classroom […] and I'm picking that up especially in Afrikaans. So, I have an hour where I see them, but you don't, I just feel I don't get to all the kids who need the individual help, so [an academic support teacher] has been joining me since the beginning of this term which is really a big help: it has been a big help. For me, that has been the biggest of all the things you mentioned.*

*****

MW20/22: *… and maybe, to come back to the inclusion, because I'm teaching Afrikaans, I see it … maybe I experience it more or at a high intensity … many boys … I just feel there are many boys who need attention … individual attention, and that I can't do that in every lesson because the Afrikaans is not at the level where you expect it to be. [...] I've got a boy in my classroom who didn't do Afrikaans last year. Well, I've got two. One boy changed from Zulu and the other boy came from, I think its Crossroads[17]. They didn't really do Afrikaans. They've got nothing, they have nothing to back them up.*

In this aspect of her dual role, Maria has not only to contend with students with learning difficulties, but teaching a second language to children who have difficulties with their first language creates an additional challenge. Afrikaans is a phonetic language and is therefore a big challenge to students with auditory processing difficulties. This situation begs the question of what specialised training teachers require in order to have the confidence to teach appropriately as well as to meet the needs of the students. Alternatively, a compulsory second language as a systemic requirement should be reviewed.

4.5.5.3 Professional learning

For Maria, given the newness of her subject, her professional learning has been significant. No information on courses was forthcoming from the universities at the time and she had to rely on on-the-job training herself. Maria describes her challenge and her learning curve in these extracts:

[17] Crossroads is an independent primary school for children with severe learning and educational difficulties.

MW16: *[…] [for LO] you need life [experience], and that's it, you know. And after … I don't know Mary … I've been busy with the junior level now for three years … actively. And it's only now that I feel you can start playing around with stuff. You know, you need to work through the stuff to know what the demand is, what you have to do. Do you understand what I'm trying to say? So, I don't want to leave the junior level when I move into the senior level next year. I don't … I still want to be involved in the Grade 8s and 9s. We're doing some very nice stuff.*

MW18b: *For me, for me … maybe because I didn't have the formal … I don't know … the formal background to it. I just felt, I just felt it took me a while to … […] I think it's also to do with, you know, your confidence, because it's not your subject, you have to build up a bit of confidence. So that was a huge impact, yes.*

*****

MW48/50/52/57: *[laughs] I can only give you the truth – you know - whether it was what supposed to happen or not! [laughter] It was those two files that Andrea – I don't know why she bought those […] files – that was my starting point because I had no, literally, had no idea what to do. That was my starting point. And, I think, since then … it's um developed … since then it's developed into something nice. I still use those […] files as my basic … you know, that's the core that I work from. […] So, for the Grade 8s and 9s I've worked from those files. Then, at the Cluster meeting I found out that they have these work books so next year we will most probably buy these work books for the Grade 8s and 9s as well. […] So literally, that was my starting point. I have, as you know because you've put many of these books in my pigeon hole, all these from the different publishers, the different Life Orientation books. I've got and I read and I must and … you know … […] I can remember the first year we still tried to find out from universities if there were any courses available that I could attend, but we never had any feedback and … and we've just moved on since then, you know so, ja ...*

MW70/72/74: *I think it was a huge advantage. I have … I have been challenged. Mary, I think I have grown tremendously in the last three or four years. Professionally, I think. I may be wrong. I don't know. But I have been challenged and you know, when you meet those challenges it makes a difference to you as a person. Yes, you do [feel good about it]. And … and it goes back to what Investment*[18] *teaches you as well, you know. It's really the advantages of ... I can't think of one disadvantage.*

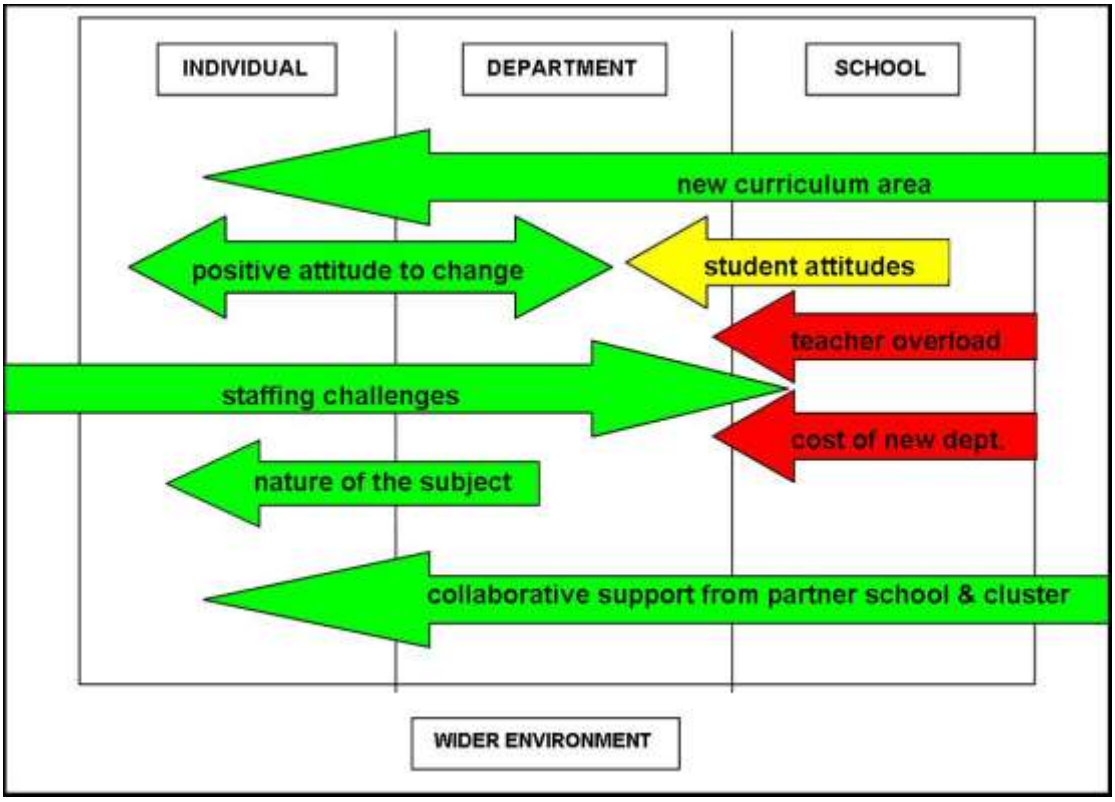
[18] *Investment in Excellence* course (see footnote 5, p.147)

In response to the question of what sparked her change in practice, for Maria and her new subject, everything changed. With humour she describes what transpired whether intentional or not. It has taken three years of experimentation at GETC level for Maria to familiarise herself with the LO curriculum and reach a point of comfort with it. In this respect, her experience is similar to that of her colleagues in the Sciences. One reason for her lack of confidence is that, having been seconded into the subject and lacking formal training, she is on unfamiliar ground. Her comment indicates the time frame that is necessary for a teacher to change to a new way of working. Innovation and comfort with doing things in different ways is not a 'eureka' moment, but a process over time.

4.5.5.4 Summary and preliminary findings: Maria

The convergent and disconvergent factors in Maria's case are illustrated in Figure 4.6.

Figure 4.6: Organisational effects: Maria



Maria has had no option but to adapt, given that she transferred out of necessity from a redundant classic discipline to a new mandated subject area. Everything was new to her: the subject area, the OBE curriculum, moving from a language to content subject genre as well as new responsibilities for a school-wide department. LO thus brought logistical challenges at organisational level and an additional workload for all teachers who have to implement the LO curriculum. In parallel with the logistical challenges, the financial challenges of providing trained teachers for an extra subject to the whole school were prohibitive. The LO load is raised by other participants. Similar to her colleagues, Maria has adapted and refined the delivery of LO over the three years of its implementation. However, the overload on the other teachers is a factor that needs to be addressed.

Despite the overwhelming odds, she has turned adversity into opportunity. It has taken three years for Maria, an experienced teacher, to get to the point where she is confident with what she is doing and she wishes to continue to work with the junior grade levels because of what she has achieved there, in order to sustain the momentum of her efforts. The introduction of LO has had a positive impact on her personally and professionally. Dealing with the nature of LO with boys has its challenges, but she remains undeterred and sets her sights high, hoping that the school will eventually become influential in this subject area, i.e. she is driven by not only her personal motivation, but her overall ambition for the school as well. Like her colleagues in other departments, Maria anticipates further impact as the OBE curriculum reaches Grade 12 level.

Maria is positive about her own personal and professional growth through this experience. She raises only one negative factor, the attitude of some boys towards the subject, but is undeterred by it. Instead, she is driven by her personal motivation and loyalty towards the school. The advent of LO has provided mutual benefit to both herself and the school. Although she acknowledges that there is still a long way to go, Maria remains positive, giving the overriding impression of optimism that everything will work out. She

acknowledges the challenges, but is not overwhelmed by them, and does not raise any particular constraints other than her own knowledge level, which is growing exponentially. She specifically wishes to continue teaching LO at GETC even as the curriculum reaches the higher grades, in order to sustain the momentum. Inclusion has had the biggest impact on her practice generally. Her practices have changed largely due to the nature of the subject matter in her new subject area. She is reliant on support from more experienced colleagues in her Cluster Group, indicating a reverse extensiveness, with influences coming from outside.

Similar to Maria's experience in LO, Francois has to contend with teaching Accounting as a learning area that is new to the school.

4.5.6 Organisational interactions and their effect on Francois' practice

Francois faces a subject that is new to him as a teacher as well as the mandated changes of the OBE curriculum. Prior to 2006, the school did not offer Accounting, but conceded to introduce it following parental demand. Francois was appointed as the OBE curriculum at Grade 10 was introduced. For Francois personally, Accounting was also a new subject and Wilding College, a secondary school, was a new school level in that he had previously taught only a general curriculum at preparatory school level. He has one departmental colleague who is also part of the school leadership team and also new to the school. There are thus essentially 1.5 teachers in his department, so the onus for developing the subject falls largely on Francois. Further, both Accounting teachers had come from government schools so the IEB system was new to them both.

In Francois' case, systemic factors and curriculum change predominate.

4.5.6.1 Systemic factors

As a consequence of these changes, there has been a considerable impact on Francois' practice. He describes his experience in the following extracts:

> ***FP4a**: Um … it's been very daunting, in the sense that I've come in with a new subject, new syllabus um … and tried to get it off the ground. So, invariably, what we've had changes-wise [is] a hell of a lot of enthusiasm initially with everybody keen on Accounting, this fantastic subject, and then realising that there's so much more to it than what they thought. So, the interest has dwindled from this massive interest where, for instance, our current Grade 11 group is 55 boys to our actual intake for Grade 10s for 2008 which is actually 20-25 boys. Because they've come to the realisation that its not as fantastic as everybody makes it sound and the content and the work is so much more, especially with the new syllabus so that's been very interesting, coming in that side of things.*

The Hawthorne effect (Wickström & Bendix 2000, p.363) plays a role in the assimilation of Accounting into the optional choices available to students: first there is a huge demand for the subject and then student interest pendulum's in the opposite direction. Such fluctuations have significant implications for the whole school system: for managing optional subjects and proportional student numbers as well as allocating teachers and physical resources. Student perceptions of Accounting also present a challenge and may indicate why the numbers of students choosing the option have varied so greatly:

> ***FP4b:** And also now, with the boys being so computer-literate as they are, they can't understand why they've got to do written work. Their theory is that it should all be done on computer which is what happens out there. So … so that's very interesting trying to incorporate the computer side and give them the foundations of … 'cause computers … you tell them the figures and it does it all for you automatically for you. You tell it it's an invoice and it gets put it in the right places. And that's what the boys don't understand. They need to understand why an invoice is put in those places not just assume that it's happened. So that's been a difficult one for them to get across*.

4.5.6.2 Curriculum change

Francois teaches Grade 11 in a continuity vacuum owing to the fact that the Grade 12 curriculum had not, at the time of the interview (October 2007), been released. Planning between related sections over different grades was therefore impossible and only six weeks remained to plan for the following academic year. The effect of this was that Francois felt unprepared and was

concerned that his students would not be properly prepared for their Grade 12 year.

> ***FP4c/8:*** *Then obviously the content which has been so much. To incorporate that side of it has been pretty difficult. […] For instance, we're doing 35% of our current Grade 11 syllabus [which] used to be Matric syllabus and they haven't lost any of the Grade 11 syllabus from before, so you've added 30% or 40% to the existing syllabus which was so much, without taking anything away. So it's just so much more work. I mean, there's two sections in Grade 11 which used to be Matric work.*
>
> *****
>
> ***FP10/11:*** *Well, we're waiting for them to finalise the Matric syllabus at the moment. It's still coming through, ja. So we don't know what they've added or not. And you can't get … we're in a position where you can't say "Well, let's leave these [???] sections and pick them up next year" because we don't know what they've planned. So, ja, it's a huge problem. So, I mean, we're battling. […] We're scurrying … trying to say "What do we leave. What can we give them for self-study", just to [get] through the syllabus. That's it. And not to mention doing the software packages.*
>
> *****
>
> ***FP14/16:*** *[…]. I'm in the situation now where you're trying to push content and new things … concepts … but I'm so nervous now, because I don't think a proper foundation has been laid. So for next year I know it's going to come and it's going to bite me because I never covered that properly. We didn't have time to spend on it, work through it, practice it a bit. So, that's a huge concern. I'm nervous too that I haven't prepared the boys well enough. […] So ja, it's definitely out of the comfort zones.*

4.5.6.3 Professional learning

Francois is quite direct about his comfort levels with the curriculum and the learning curve that he is experiencing, clearly expressing his own shortcomings relative to his perception of the students' needs. He uses the term 'scurrying' to describe the time pressure that he is under and refers repeatedly to his nervousness or discomfort with matters over which he has no control. The workloads for him and his students are immense. Francois is modest and frank about his personal ability to be creative with ideas. However, the fact that he mentions trial and error indicates that he is trying out

new ideas. These appear to come from within and are drawn from what he believes is relevant to the background of the students, coming as they do from a high socio-economic environment.

> ***FP26:*** *Well, I think … you know … well, some of them … I think it's just trial and error, I suppose. From what I've used before, it didn't work, so let's try a different approach. Maybe I can connect with them that way. Generally, what I'm trying to do … well, what I'm trying to do is … if there's a lesson and it works and you know, you sort of see the lights going off, if I can put it that way … then I try and make a mental note of it saying "Well, that approach worked with the boys. I seem to get a positive response. Let me try and store that one and use it again." But the idea is generally, you know … as I said, I battle. I'm not the most innovative [guy] with these wow ideas etcetera, etcetera. I'm pretty much run of the mill; this is what we need to do so make it relevant to their situation for them. So for instance, they talk about a financial statement in the business world out there. I often refer to it […] or, you know, their context of this is their target market, that sort of thing. Um … also things that they relate to you know: going buying clothing, buying play stations. So I try and make it relative in their sort of … what's of interest to them, what they shop for, that sort of thing.*
>
> *****
>
> ***MR17:*** *And when you say you're having to work with different material and maybe find … are you having to find new ways to deal with that material or is your delivery in this particular subject very similar to what you have been doing before?*
>
> ***FP18:*** *No, the delivery is very different. You know, you try and make it as relative … as relevant to their sort of situations as possible. Now, one of the criticisms is "try and make this subject more interesting" and its' very difficult, because the subject is black and white. There's no grey area. There's no … there's a right or a wrong. And there isn't … for instance, take Maths, where there are three formulas to work something out. There's only one way that it can be done. Ja. It's not negotiable.*

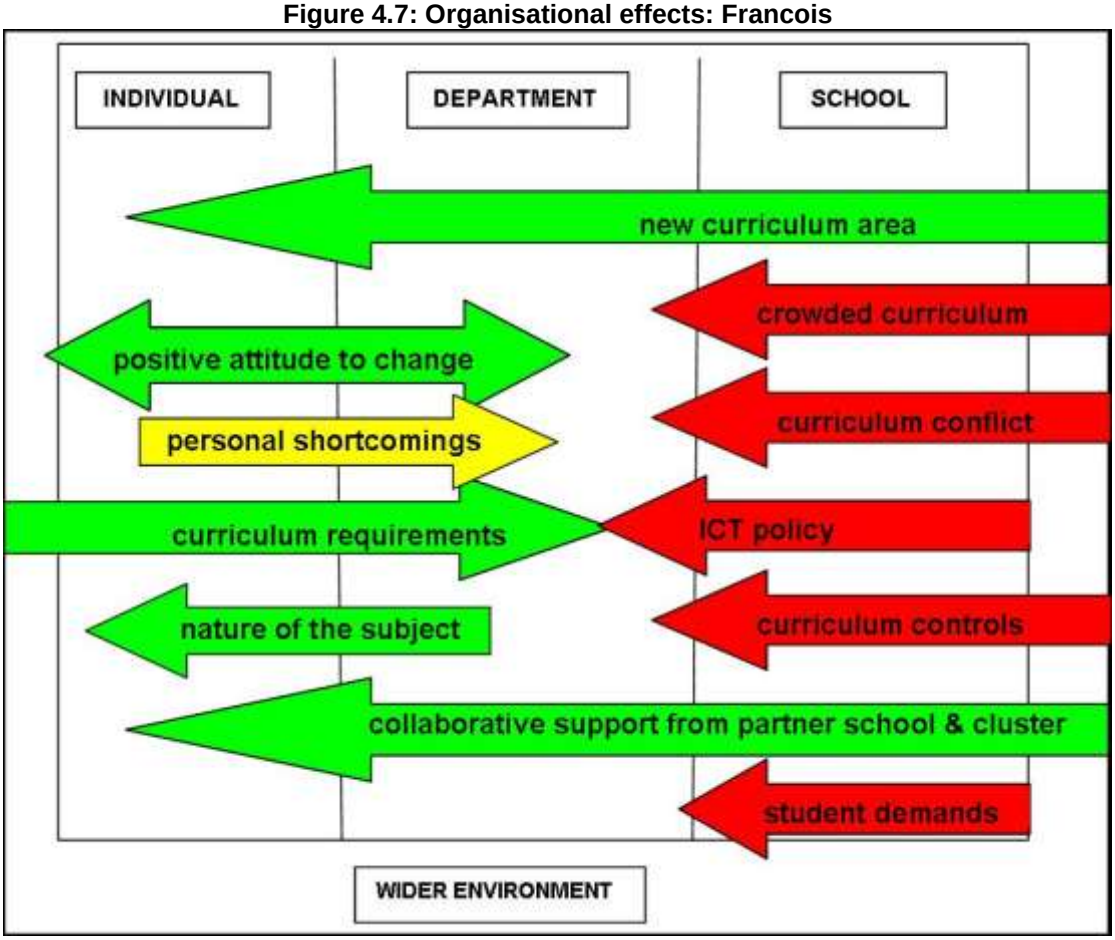
Francois believes that it is difficult to innovate within Accounting as it is a subject that does not readily accommodate creative outcomes-based strategies. In Accounting therefore, the nature of the subject has the opposite effect to the nature of arts subjects in which creativity is inherent. Francois is tasked to *'make the subject more interesting'* but feels constrained by its

prescriptive nature. However, he tries to use case-studies to demonstrate the application of the subject.

4.5.6.4 Summary and preliminary findings: Francois

Enabling and challenging factors converge for Francois in implementing mandated changes and in integrating himself into a new environment. These are illustrated in Figure 4.7.

Figure 4.7: Organisational effects: Francois



Convergent factors are the opportunities created by the newness of the subject, the OBE curriculum, Francois' new position and the initial interest of the students. Over and above this are factors such as his willingness to learn and experiment and his openness to any support that is offered. Disconvergent factors are the uncertainty and lack of clarity in the incomplete curriculum, the volume of content, the waning interest and demands of

students and the prescriptive nature of Accounting which does not lend itself to OBE strategies. He has creative ideas he would like to implement, but curriculum overload restricts him from realising these opportunities. A factor not addressed in this section is access to ICTs. This will be addressed in Chapter 6.

4.5.7 Preliminary findings: Organisational interactions and their effect on teachers' practice

The variety and complexity of interactions that occur between mandated change and teacher practices in the context of Wilding College is evident from the above extracts and analyses. Whilst the teachers were asked virtually identical questions their responses to the question regarding how mandated changes had affected their practice provided as many different perspectives as the number of participants. The nature of the subject area, the size of the department, the degree to which the subject is established, the beliefs and attitudes of the teachers, their length of service and experience and the backgrounds from which they come all play a part in their responses to change.

Henry and Richard illustrate the dichotomy of personal responses to mandated changes. Henry attributes his acceptance of change to his own nature, whilst Richard attributes his to the nature of the subject. Bronwyn and Ineke have embraced change to the extent that they feel threatened by what they perceive to be retrogressive further changes in the curriculum. Thabo and Magriet have embraced the philosophy of inclusion and want to change their practice but are caught in a stressful cycle of conflicting changes that they appear unable to escape from. The experience of Hennie and Arthur helps them to rationalise change although they show some scepticism of how well the OBE curriculum is being implemented in their department. Henry is stifled by the lack of a like-minded colleague and intrigued by student factors that conflict with assumptions of a socially networked society. There is a paradoxical tension between Richard's creative nature and his realisation of socially-constructed knowledge in the practical component of his subject and

the traditional delivery of the theoretical component which he has no time to explore. Maria and Francois deal with the immensity of the challenge of the new with remarkable fortitude.

Common convergent factors are the collegial and professional relationships that are apparent both from observation and from what the teachers themselves recount. Collegial and professional relationships will be addressed in the following chapter in depth. The single factor that pre-dominates and is a common concern to all teachers is the lack of time to meet the needs of their students. This may also explain why so few teachers have completed the assessor's course portfolio even though it is compulsory and fundamental to implementing the new curriculum.

Taken at surface level, the implementation of mandated changes has been systematic in that it has been incremental over one academic year at a time. However, in practice, the implementation process for the two major changes has manifested as much more ad hoc. Curriculum change in certain subjects has not proceeded in one linear direction, but first in one direction and then veering into another, sometimes reversing and sometimes without clear direction. Similarly, the change to inclusive practice, although more consistent in its direction, has not matched the reality of classroom experiences due to a combination of three factors. These factors are the dearth of classroom support, class size and a move away from streaming. Teachers have had to establish their own benchmarks, redesign their practice and manage their own professional learning in real time with little or no opportunity for planning workshops, peer demonstration, observation and critiquing to ensure iterative development of their practice.

Despite these challenges and limitations, positive convergence occurs to the extent that curriculum implementation is moving forward and academic standards are being maintained, although some teachers acknowledge that their practice has regressed or that they have not been able to sustain

innovation. Disconvergent factors are a reality that needs to be addressed at system, school and departmental levels.

Against this background, the next Chapter will explore and describe how collegial and professional relationships between individuals and between individuals and departments, the school leadership and entities beyond the school determine the mutual benefit of innovations in practice.

4.6 Summary of Chapter 4

Chapter 4 has introduced the school and the teachers that form the participant sample of this study, outlined the main themes identified in teacher responses to Sub-question 1 and described the findings that relate to this question. The interactions between mandated change and teacher's ability to innovate in their classroom practice have been described using evidence of convergent and disconvergent factors. Chapter 5 will describe collegial and professional interactions and their effect on teachers' ability to innovate, seeking evidence of mutuality.

Contents

Chapter 5: Findings: collegial and professional interactions and their effect on teachers' practice

5.1. Introduction …….. 211
5.2. Schools as professional learning communities …….. 212
5.3. Formal networking structures …… 213
5.4. Collegial and professional relationships at Wilding College … 214
5.4.1. Working together: Bronwyn & Ineke …… 215
5.4.2. Working together: Arthur & Hennie, Magriet & Thabo … 223
5.4.3. Working together: the case of Henry ……..... 240
5.4.4. Working together: the case of Richard ……. 247
5.4.5. Working together: the case of Maria ……. 252
5.4.6. Working together: the case of Francois …… 256
5.4.7. Preliminary findings: collegial and professional interactions and their effect on teachers' practice ……. 261
5.5. Summary of Chapter 5 …… 266

Chapter 5
Findings: collegial and professional interactions and their effect on teachers' practice

5.1 Introduction

The previous chapter introduced the school and the teachers that form the participant sample of this study, outlined the main themes identified in teacher responses to Sub-question 1 and described the findings that relate to this question. The interactions between mandated change and teacher's ability to innovate in their classroom practice were described using evidence of convergent and disconvergent factors.

The second sub-question that investigates the effect of context on teachers' ability to innovate is:

> *How do collegial and professional interactions influence teachers' ability to innovate and to sustain innovation in practice?*

In order to answer this question, this chapter will, using the data from the interviews, describe the collegial and professional interactions at Wilding College and their effect on teachers' ability to innovate, seeking evidence of mutuality. The chapter will provide a brief overview of schools as professional learning communities; describe the formal networking structures to which the school is linked; describe collegial and professional relationships as a theme that emerged from the data; and then describe and discuss the findings of each interview in turn.

To provide the background to professional learning the following section will provide an overview of professional learning communities in schools.

5.2 Schools as professional learning communities

A school as a professional learning community (Wenger, 2008 p.2) emphasises collaborative opportunities amongst professional teachers and focuses on teaching and learning (Giles & Hargreaves 2006 p. 126). Professional learning communities as communities of practice have their practice at the heart of their existence, develop around things that matter to their members and reflect their members own understanding of what is important. Communities of practice can be influenced from outside, including by external mandates, but community members will develop their own practices in response i.e. they are self-organising systems (Wenger 2008 p.2).

Professional learning communities are essential to schools in the complex knowledge society (Senge 1990 p.308) but are difficult to establish in secondary schools because of hierarchical administration and the strong subject-based structure that counters collaboration (Giles & Hargreaves 2006 p.127). This is evidenced in the fact that almost a decade after Roschelle *et al.* (2000, p.76) called for professional learning communities that would enable teachers to innovate with ICTs; there are still calls for this to happen (see Ch. 2 Section 2.3.4, p.44). The Draft White Paper recognises ICTs as "*the means of communication, collaboration and engagement that enable the processing, management and exchange of data"* (DoE 2003 p.16) but, as Peck, Cuban and Kirkpatrick point out (2002 p.53) school structures often limit collaborative cross-pollination of innovative ideas.

Communication is essential to the diffusion of innovation and clusters or networks are key to the communication of creative ideas in learning organisations. Clusters and networks function as *"social technologies"* and a means of co-operative knowledge creation (Steiner 2004, p.4). Whilst interaction in networks is mostly informal, it is part of an organisation's larger knowledge management strategy for knowledge creation. As learning organisations, schools need to optimise professional learning within clusters or networks to encourage the diffusion of innovative ideas. For innovation to

succeed schools require supportive leadership, lateral networks rather than strong hierarchies, effective group processes, clearly outlined organisational objectives and decision-making processes that involve all members of a group (Sharma 2005, p.54-56).

Collegial and professional interactions between individuals and within and across departments of a school, as well as externally with networking groups and other professional entities are essential to a professional learning community. Such interactions have significant positive or negative effects on individual teachers' ability to innovate. Where there is positive convergence, mutuality needs also to occur for change to become institutionalised. Mutuality characterises reciprocal and empowering interactions with mutual benefits accruing to those affected by an innovation (Sherry & Gibson 2005, p.86). If an individual teacher exhibits innovative excellence and, in turn, disseminates their skills to colleagues within a common department or beyond, there is likely to be a mutual benefit to all. For this to happen, teachers need to collaborate or be able to work together. Informal as well as formal networking structures support such professional relationships.

5.3 Formal networking structures

Professional relationship or networking groups exist within the IEB[1] group of schools. The IEB has two structures that provide opportunities for teacher networking: User Groups and Cluster Groups. These groups exist in a national and regional structure. The objectives of the User Groups are to:

- advise and consult with the IEB
- involve teachers in all aspects of the assessment process to ensure that learning goals and assessment criteria are clearly defined

[1] IEB = Independent Examinations Board. The IEB is primarily an assessment agency. Many, but not all independent schools write the final examinations set by this board and therefore adhere to its standards. However, the IEB is not limited to independent schools. Some public schools write the IEB examination.

- promote the professional development of teachers in relation to curriculum, assessment and teaching methodology
- create a network facility for teachers of the same subject to share experience, methodology, tasks, concerns etc.
- create opportunities for school-based action research, development and continuous assessment practices to inform IEB decision-making (IEB 2005 p.4)

Cluster Groups are formal, prescribed structures for HODs or their nominees. They usually convene three times per year. Their function is described as follows:

> *"Clusters, usually defined by geographical proximity, normally from within regions … Clusters of five or so schools are important in the moderation process. They concentrate on implementing SBA policy. They primarily hold meetings working to an agenda to accomplish their function. Their resources are normally limited to the members of the group. They nevertheless play a vital role in the professional support of teachers with regard to the assessment of school based assessment (SBA)" (IEB 2006).*

Attendance at User Group activities such as meetings, workshops and conferences is limited only by financial constraints and operational requirements (HOD minutes).

At Wilding College teachers work together in the ways described in the next section.

5.4 Collegial and professional relationships at Wilding College

This section will describe and discuss the findings of collegial and professional interactions provided in answer to the interview questions of how teachers share ideas and collaborate within and beyond the school. To establish the extent of mutual benefit from innovations, apart from what was revealed in the preceding chapter, teachers were asked how they had worked together as a department to foster innovation and how they worked or networked with

others beyond their department or beyond the school. In order to establish mutuality between individual teachers and the school as an organisation, they were also asked about the role of the school leadership in fostering innovation. Their answers are not dealt with separately for each of these issues as many of the factors are interrelated; instead they remain interlinked in the interpretation.

Collegiality is "*an essential element of the spirit of community*" in a school and requires co-operation in an atmosphere of "*mutual understanding, respect, and trust*" among colleagues for the common good of the school (Chung 2006, p.3). At Wilding College collegiality as a spirit of community amongst the staff is openly acknowledged in meetings by the principal and deputies. From observation, collegiality in the sense of supportive camaraderie between teachers is palpable. There is an open sense of teachers being united and supportive of the common goals of empowering boys through the broader curriculum and striving for high levels of academic, sporting and cultural achievement. Collegial relationships were raised specifically by some teachers as central to their practice.

Collegial relationships with the staff of the partner schools are less positive than within Wilding College itself. The partnership is recognised by some teachers as a factor in the interviews, but unless raised in such a way, the partnership itself is beyond the scope of this study.

5.4.1 Working together: the case of Bronwyn and Ineke

For Bronwyn and Ineke, working together within their department is paramount. As Life Sciences teachers they have experienced inter-departmental collaboration with their Physical Science colleagues in the delivery of the combined Natural Science subject to Grades 8 and 9. Their collaboration beyond the school is important, but limited. They have a good relationship with the school leadership, but expect more from it.

5.4.1.1 Intra-departmental relationships

Bronwyn and Ineke are very clearly in agreement about how they work together as a department: they state up front that they get on with each other and the evidence of this positive relationship echoes throughout the interview. Their good relationship is important to them and manifest in the openness and comfort of their interaction as demonstrated in these extracts:

> ***BK43:*** *I think, as Ineke always says, the bottom line is we get on with each other.*
>
> ***IG44:*** *Mmm [affirmative]. And we share stuff ...*
>
> ***IG46:*** *… verbally and on paper. And if I'm running off something for my class I'll do it for the other classes as well. If Bronwyn finds an article she thinks we can use for a test, she'll give it to me. We always make … look out for things for each other to use. Because Bronwyn champions the G11s. I champion the G10s. So we are always, you know, interacting with each other and swapping information.*
>
> *****
>
> ***BK59:*** *I think, also, we do share a lot of our stuff. We're not people who [breath intake, gesture: holding onto table] … this is only … [for me]. I've said to Ineke "you're allowed [to] help yourself to my files".*
>
> ***IG60:*** *And, I mean, I do. I use Bronwyn's files all the time because I've got nothing. So, I had to start from scratch.*
>
> ***BK61:*** *And I think that is the relationship … it's very open, supportive. We support each other. And I mean as Ineke says "You're not allowed to use old books". Now we have to get on track. And it's good to … I needed to hear that because I'd got too comfortable. It's very easy to sink into that … comfort zone. I mean we used to laugh about that. Ineke thinks I'm anal because if the staples not in the right place, I get cross! [laughter]*
>
> ***BK62:*** *But that you see … I think that's where our strength comes from. We don't allow anybody else to pull us down.*

Their relationship is reciprocal and empowering. In continually seeking new things they rely on resources as a source of their inspiration for new

information and innovative ideas. Bronwyn shares her work openly and implies with her words and body language that she is unlike other teachers who keep their work to themselves. For Ineke, coming back into teaching from the corporate world, it was imperative for her to have access to Bronwyn's wealth of accumulated resources. Ineke reciprocates with her corporate expertise. Need and benefit complement each other to mutual advantage.

The evident good relationship between Bronwyn and Ineke extends across their department. Recent staff turnover has changed the balance of their relationship dynamics but with time they overcome the effects through their positive mindset and high morale:

> ***IG63:*** *Yes. We set high standards for ourselves and we, we work together … as a team.*
>
> ***BK64:*** *I think that's what [a colleague is] enjoying … he said "it is such a pleasure being back". You know, we have this … the relationship. I think that's why it's affected us so badly with [another colleague] being taken out of it. But, we're coping with that a bit better. We didn't at first.*
>
> ***IG65:*** *But he's in it but he's out of it.*
>
> ***BK66/68:*** *He's actually more out than in and we struggled with that at first. Hugely, and, I mean, I'm being very honest now. […] And now we've actually moved … we had to move … we had to move through the situation and past it, which I think we've done, because, I mean, I blew up […] one day when asked to substitute. And I said, "But don't you know that I'm substituting for [a colleague] when he's always … when he's away?" He said "I didn't know that". And then I did apologise. But, I said, it's my frustration.*
>
> ***BK70:*** *But anyway, we haven't allowed him to pull us down.*
>
> ***IG71:*** *No.*

5.4.1.2 Relationship with the school leadership

For Bronwyn and Ineke, the relationship with the leadership is different, in that a member of the leadership team is a member of their department. His change of role has affected his input into the department and both interviewees express personal disappointment at the absence of his influential presence. The relationship balance appears to have shifted, but his influence is sustained. His role as an IEB examiner and access to his expertise and guidance is valued by his departmental colleagues. Due to the nature of his promotional post, department colleagues find themselves covering his classes quite regularly, impinging on their free periods. The impact is from systemic factors, not a diminished relationship. This adds to their workload and is the single negative point of frustration that does creep through in the interview, although it is dismissed by Bronwyn and Ineke in their usual positive way. Although they rationalise the effect of his changed status they still miss the stimulation he provided to their innovative thinking, indicating the value they place on the professional relationship:

> ***BK80:*** *And I also think he … he also started our … thinking.*
>
> ***IG81:*** *Ja, yes. He's been a big pioneer in changing our way of thinking and questioning and …. He often challenges us, pushes us out of our comfort zone, which is good.*
>
> ***IG83/89:*** *That's what we miss. That's what we've missed, in that he hasn't done it as much now, this year, as he did last year when he was HOD. […] not being there to question me, to push me out of my comfort zone.*
>
> ***BK90:*** *You know if you look at it from the boys' perspective because he's very much 'look at it from the boys' perspective'.*

The department receives good support in the provision of up-to-date resources essential to their innovations partly as an outcome of their departmental link in the leadership and specifically his IEB role, implying that without that link, the level of support might not be there. As an examiner, he needs to be well-informed on all aspects of his subject and his expertise is

reciprocated by the provision of the up-to-date resources. Nevertheless, Bronwyn and Ineke doubt that the rest of the leadership has much knowledge of what they do in their department, a pattern of support similar under the previous leadership. Albeit they acknowledge awareness by the leadership of their good departmental status, seeming disinterest is hinted at through the lack of response to invitations to observe developments in their department. Bronwyn and Ineke attribute this to the load they perceive principals to carry rather than disinterest. Bronwyn's use of the word *'haul'* qualifies the effort that is required to try and gain acknowledgement from the leadership. There is a need for affirmation by the leadership which is perceived to be lacking:

> ***IG75/77:*** *I don't think [the leadership] even know what we're doing. Except [the deputy]. [He] knows obviously. And [he's] always been … if you go to him and you have a problem and you need help he will make time and sit and listen to you and he will help you. He's got a good biological brain and he's an examiner so we often do pick his brain. But I don't think the others really […] Well the others, the other leadership, the other deputies, [the head], I don't think they really are …*
>
> ***BK78:*** *But in the old management as well, that happened. We used to try and include them. 'Come and look to see what we're doing in the prac', but we just [shrugs] could … we could never haul them in. I first of all think that they're too busy. They know that we run a good department so, they leave us. […] But I must say [the deputy] … like with that CD we wanted to get the new questions on, which we do need. He says no, you must buy it. It's expensive, but go ahead and buy it. So, in that role he's very supportive. He does like us to have the latest. Because, I mean, it's also for him, because with his reputation, teaching in this department, he can't just allow it to go into nothing, which I don't think will ever happen.*
>
> ***IG79:*** *It's good for him as an examiner to be up to date with the latest trends, you know, the latest things. So it's to his benefit.*

5.4.1.3 Inter-departmental relationships

The school has followed the national mandate to combine Life Sciences and Physical Science into the subject, Natural Science in Grades 8 and 9, with beneficial effects on curriculum development and student thinking in both

departments. There is a good working relationship between the HODs of the two departments. The teaching load is shared across staff in both departments and Bronwyn and Ineke work in the same way with the Physical Science teachers, with each teacher developing one or more modules of work. Unlike the Physical Science teachers who raise certain doubts about the implementation of the module system (AS28/30, p.221), neither Bronwyn nor Ineke raise this point.

> ***IG54:*** *That's Natural Science, that's not really the Biology[2] department as such.*
>
> ***BK55:*** *But, I've still … I've developed four out the six … Biology units.*
>
> ***BK57:*** *It's the same thing [in Natural Science]. I ask … I write it and then I ask Arthur to go through it and he makes a few suggestions which I change. Then everybody has access to it.*
>
> ***IG58:*** *And everyone uses the same module.*

5.4.1.4 Relationships beyond the school

Apart from this systemic affiliation, there are three other potential sources of external influences: the partner schools, the regional Cluster Group and the Life Sciences teachers' network mailing list associated with their User Group. The mailing list is an innovation on the part of a colleague elsewhere and its impact is through the stimulus that the shared resources provide:

> ***IG92/96:*** *Well, we meet with our Cluster Group and then we exchange ideas quite a lot. We have meetings with the [partner school] every now and then and we swap stuff. We don't always use their stuff, but we do talk about things and share ideas. And we've got a Biology teachers' network … that is a nation-wide network and people can send stuff: questions, articles, whatever to […] and we send it to one person and he sends it out to the whole group that's on the network.*
>
> ***BK97:*** *It's very powerful.*

[2] Biology is the former name of Life Sciences and is still used informally.

> ***IG98:*** *We've got loads of stuff. I mean, [one HOD] finds tons and tons of websites and animations and she sends all of those through so that's really been a really good source of information.*

Occasional meetings are held with partner school colleagues, but their impact does not appear to be as significant as that of the mailing list, which they describe as having a powerful impact. Content is the issue that divides the approaches to curriculum between the partner schools. However, the nature of the schools allows teachers to work with content that is honed to their students' interests:

> ***BK114:*** *You know, I think, Mary, I think that's a time constraint. You know, we've given the [partner school] our modules like for Grade 8 and 9 and then I don't know if they use them, but they teach very differently in Grade 8 and 9. But I do know that they've got it. But we never … to get together … we tried that once … oh!*

> ***IG115:*** *It's hard enough to get just us to get together within our department and get stuff out and ready on time. To still do it with outside people … we're just too busy. I can barely open all those emails that come from the user group and download everything and remember where I've stored everything, you know. But I do keep everything … I'm anal [???] like that.*

Neither Bronwyn nor Ineke have been involved in any other form of partnership beyond the school in developing units of work. Bronwyn mentions one attempt at unit development with the partner school, but qualifies the attempt with a despairing *'oh'*, whilst Ineke attributes a lack of collaboration beyond the school to a lack of time and in particular, finding common time.

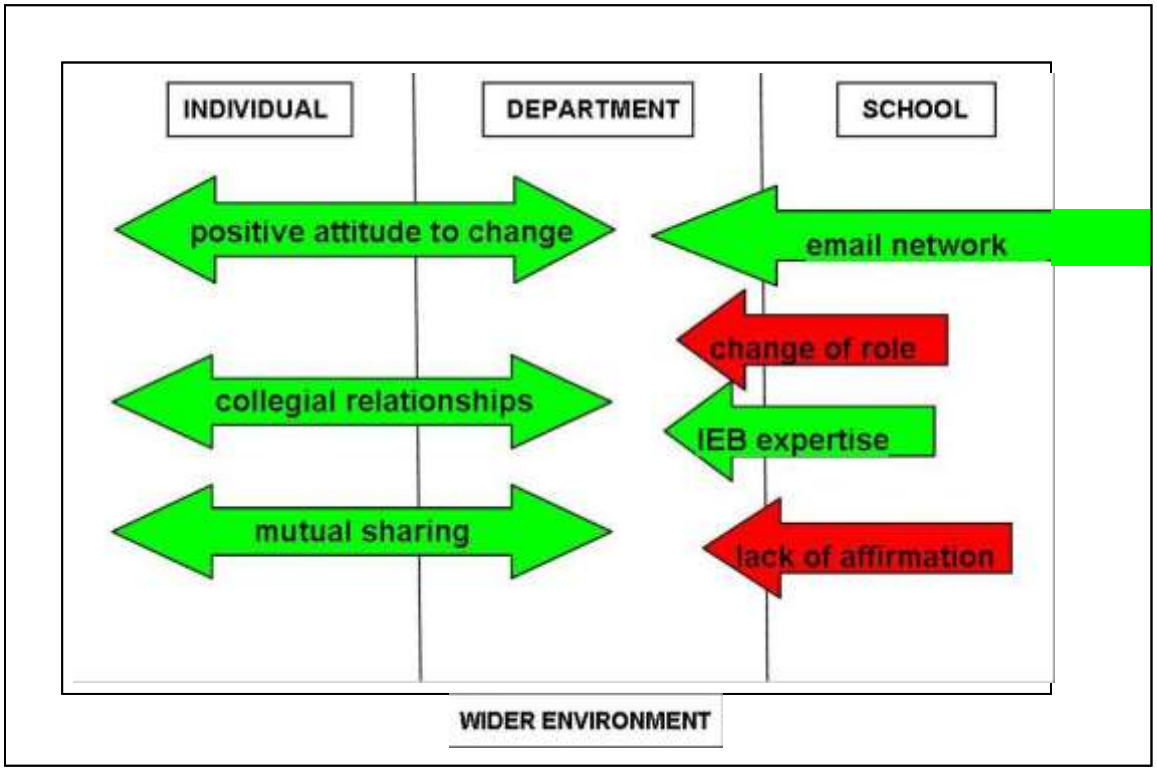
5.4.1.5 Summary and preliminary conclusions

The pattern of factors that affect mutuality in the case of Bronwyn and Ineke is illustrated in Figure 5.1.

Despite time constraints, Bronwyn, Ineke and their colleagues collaborate extensively within their department. Mutuality is evidenced in their good relationships, including personal friendships and their reciprocal relationship

through a colleague with the leadership, although his diminished role in the department is regretted. However, both Bronwyn and Ineke appear to be disappointed at the level of acknowledgement they receive from the remainder of the school leadership, although this does not constrain them. Collaboration with their Natural Science colleagues helped develop their thinking and curriculum for grades 8 and 9. Whilst they appear to have little in common with the partner schools, the monastic nature of the schools has enabled each to develop their curriculum content to the advantage of their own gender group. There is little perceived benefit from their relationship with their Cluster Group. On the other hand, the Life Sciences network is a critical enabler in their access to online resources and is a powerful tool for reciprocal sharing across the participating schools, with mutual benefit accruing to all active members of the network. Networking is facilitated by their access to ICTs, although ICTs have not been fully exploited for the purpose in the same way that they use the IEB website.

Figure 5.1: Collegial & professional interactions: Bronwyn & Ineke



The power of good relationships comes through clearly in this interview. Where the benefits of sharing and openness with each other are mutual, creative processes are easily sustained. A positive mindset, apparent from both interviewees and that appears to extend across the department, is also crucial.

5.4.2 Working together: the cases of Arthur and Hennie, Magriet and Thabo

Two pairs of teachers from the Physical Sciences department were interviewed. Each pair gave a different perspective, depending on their relative roles in the department. Whilst the relationships between each pair of teachers were clearly good, in contrast to Bronwyn and Ineke, relationships were not raised specifically as an enabling factor. On the contrary, certain difficulties were raised with regard to coherence of practice across the department, diminished collaboration with the partner school and limited impact of the leadership and external influences.

> ***AS48:*** *We've worked quite hard at [fostering innovation]. I mean … we've taken about half a dozen days off over the last two years … to workshop things. So we've done a lot of work … in addition to our individual stuff and so on. And we need to do that again for electronics.*

> ***AS50:*** *Most of [our workshops] have been very successful. We sat down with a specific task and the first couple were just 'unpack this curriculum'. Some would take this strand and some would … some group take that strand in a group of two or three … flesh them out and organise the thought processes. And then we've been through some of them … some of those strands a bit more closely and tried to pull out some of the nitty-gritty. And we need to do that for electronics now because most of us are from a physics background [???] nervous about it [???]. I think that's going to work quite well. [???] … which is the project for the Grade 10 and 11s.*

5.4.2.1 Intra-departmental relationships

Arthur has arranged days off to workshop the new curriculum together with his department staff, the only mention of formalised intra-departmental workshops. A module-based curriculum developed from these workshops

with each teacher, on average, responsible for designing one module per term per grade. Arthur and Hennie provide insight on how they worked together as a large department of eight teachers to develop the modules. With the mutual goal of the Grade 12 curriculum in mind, they distributed the workload. As the new curriculum has moved up through the grades, the process of developing the new units of work has been adapted by the teachers, with a stronger focus on the senior curriculum. Both pairs of Physical Science teachers describe the effect of the modular system:

> ***HJ24:*** *We sat down as a department first and […] we looked at what was required in Grade 12 and then worked backwards. […] It's my responsibility, but it's a collective thought process that goes into it. But, ultimately, I set the test, I'm doing the pracs, and I'm responsible for that module.*
>
> ***AS28/30:*** *[…] But there are problems, so … the problem is that there is not continuous development by the same person, so we … it is a bit bits and pieces … um … and someone might have worked on developing an overall sort-of mind map of the section … Grade 10, 11 and 12 … and somebody else might do those notes … for the Grade 11s … and then they can't always [???] the thinking process that is there. We've also used our standard resources as much as possible: textbooks, instruments, Multimedia Science, stuff like that. […] [Teamwork is] a default situation, but it's the only thing that we can do. The teamwork has been good, but not always as good as it should have been.*
>
> ***HJ31/33:*** *But also, if I were responsible for this one section, I think the idea was it's my responsibility, but it still required of all the others to actually be on top of this module, because it's new. And I think, what we did not do so well, with time constraints - and what have you – is to go and come back again and say "right, I've designed this module now and this is how it works. What's your input?" … before we went out to teach it. I think that's a big lack. We just … it's a time issue, really no excuse, but it's really a problem. So, yes … it's a … It's a … we would split it, and it works well, I'm doing this, but then it's my ideas, but Arthur still has to go and … or the other way round and make that his own, my own if it's his work. You see, and that is not really happening.*
>
> ***AS36:*** *But I think the reality is also that people don't … people don't make it their own before they start to teach. You read the document and it makes sense, but when*

you start to teach it you then realise, oh well, well done, I don't really understand what you're talking about here. I don't understand this … what's going on here?

HJ39: *And also, the resources … creating resources, finding resources … that was ultimately … I think … the whole thing is that not everybody goes and (shweee!) spends endless time in finding things to do, but actually, that would be brilliant if we were all just so committed to this whole thing. Because I can set this module, but you, you just can't get to the lesson. I had to do the principles of waves. Goodness, how do I do this? I wasn't told how to? What do I need? You see, that's what he's talking about. There's no individual; well, not 'no', but not optimum individual responsibility or ownership of this new curriculum.*

*****

TL62: *… We sort of divided that curriculum into different units and then each group take over things … that and that. But the problem which we had last year was that we then did not meet again such that each group [could] present to the larger group about that particular topic which we're doing. So we all went there and did different things and that's where it ended up.*

MD63 & 67: *[…] We did bring it all together. But, even though you do, like you did, for example, section A and I did section B. I still have to present section A to my class, which means that even though you prepared the notes and everything and everything and everything I still had to study it. Not study it, but it's exactly the same amount of work for section A as section B, even though I did not make the notes. So that does not make my work less. […] You have to be perfectly familiar with something before you can present it. And some of the sections […] haven't been done in high school for seven years. […] we have to go and study again, take the knowledge we have, work [in] the new knowledge […] So it takes the same amount of time even though I did not make the notes.*

*****

MD75: *[The modular curriculum] does help. For example … because … lets take inter-molecular forces … I made the notes. OK. So, because I made the notes, I've got to sort of bear the background of where we need to go. So now, [a colleague] for example or you [to TL] come to me and say: "all right, what do you want from me here?" And then it works because then I can tell her … I assume or I … we're going here and you need to know this and this and this. That helps. So … that helps but … I don't know …*

> ***TL76/78/80:*** *Ja, I think it helps because, at the end of the day, it shares the load. […] It's best that. I mean, we divide the work. We do the work and then we present the notes and then […] we circulate those amongst ourselves. We shorten the prep time for all of our lessons.*
>
> ***MD77/79/82:*** *Yes, it shares the load. […] Ja. No. It definitely shares the load. […] We try to [understand each other].*

While the team work is evident from the above extracts, in that each teacher is assigned a share of the load, there is no evidence of collaboration evaluation. There is a benefit in that the modules are prepared, but not a sense of common purpose in following through with the design. This is evident in references to for example: the lack of continuous development (AS 28/30); reservations about the teamwork (HJ31/33); the lack of understanding of intention (AS36); variable quality of resources and lack of preparation (HJ39); lack of feedback (TL62); and lack of familiarity with the content and the material (MD63/67). Hennie's views on professional learning (HJ31/33) amongst his colleagues corroborate precisely the concerns that Magriet and Thabo raised about the time and effort needed for a teacher to take ownership of a module. Whilst one teacher is responsible for the design, the others still need to embrace and deliver the product in the classroom. Once designed, the designer needs the opportunity to give feedback to colleagues who, in turn need to come to terms with and personalise the module before they start to teach. While the content is developed in the form of notes, it appears that the underlying learning strategies to be applied lack sufficient development as the teachers arrive in class and are unsure of what to do. It is precisely this process that Beetham and Sharpe (2007 p.2-3) refer to: the change of focus from an emphasis on teaching content to passive recipients to one of active participation by unique learners in the learning process arguing that pedagogy embraces the active learning process; the preparation, scaffolding and facilitation of that process and reflective practice.

Arthur (AS28/30) expresses some doubts regarding professional responsibility in that the team work did not meet his expectations. This brings to mind the

point made in the previous chapter between busyness and effectiveness (p.31-32). Whereas prior to the modular system, a teacher was entirely responsible for the development of every unit for their own delivery, in the modular system there is *collaborative* responsibility. Although not stated categorically, an undercurrent of lack of trust is intimated (AS28/30 p.220, HJ39 p.220 and AS57 p.229). Arthur concedes time as a significant factor impacting on delivery and inhibiting the teachers' ability to meet expectations.

There is also concern about the ongoing development of the modules for which teachers need to take individual responsibility. Although the school is well-endowed with resources, including ICT-based resources, Arthur doubts whether the expected development is happening. There is mutual benefit overall for the group, but it is not necessarily an even reciprocal process within the team.

5.4.2.2 Inter-departmental relationships

For the Grade 8 and 9 Natural Science modules, Physical Science teachers collaborated successfully with colleagues in the Life Sciences department, attributed to continuity of content from the old curriculum and detailed structuring and mutual benefit was derived. Hennie describes the process as co-teaching, but in fact, it is not co-teaching in the sense of two teachers present in the classroom at a single time or one teacher facilitating a double class whilst the other prepares. Rather, he is describing collaborative planning of the modules:

> ***HJ52:*** *We share with Biology because it's Natural Science so we've got more teachers and what we tend to do there is … is pretty much the same, but its not as new because the curriculum changed a little bit but it's the same core concepts. […] And the way we do it is pretty much the same. We would … I would take one section, a Biologist would take that and we co-teach. One person would develop the notes and everybody would sit around and go through the notes beforehand … that we did very well "and these are the pracs that we all have to do and this is the rubric and the mark scheme. It's very structured I think but again we're going on we are adapting to the new curriculum and I find it much more [???]. And I think it's because we've got*

> *this mindset … this mindset that it's not following the curriculum but if [the students] leave Grade 9, what can we achieve?*
>
> ***AS53:*** *And we also went through this whole process five years ago. And we've changed and adapted it since then. So in the last two years we haven't really changed our modules much in Grade 8 and 9. We just want to focus on the Grade 10, 11s and 12s and I think in 2009 we'll probably revamp and change our modules quite a bit.*

The new curriculum also include aspects of Earth Science, for which inter-departmental collaboration with the Geography department was initiated, but discontinued after one year due to a combination of factors. This component was brought into the Natural Science curriculum and designed by a Geography colleague to incorporate a pre-determined methodology. Although this opportunity exposed the Physical Science teachers to the new methodology, the module was dropped after the first year. Arthur acknowledges that there were methodological problems and is able to pinpoint this to insufficient design:

> ***AS119-129****: We … we tried some of those [question] approaches […] but we found we weren't focused enough in the questions that were asked and we've never gone back and … and revived it. […] We weren't focused enough [i]n our overall parameters that … that we gave them. So we found that they … they wasted too much time and wandered round too much. […] Whether that's it … its probably not just – you know – a global design problem … um, but it's also a fault in the way that we implemented it in the classroom. We [???] which we probably should have, but we think [???] […] I don't think we scaffolded sufficiently well for both the teachers and the kids.*

5.4.2.3 Relationship with the school leadership

All four teachers concur that the school leadership is very supportive of their needs and believe they have high expectations of everyone, although the provision of resources is deemed to be inadequate in terms of such expectations. The leadership has also provided a buffer to the impact of contradictory mandated changes.

> ***AS70a:*** *I think we've been given quite a free hand and been given a great deal of trust. They trust us to do the job and to do it well and that's good because it shifts the responsibility and we try to pass that on to the rest of the department. Um … [long pause] … I think they have tried to shield some of the blows that comes from official government declarations every now and again which are silly and then get reversed six weeks later and there you know a lot of people are very apt to … to … they under-react. I don't think they have with … with this new LO. They've over-reacted a bit. That's my opinion. [wry smile, laughter]. I think generally they've been fairly supportive in an indirect fashion. Just provided the background and some of the resources, but not all of the resources we need. But the main resource we need actually is time … and that's the one that's got the most stretch on … [chuckles]*

Arthur's last comment is noteworthy: the leadership cannot provide what is really needed and that is time. If teachers are overloaded and cannot find the time to do what they need to do properly, where does the responsibility lie for solving this conundrum? Human capacity is a finite resource and words such as *'struggling'* and *'survive'* (MD89) indicate how close teachers are to their limits. Magriet leaves a number of her sentences hanging giving the impression of despair: *'it's just that …'* (MD85) and *'but I don't think any of us can'* (MD89). Teachers are sent on self-improvement courses for which they are grateful, but still battle to find the time to improve their practice, although the Assessor's course that Thabo refers to is directly relevant to the curriculum:

> ***MD85:*** *I think so. For example, I went on the Investment in Excellence course. That helped me in my classroom. To bring it all together. That helped me amazingly. I must say, that helped me a lot and it was … [The principal] and those guys that sent me … that allowed me to go. I'd say that … ja. We do get help … ja ... it's just that …*

> ***TL88:*** *Actually during the first term when I was on long leave, I heard that there was some course in assessment and I went and spoke to [the principal] and then he said, OK, the school is busy trying to find whoever the facilitator is to come to the Boys' College and everyone will sort of be expected to do that course, that course in assessment. So, I think the management, the school is actually supportive. If you come up with things, ideas which you feel that they will uplift you … the knowledge that you can apply that in the classroom. I think they will support that.*

> ***MD89:*** *I think all of us … we're struggling as best as we can with what we have at the moment. And I mean, the leadership … have changed. I mean [the principal] was newly appointed so he's got a helluva lot on. Same with our deputies – they're all new. So they've got a whole new load on them that's different. So at the moment, I think, all of us are just trying to survive. I mean, it's very hard for me to encourage you while I'm still trying to keep on top of everything. So, I think they're doing as much as they can, like the Investment in Excellence, but I don't think any of us can … [sighs]*

5.4.2.4 Relationships beyond the school

For the four Physical Science teachers, the dynamics of interactions beyond their own department are varied. There is a difference between the outside influences that have a bearing on the HODs and those that have a bearing on Magriet and Thabo. Also, collaboration with the partner school, in which there was little reciprocation, fell away five years ago and has not been revived:

> ***AS89a:*** *[…] Ja, um … The [partner] school we haven't … which has been a disaster because we used to work very closely with them and tried to work more closely with [???] department.*

> ***AS91/93:*** *There was a clash of personalities in the department [???] and they've struggled. We've actually helped them more with their struggles than what they have helped us. […] Yes … and it's been um … trouble … [???]*

> ***HJ94:*** *For me it's a little bit different. I can't think in all my time being here that we have had contact with them. I only see them at Cluster meetings. But I believe that before when Linda was there – Linda – it used to be very different. That's what I've been told and I'm sure that's correct … lots of interaction. But there's been none of that. And again … its time … I don't know if we … so … OK [voice tails off; chuckles].*

In the last few phrases Hennie gives an indication that something should be done about amending the situation *('… it's time …'*) but then seems to have second thoughts *('I don't know if we …').*

There have been numerous changes in the structures of the Physical Science department. At one stage a single Physical Science faculty director was appointed to oversee curriculum development in the partner schools but this post soon disappeared. Although the relationship with the partner school flourished when a colleague transferred to head the partner department, once that incumbent left, the relationship disintegrated. Arthur describes this as *'a disaster'* attributed to personality clashes, while Hennie cannot recall any contact over the previous four years of his tenure. There have also been numerous changes in HODs within the department as well as changes in the hierarchical structure with first one, then two and, subsequent to the interviews, a reversion to one HOD. Such lack of continuity with concomitant changes in dynamics throughout a period of major curriculum change may well have undermined potentially collaborative relationships.

Arthur and Hennie belong to the IEB User Group as well as to their local Cluster Group. There is good reciprocity within the User Group which has recently set up a Physical Science teachers' blog in order for members to share ideas. The links are proving worthwhile and deep conversations are happening, although contributors are limited to a few regulars. On the other hand, Hennie is frustrated that their contributions to the Cluster Group are a matter of one-way traffic:

> ***HJ96/100:*** *In the Clusters, the Cluster meetings we would sort of … sort of try to … to get the thing going and people sharing resources and so, but it didn't happen. It's very strange how, how people perceive us. And I don't think it's just me or the [school]. […] Because I think we … I'll … I'll send them our exams and mark schemes and "this is what we do" … and ... and there's been nothing in return. […] Well, at one cluster I actually made copies of what we'd done when we'd just started. We'd designed practicals in Grade 10 because it's new and wah-wah… so we've been very good at that in creating our own resources in terms of the fun and practicals. And I copied for everyone and its fine and we sat and talked about it, but it's a one-man conversation this Cluster.*
>
> ***AS101:*** *But the User Group's been better. There is a blog.*

HJ102/104: *Yes. There is a blog. Yes, it's for the whole country.*

AS111*: But it's produced some quite good stuff.*

HJ112: *Yes. But again it's the same people: [Another school] … and we've submitted some stuff and … and that's basically it. But the conversations that are going on about fundamental issues … in the group … brilliant.*

AS113: *And they go out and criticise quite a few things.*

Despite the HODs attempts to establish the practice of sharing ideas and resources in the Cluster Group mutual reciprocity failed. According to Arthur the school provides far more support and influence to the other schools in the Cluster than what it receives, which he attributes to outside perceptions of the school. Given that the school aspires to be *'a leading school'*[3] the fact that it has more to share than what it receives is likely. However, there is also a possibility that the HODs are not as open to the ideas of others or that lack of reciprocity might be their impression. Magriet and Thabo give their view on the Cluster Group, providing an example of their differing realities:

MD110/112: *So it's not … it doesn't involve us. No. I think … he normally writes a report back, but … frankly, I can't remember … [loses focus]*

TL113: *Another issue is that when … when [either HOD] go[es] to the … to this Cluster Groups, when they report back to us, it's more of what we've… those are the teachers … we'll take what we've done, you know. Like … they'll be commenting about what we're doing here […] than what they are doing. So, it's like we give them whatever they need at the cluster, Cluster Groups. They will say, "Oh, this exam, this prac and this what, what, what". We are doing this and everybody wants to copy us. You know … things like that. It's like we are … we are … we are like … on top there and everybody wants to … to reach there and copy what we are doing.*

MD114: *I'm sure it's not always like that.*

TL116: *No, it's not always like that, but mostly.*

[3] Reference is made to this on the school website.

MD117: *No, but that's the impression they leave and I'm sure it's not that way. The thing is if I go there I might get [a] different perspective.*

MD121/123: *They send us their perspective. Which is only fair ... I mean … they go. But, I mean, if I go, I will definitely maybe get a different view because for me, outside of [this school], I never knew this school existed, until I got here, until I was accepted. And a lot of people here think that we are the cream of the crop […] which, I'm afraid, not everyone else will think. So, I think it's different. It's different.*

MD125: *I think there might, I think there might be some stuff from the other schools. I just don't think it comes through.*

TL126: *Ja, ja. I'm sure there might be. I mean, the way we are like, for example, now struggling with the Grade 11s. I'm sure they are. And if maybe we … we were to share those problems … we were to share the solutions …*

MD127/129: *No one wants to admit that they're struggling, because it makes you seem weak. […] It makes you … it makes you look that [as though] you don't know what's going on when actually no one knows.*

Although they have no evidence of mutual sharing within the Cluster, both Magriet and Thabo suspect that it might occur. In sharing problems, solutions are more likely to be forthcoming and Magriet speculates that it may be a matter of pride, of not being able to admit to struggling that closes minds to possible solutions from others.

Arthur raises two significant influences that emanate from the educational research of Michael Shayer and David Hestenes. Shayer's CASE[4] methodology was introduced to the school by the previous principal and strongly influenced Arthur's thinking and practice. CASE was initially a voluntary strategy for teachers to employ, but it was found that not all teachers were incorporating its methods. By making CASE examinable, teachers were obliged to incorporate it:

[4] CASE = Cognitive Acceleration in Science Education. This programme is evaluated in: Adey, P. & M.Shayer (2006) Accelerating the development of formal thinking in middle and high school students in *Journal of Research in Science Teaching* 27(3) pp.267-285

AS75: *Ja, [the principal] brought CASE in first and then it sort of died out. I think there is a Michael Shayer influence through [the principal], and quite a strong one.*

AS57/59/61: *[A]ll [teachers are] supposed to be [teaching CASE]. We found that when we left it as an option … as a compulsory thing but not examinable … people were taking short cuts and leaving it out so we put it into the exams … [shrugs] […] Yes, but … [sighs] … its both [a methodology and a programme], but it does address specific skills, thinking skills. And so it addresses understanding of numeracy and […] probability and so on … or scientific methods or whatever. Everyone's quite comfortable with the scientific method ones and we've done those. But some of the harder ones towards the end of the CASE, people aren't very good at doing them, so we've pushed those in, in terms of [???] and … and then we examine those skills: [???], scaling up and scaling down, ratio etcetera.*

HJ63*: [laughs] It's very hard to say <u>now</u> … [what the impact is of CASE]*

AS66*: I think [the influence on student thinking is] more year-based. So one year's weak, another year's strong.*
HJ67: *But whether that's the influence of CASE … the influence of CASE … it's hard to say.*

AS68: *Another thing … I think CASE has been taught with various degrees of skill: another problem. So, it's too simplistic to say a straight cause and effect – unfortunately.*

AS77: *There's quite a bit of David Hestenes [???] and his modelling influence[5]. […] … modelling [???] modelling physics. His stuff is on the Intranet.*

AS80/83: *Do you remember that modelling motion stuff we did at the end of last year … with the ramp? […] That tried to be a condensed snap shot of some of his [Hestenes'] stuff, where, where … instead of saying "this is what a force is, this is what motion is" we give the boys a concrete experiment to do, but an open-ended one … "measure the motion". Or, "consider this, consider what could happen" and they then design the experimentation, do the experiment, wrap it up and … and defend their work.*

AS87: *We've had quite a bit … a little bit of work with [another school].*

[5] See, for example, D. Hestenes (1987) Toward a Modeling Theory of Physics Instruction, *Am. J. Phys.* 55, 440-454.

> ***HJ88:*** *[Another school], ja. Some guidelines in terms of how they are going to assess their work, which helped us a lot in getting the assessment standards right. How do you report results? How do you set a paper in terms of making sure that you are assessing each outcome? So there's that. But in terms of content there's not much.*

Arthur has not formally determined the effects of the introduction of CASE, but it is apparent that there is inequitable and inconsistent delivery. The CASE example raises the question of how new methods are introduced and the amount of training time required for teachers to familiarise themselves with the materials and the methodologies to be comfortable enough to make the required changes to their practice. Clearly, current time allocation and processes are insufficient.

Arthur explains that Hestenes' influence included an example on which we had collaborated in filming students' experiments, the only example of creating with multi-media mentioned. This investigative example confirms Arthur's earlier reference (AS9/11 Ch. 4 Section 4.5.2.2, p.167) to his change to more student-centred learning.

In response to the question of external influences, Magriet gives an instant unequivocal *'no',* whilst TL ponders the question long and hard. Thereafter Magriet qualifies her response, and provides a reason:

> ***MD96:*** *No.*
>
> ***TL99:*** *Hmmm … [long pause]*
>
> ***MD100:*** *No … I'm so caught up here. I don't think I get out that much.*
>
> ***TL101****: I … I've been … like, for example, I've applied for this position. Now, […] they need me to write a report on some exam which is available, so I have actually started to learn … and to try to … how to write a report on an exam and stuff like that and I can see that that is helping me, not only for me to probably do the best in that report, but also here at school. I see it in different ways. Also, it will help now when we are setting the exams, for example. I can see how the boys will actually interpret the*

question, how will they answer it, so try to accommodate them as well. So, it has actually helped me a lot. And, I think, that [???] at least it has helped.

In contrast to Magriet, Thabo has been exposed to two significant external opportunities which have influenced his thinking. Firstly, he has had interaction with the IEB which, besides the intended outcome, had a significant influence on his understanding and view of the assessment process and student responses: a professional learning opportunity in two different senses. Secondly, he had exposure to postgraduate studies. However, although Thabo provided the university with requested information regarding CASE, he was disappointed that dialogue did not continue and that reciprocal information was not forthcoming. His experience echoes that of Henry (HN41b Ch. 4 Section 4.5.3, p.177) regarding the disparities between *'university professors and industry people'* and the thinking of practicing teachers:

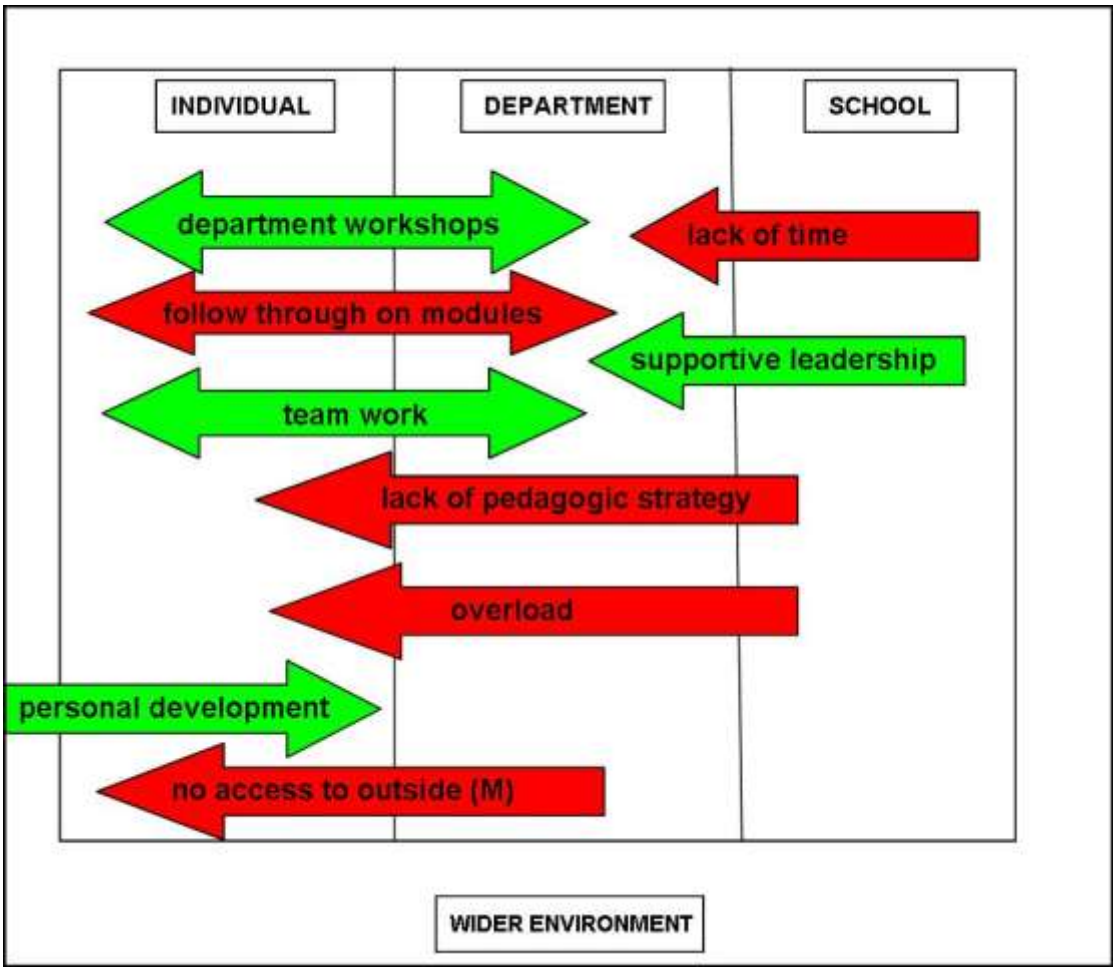
TL132/134/136: *Actually, I had some ideas when I was doing my M.Sc. […] I turned in an assignment about CASE … how, how we do it here at school and stuff like that, and how I do it and how I see it as a sort of a tool […] to make learner's think and stuff like that … and after marking the assignment – it was for marks, of course – but they then wrote to me, separately, that I should actually tell them more and give them more information about CASE and where I got my sources. They can see …Apparently they tried to look and they couldn't find and so I tried to look and give them more information […] but I mean now, I did not like get some others one's, you know, back. Like, they could have said "Oh … there is this other one and this other one which other students, you know, brought about", but that didn't happen. So it was sort of a … a one way process. […] I gave them information and nothing happened to me. I didn't get any other information, you know. So that's, that's what happened. Ja.*

5.4.2.5 Summary and preliminary conclusions: Arthur, Hennie, Thabo and Magriet

The patterns of factors that affect mutuality between the two pairs of teachers are illustrated in Figure 5.1 (Magriet and Thabo) and Figure 5.2 (Arthur and Hennie).

Development of modular units was adopted in the science departments because it was perceived to ease the workload of the teachers. The experiences of these four teachers in developing their modules and teaching those designed by others provide varied perspectives on the difference between assigning work to teams and achieving a purpose through collaboration within a community of practice. Unless true collaboration is applied to achieving a specific pedagogic goal then, while the mechanics of the process occurs, the ultimate goal remains unattained.

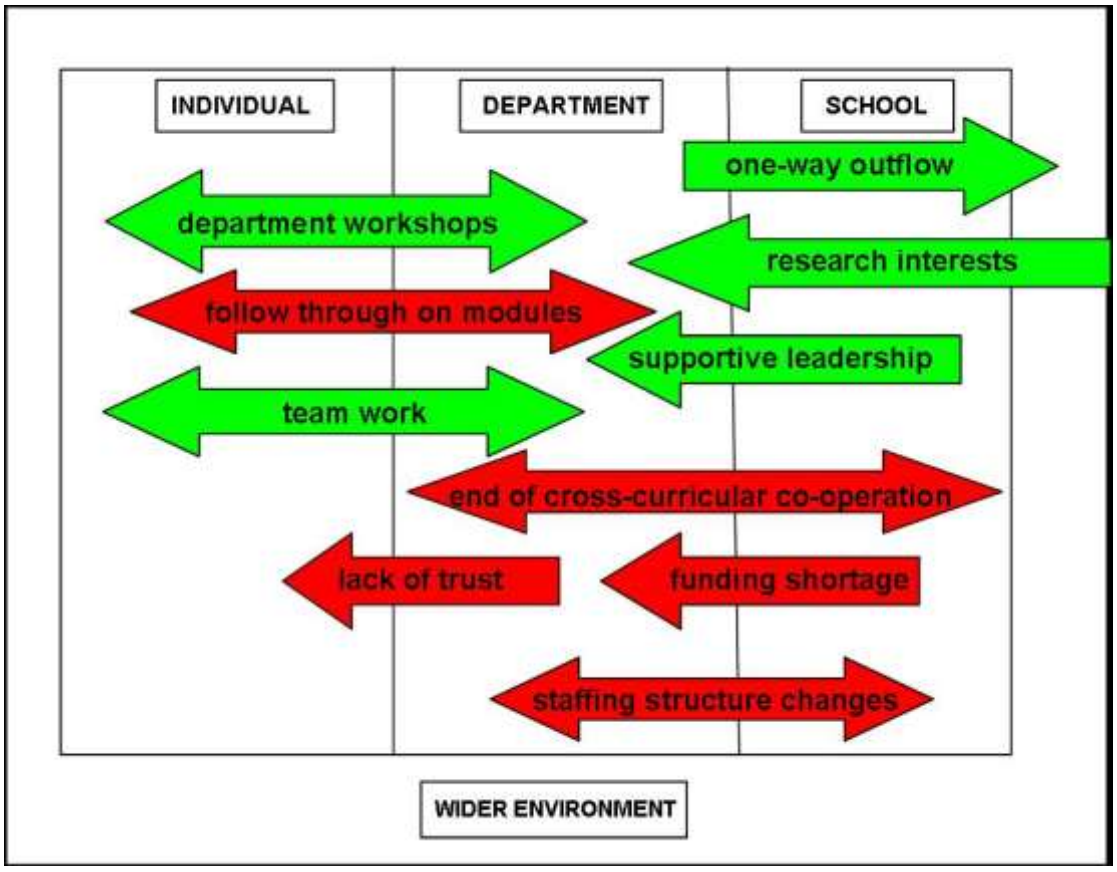
Figure 5.1: Collegial & professional interactions: Magriet & Thabo



Face-to-face encouragement from leadership is lacking but is attributed to the huge workload and the multiple changes of heads and deputies over the immediately preceding period. The leadership places professional trust in the HODs which, in turn, is passed on to teachers. The intermediary role the

leadership has played in deflecting some of the blows of conflicting curriculum changes is acknowledged. However, in Arthur's opinion, the biggest challenge for the leadership is to provide teachers with the time they need to meet their own as well as the school's expectations. Also, whilst many resources are provided, the reality is that the resources are still insufficient to meet expectations of what the teachers are encouraged to achieve. Whilst access to resources is an enabler, given what the leadership expects of the teachers, such access to resources still remains a constraint.

Figure 5.3: Collegial & professional interactions: Arthur & Hennie



Magriet is grateful for the opportunity of attending a personal development course and acknowledges the positive influence it has had on her classroom practice and the role of the leadership in this respect. Nevertheless, in many contributions that she makes in the interview there is an indication of her sense of frustration in her body language (such as sighing) and her words. Thabo emphasises that the initiative needs to come from within in order to

obtain support for professional development i.e. he advocates a bottom-up approach.

From observation, the fact that teachers are expected to attend personal development courses usually held over a combination of weekdays and weekends is pertinent. Attendance at such courses increases the workload for colleagues who need to cover classes left without a teacher as well as diminishing time on the core business of preparation and teaching. Teachers are short of time to develop their curriculum, but are unable to build in that time. There is thus an imbalance between sanctioned personal development time and desired professional learning and planning time. However, time had been taken out of the teaching schedule for the original development of the modules, the only reference to such time given by any of the teachers.

The introduction of CASE methodology across the department was less successful and to ensure equitable implementation, the HODs had to make it examinable. It would appear that teachers in this department remain more focused on content, rather than the cognitive skills that CASE supports. While the process of familiarisation with the CASE materials was not explained, it needs to be questioned why such methodology was not embraced voluntarily by all the teachers and secondly, if there were reservations, why a full evaluation of the innovation did not occur. Lack of thorough preparation and evaluation may lead to the demise of an innovation rather than a problem with the innovation itself.

Collaboration with the partner school has disintegrated. Whilst its demise is attributed to personality clashes, the role of school leadership in this matter should be questioned. Is the school leadership aware of the problem and what means does it have to facilitate resolution of problems in professional relationships? The fact that the situation has deteriorated at the same time as the school has endeavoured to heighten the benefits of partnership would appear to place responsibility with the school leadership. The situation does

not augur well for collaborative practice, yet provides evidence of how overload might inhibit such practices. Whilst there is opportunity for collaboration and physical network connectivity and capacity, such collaboration has not been encouraged.

External influences on the Physical Science teachers are limited and recalled with hesitation. Those that have occurred are significant although implementation difficulties are ongoing. In contrast, the outward flow of influence is deemed to be much greater.

5.4.3 Working together: the case of Henry

[For ethical reasons, as mentioned in Chapter 3 (Section 3.6., p.134), the findings on this section of Henry's case are confined to a limited access Appendix.]

5.4.4 Working together: the case of Richard

Richard works in a mutually beneficial relationship with his departmental colleague and is significantly influenced by his professional relationships beyond the school, although he has some reservations about his relationship with the leadership.

5.4.4.1 Intra-departmental relationships

The communication benefits are immediately evident in a two-person department. Richard describes how he introduced team-teaching, how his team-work with his colleague developed out of the nature of the subject and why the professional relationship has been able to grow to the benefit of all. In answer to the question of how he works together with his colleagues Richard responds in detail:

> ***RL24/26**: Ja, definitely, team teaching I suppose one would call it. […] that's been essential. And prior to … to that I didn't really do any team teaching as such. So you can say the last six years, probably the last five years because in the first year we didn't. So it's over the last five years, ja, we've been team teaching.*
>
> ***RL28a:** Well, basically, I think in Art, because you're not lecturing or … um … chalk and talk kind of teaching … and also because, particularly in a practical, because it's not content driven … um … then one's able to bring in other methods. So, it allows you the freedom to do that. And fortunately […] Alena's quite self-motivated, motivated. As a person, I mean she's part-time, but she's here all the time. So she wants to be involved. It's got to come from the person. It wasn't like an instruction. […]*
>
> ***RL28b:** Its quite interesting … today … Megan came in and I was doing some work for her and she was just watching what was going on and she said "Does Alena say the same things as I say to them? Because they ask advice from both of us." And I was explaining to her "yes, 'cause she's now learnt. She's well trained. She's also got a very sensitive eye. She's got the same … and its … people think Art is just pure subjectivity. In one sense it is, but a lot of it is objective and you can make it more objective and I think that's where I have trained Alena to be objective. And particularly if one knows the standard, like this is secondary education, what is expected, this is what the outcomes are. Here's the outcomes, now follow it. That's*

where we're going. We're not trying to go anywhere else. Um … and so, she says normally exactly what I say and we don't even have to pre-prep answers to questions.

RL30: *Ja we both … I think it comes from training as I've basically been very open with her. I've always said to her "Say what you feel, but for the first year come around with me and see what I'm saying". Ok, so she's seen what I've said and what I think and how I think and then she will then come along and, as I've said, they can now ask her what she thinks and she'll say exactly the same. […].*

In Richard's case, the nature of the subject, personal motivation, the nature of boys and the desire to teach to the individual are factors that allow experimentation with different ideas and methods. All of these factors have converged to allow optimum support for each individual student according to their needs. Megan's informal, unannounced visit to the classroom leads to an interaction and observation by a colleague from a different department that provides rare feedback. Richard details how the way in which he and Alena have built their team-teaching approach has aligned their thinking. A common understanding of the required outcomes as well as empathy for the creative process underlie this approach to their students' practical work and mutual benefits accrue to the teachers and students alike.

5.4.4.2 Relationship with the school leadership

Richard insists that it is important to be able to describe the history of his relationships with school leadership in order to contextualise his current relationship. Support from the leadership has always existed, but for different reasons. Serving under different principals in different schools, Richard has found that the leadership's acceptance of Art has oscillated between extremes from its marketing potential to its intrinsic worth. Rather than a personal or professional relationship, in the case of Art it is the principal's personal belief that is identified as a factor having a significant effect on the Art teacher's creative leeway. With each change of leadership, the teacher needs to adapt to the change in appreciation for the subject i.e. the principal's beliefs affect the subject, much like they do with ICTs (Breuleux 2002 p.10; Otto & Albion

2002, p.3; Staples et al 2005, p.301; Sharma 2005 p.53). Richard explains the principal's influence in this way:

> ***RL41/43/47:*** *Well, I'm just trying to give you the background, because you need to understand like how one thinks … in the context. The first management style I didn't really notice it, I missed it. The second one … um … the manager, the main management was based on accountancy and stuff. And … he approached me and said he knows nothing about Art … um … and therefore just go for it which is quite nice in one way but you didn't really feel … um … appreciated. You sort of felt this now is really good and basically the person trusts you to do whatever you're going to do. But he didn't really see any benefit in it really. But the nice thing was it was quite open. It was like "I don't understand this, but, you know, it's like Greek to me, basically, but obviously something's happening". And I think that over the years he eventually saw some …what do you call it … a sort of way of selling the school through […] [m]arketing … he saw some marketing potential eventually actually and that's what he liked. And, so that was quite nice. And then, when I came here, it was really nice that the management people seemed to relate to Art and understand it and be excited about it. There was a like "this is beneficial not only because it's a subject that we're going to offer in the school, but because like it actually contributes and it has something to offer people and its significant to life and the world" and management had … a … sort of … ja, much deeper appreciation and you felt more appreciated therefore in a way. So I found that quite exciting. But now there's been another change again, so now obviously … now I think there's not that big depth so I think I'm almost now between the first place and the second place. […] <u>But</u> … so my perception could be slightly wrong as well, because there hasn't been much change really … between the two management styles. I mean the two just changed over fairly smoothly. […]*

5.4.4.3 Relationships beyond the school

In response to the question of external influences on his innovation processes Richard explains how his own creative involvement is a much greater source of inspiration than other schools. Even though he runs his Cluster Group, it is not beneficial. Richard explains these different involvements:

> ***RL50:*** *Ja, basically as I was saying right … start in terms of no, just working in art and making art continually. That's basically where I get inspiration from … um that's basically what drives my changes, so anything I do I try and feed it into the*

classroom. So you know because I … even while I've been teaching I've been doing quite a few other jobs for other people which I find interesting and I think beneficial to teaching. […] So obviously I do that and then I'm learning. I've got to sit down and I've got to learn. Because often I'm dealing with stuff that I haven't tackled. With my fine art background … it's now like I'm dealing with something that I've ignored say like animations in computer art which is something I've limited in my fine art. I've rarely used it. So I've taken on those sort of jobs and I've fed them into my fine art and I've fed them into my teaching because … I try and see what's the value of it first. Is there a value in it? And I think those are the kind of jobs I could take on and think "This would have a value that I could feed into teaching". […]

***RL52**: Ja, I suppose I haven't really had much influence from other schools. But I think that's my own choice. I also find … I haven't found really other teachers are that helpful [chuckles]. I run also … our Cluster Group and I don't find it helpful at all. The teachers take from me, but I never get anything back. That's how I feel.*

***RL54:** Well I mean with the artists I think it's … its sort of much … everybody's a little bit too busy, I find. Um … obviously … ja, the ideas I share are with the artists, people who I have around and I talk to but not always, not frequently. It's not formal. I'd say its informal exchanges.*

Most importantly, mutual benefit derives to Richards' students. From his description, it is clearly evident that he is comfortable with encouraging complex cognitive challenges with his students, although there is a twist to his logic at the end in that he has not achieved his ambition with computer art (RL77 Ch.6, Section 6.4.4.1, p.322):

***RL65a:** Basically, what I find is what I'm excited about is what a group of students will get excited about. So if I decide this … like next year now … I suddenly decide I'm really excited about sculpture and I go out and I don't know at this point if any of them need sculpture or if that'll extend them but I can bet that by the end of the year there will be whole bunch of them doing it and have chosen to and be learning and being extended [laughs]. You see, so sometimes I … if I push something I think I can persuade the students to like that, but not in every case. Like for example, I have been pushing computer art because of the value, I think, as a thinking tool and [that] has been used as a tool at the moment, but might not last for very long with all the*

power shortages[6] *[laughs], the lack of power in the world. But I think it's a way of thinking and it's a way I can extend them and it's a complex way of thinking. You've got to think in a whole different way. There, I know my statistics are quite poor in a way, but if I get two or three just to take up that tool as a way of communication and as a way of thinking and a process of being creative, then I'm lucky. And there I'm pushing it, but it's not working. Whereas I said to you just now that I could take something and I'd get something out of it … doing sculpture with a passion.*

The issue of computer art is discussed further in Ch.6 Section 6.4.4.1., p.322.

5.4.4.4 Summary and preliminary findings: Richard

The pattern of factors that affect mutuality in the case of Richard is illustrated in Figure 5.6. Innovation and innovative thinking are inherent in practical art: it is not inhibited by content and, on the contrary, focuses on creativity. The product of the creative process is conceived as a public work inviting dialogue.

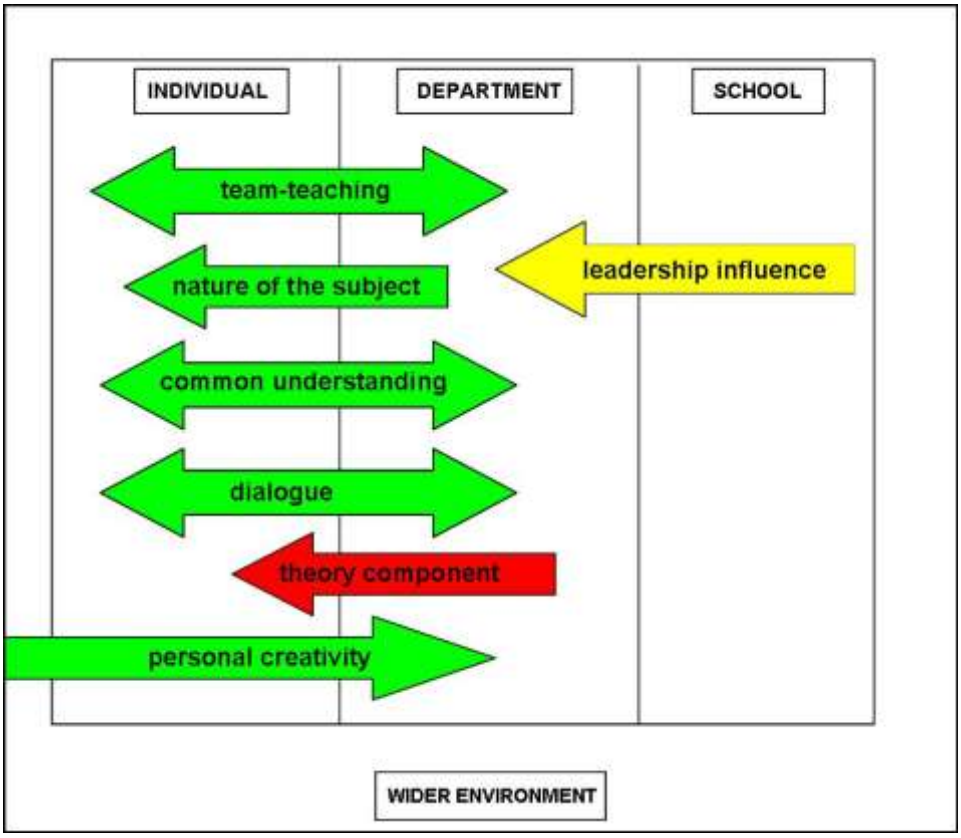
Dialogue is essential to the creative process: dialogue between the co-teachers as well as their dialogue with the students. In order for team-teachers to be objective, mutual understanding has to be in place prior to their interaction with a student. What appears to be an instinctive chemistry is actually a carefully orchestrated relationship built around supporting the creative process. Good communication and complete trust ensue. The question arises to what extent students that are not exposed to a creative subject are exposed to such critical thinking processes.

The outside influences that Richard brings to his teaching are those from his own experience and professional learning beyond the classroom as a practicing artist with mutual benefit to both his art and his teaching practice. Richard takes on outside jobs specifically for the opportunity they provide to enhance his teaching. He deliberately sources innovative ideas from outside, masters different techniques and then applies what is appropriate in the classroom. Similar to Arthur and Henry, Richard feels that the Cluster is of

[6] This interview was conducted at a time when South Africa was suffering extreme disruptive power shortages nationally.

little benefit even though he runs it himself: his is a one way process of outward influence. The Cluster Group thus emerges as an obligatory waste of time. However, Richard does have informal contact with other practicing artists with whom he shares ideas to mutual benefit. The effect of the principal's attitude towards Art is neutral and is therefore indicated in the figure by a yellow arrow.

Figure 5.6: Collegial & professional interactions: Richard



5.4.5 Working together: the case of Maria

In Maria's case, the nature of her subject and systemic factors result in an intertwining of intra-departmental and leadership relationships. She is also reliant on relationships beyond the school.

5.4.5.1 Intra-departmental and leadership relationships

Given the immensity of the task that Maria faces in implementing her new subject across the whole school, delivery of the LO curriculum poses particular challenges for her. The school found itself in a dilemma. Although

the extra learning area was mandated nationally as a compulsory subject across all grades, it was the school's responsibility to find a logistical solution, adapting both schedules and teaching resources to comply with requirements. Additionally, Physical Education was incorporated as part of LO and needed to be assessed similarly to content subjects, whereas it was previously considered part of the outdoor sports programme. Maria thus had two colleagues seconded in from the sports staff who now assist in teaching the LO theory side in grades 8 and 9. To accommodate LO without dropping other optional subjects, every teacher has had to take on responsibility for at least one LO class in Grades 10-12 (see Ch.4 Section 4.5.5, p.195). Maria describes the learning curve that all have experienced:

> ***MW84:*** *At the Grade 8 and 9 level, my two colleagues have, I think … I want to say they've grown as well. I don't think they want to take the responsibility because they … but if I ask them to do something, they do it. It might sometimes be a bit late or whatever, but I think they've also grown to a certain extent and I … but they're very willing, they're very willing and I'm quite happy. I know we've still got a way to go, but we're making progress. At the Grade 10 and 11 level it's been … I don't know what the right word is, I … because now I'm asking all the staff to … to help me with Life Orientation. And some of the people have been absolutely phenomenal and they're working hard and they're meeting deadlines etcetera, etcetera and some obviously, you know … we're all doing I think, too much; we're all stretched to the limit most of the time … and they just can't.*
>
> ***MW86:*** *So, I think I've had the whole range from very good to [chuckle] … not so very good. But, I understand. We dropped this on them … I think … although [the principal] said from the beginning that every teacher is an LO teacher, it was still an additional thing that we asked of them. So I understand that as well. I do understand that. But it's been an interesting year so far, I must say. But, you know, everybody … and I must … everybody tries … some maybe more than others but in the end, and that I can say that with an open heart, everybody tries to.*
>
> ***MW88:*** *Well, [I communicate] by email. That's the only way, because it involves, literally, every staff member so it's done by email or in the staff briefing on a Monday.*
>
> ***MW95:*** *They have really been phenomenal. Really. Ja. You know, when I approached [the deputy principal] with this … because to me it was quite a <u>shock</u>*

> *when I realised that we need to have certain things in place and we met with [the principal] and [his] reaction was then "we must get it in place immediately". And that's why I got the Wednesday Chapel Service time. I think that was a huge sacrifice on the school's part, you know. So their support has been absolutely fantastic, ja.*

In the case of LO, the whole school from the principal downwards has been involved in trying to find a solution to the challenges that the new subject brought. Essentially therefore, the whole teaching staff comprises the LO department. As HOD, Maria recognises that each teacher is stretched to the limit most of the time with each having to play multiple roles. Some have the capacity to cope with the demands of LO while others simply do not, although Maria insists that everyone is trying their best to cope with the extra load.

Communication in this disparate department is a particular challenge. Apart from one special general staff meeting when the logistics of LO delivery was explained to all teachers, the complexity of the timetable provides no opportunity to hold a department meeting. Maria therefore uses different methods to communicate with her Grade 8/9 and Grade 10/11/12 teams of teachers. In Grade 8/9 she relies on good relationships with her two colleagues to implement the curriculum requirements according to her instructions. Other than that, the only face-to-face opportunity for teachers to communicate is during the staff briefing, a thirty minute public notice session during tea-break on a Monday that covers every aspect of day-to-day management of the entire school for the forthcoming week. There is no opportunity whatsoever for LO teachers to meet, discuss or workshop ideas and approaches to either the curriculum materials and resources or classroom strategies. The fact that each teacher has access to email is a critical benefit in communicating information in the latter case. Although the ICT capacity at the school goes well beyond email, it appears that no other ICT opportunities have been explored to enhance asynchronous communication or collaboration in this disparate department. New problems are addressed from a traditional point of view although the potential exists to deliver in innovative ways i.e.

there is convergence of opportunity and technology, but it is not implemented as a management solution and potential mutual benefits are inhibited[7].

5.4.5.2 Relationships beyond the school

In her situation Maria is totally reliant on the goodwill of others, having drawn benefit from the User Group conference as well as the Cluster Group. She also inherited materials from a colleague that have been used as an important resource:

> ***MW97/99/105:*** *But, she bought those files before she was Grade 8 and 9 Director. I don't know why she bought them … I think she bought them … she […] I don't know … she came across it … I honestly don't know why she bought them, but that was … that saved my life, it did. And I must also mention, you know, Rowena [in the partner school]. She's so clued with the Life Orientation, she really is. […] She's also been quite helpful. […] She's been doing this for many, many years … since she arrived in South Africa she's been doing Life Orientation or whatever it was called then … Life Skills or whatever. I think there's a whole wealth of information.*
>
> *****
>
> ***MW111:*** *They don't. You subscribe to [Teen Active] on an annual basis. They get people to write articles on health, on career, on keeping fit etcetera, so it's quite an interesting website. So that's one [resource].*
>
> .

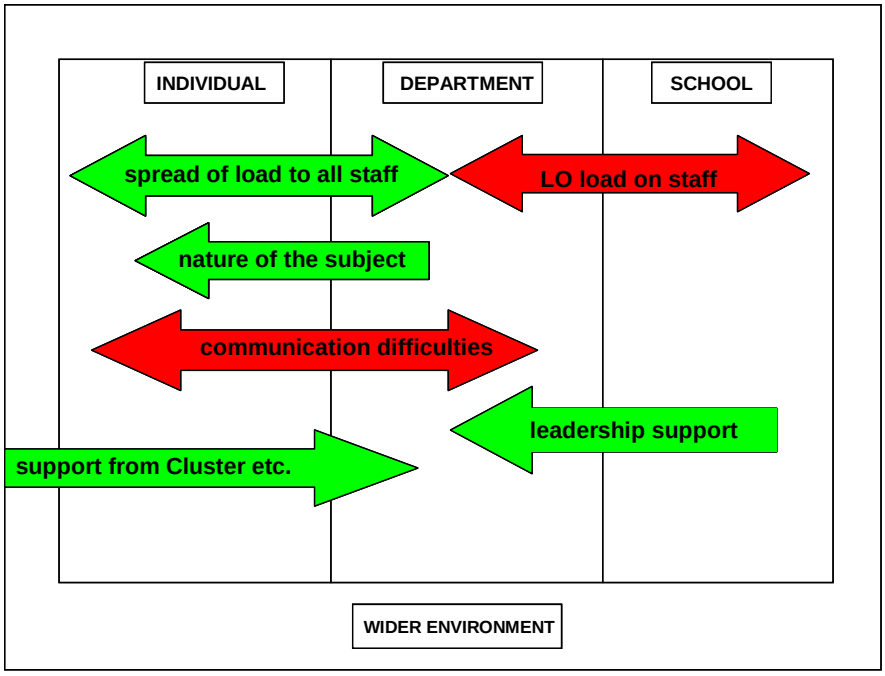
Maria openly reveals her vulnerability and reliance on the ideas of others. She has already mentioned the influence of individuals in the school and how reliant she has been on their ideas. Availability of resources is also critical. The school subscribes to the *Teen-Active* website which students can use interactively and from which she receives communications by email. However, it is non-contributory site in that it does not provide a forum for LO teachers to communicate with each other.

[7] As at Feb 2009 the first module of the LO curriculum has been added to Moodle, the school's learning management system that is being implemented. However, the module has been added as a website resource developed by Grade 11 IT learners rather than as a result of collaborative planning by teachers, albeit collaborative refinement may ensue.

5.4.5.3 Summary and preliminary findings: Maria

The pattern of factors that effect mutuality in the case of Maria is illustrated in Figure 5.7:

Figure 5.7: Collegial & professional interactions: Maria



Maria meets the challenge of delivery of the LO curriculum with remarkable fortitude despite her disparate team and their lack of any training. She acknowledges the full support of the school leadership in finding and facilitating a solution, but nevertheless, has to contend with variations in delivery due to the general teacher overload. On a more personal level, she feels vulnerable due to her lack of experience, but overcomes this through networking with individuals, relying on colleagues in her Cluster Group and depending on access to both printed and online resources. Online and email access is critical to her ability to function.

5.4.6 Working together: the case of Francois

Francois, like Richard, also works in a mutually beneficial relationship with his departmental colleague and, like Maria, is dependent on the school leadership and his professional relationships beyond the school.

5.4.6.1 Intra-departmental relationships

The new circumstances that Francois faces have been explained (Ch.4, Section 4.5.6, p.201). He openly acknowledges personal shortcomings arising from these circumstances, but is also limited by the small size of his department. Francois and his colleague share the load, each taking responsibility for different grades and he is reliant on his colleague's expertise:

> ***FP33:*** *[chuckles] With Patrick coming in and I mean … he's picked up Grade 10 and 11 which is great. So, I mean he's got a wealth of knowledge. He's taught the subject for so long and [has] so much experience, so that's helped a lot so I'm not on my own trying to fight fires and you know, put things out … you know, try and put all the tests together myself and all of that stuff. So that … that helps. Um … but it is difficult being such a small department and also, I must be honest, my teaching experience as far as Accounting is also very limited.*

In his new situation, Francois feels vulnerable without a mentor familiar with the IEB system who can help him, as Patrick is also new to the system. Francois meets regularly and informally with his colleague to discuss practical matters, but they have no time to discuss or develop classroom strategies. Francois' time is limited by his workload and his colleague's time by his leadership duties. Instead he is totally reliant on the partner school and the Cluster Group for such support.

> ***FP37:*** *I was teaching EMS[8]. And I'm … I was teaching prep school. So, the whole high school is very new to me. So, it's … it's been a huge challenge to get on top of things. There's no doubt that I prefer this to where I was before. But it is difficult with a new subject, changing syllabus … um … that there's no sort of … somebody in the system that's done it for so many years and has an understanding and can say, "Look, forget about that, let's do it this way" … or, you know, knows the ins and outs. As much as I am trying to find out [???] what works, what doesn't work what are "they" requiring from us now … namely the IEB … what they're not and that sort of thing. So it's been very difficult trying to sort of get your head around certain things and keep on top of it.*

[8] EMS = Economic and Management Sciences

5.4.6.2 Relationship with the school leadership

Ultimately, Francois is overwhelmed by the unconditional collegial and professional support that he has received. His openly expressed self-doubt is answered with encouragement and affirmation:

> ***FP57/59:*** *My experience here has been … fantastic is putting it mildly. You know, I've been dumbfounded by how supportive and helpful people are. So that's been very encouraging. Um … you know I've often had conversations with [the deputy head]. I say "Look, you know, I have no idea what they want or this is happening. Can't you find someone else to … HODs for example … [laughter] who knows what they're doing? That would just help you know … take a bit of pressure off the system". And he says he's not interested in … in taking ... in doing that … um … because he thinks I'm doing fine etcetera, etcetera and I'm representing my subject and looking out for the best interests for it etcetera, etcetera which is fine. So I must say he's been very supportive as far as any requirements for the IEB etcetera. If I don't understand I bounce it off of him and he's been very accommodating as far as that's concerned. […] So that … that helps a lot. And ach, in general, I mean, not just academically, in general the management have been unbelievably supportive. Fantastic … so I can't complain at all … at all.*

5.4.6.3 Relationships beyond the school

Francois benefits from extensiveness on the part of a colleague from a partner school and those from the cluster, but it is an incoming rather than an outgoing influence. The Cluster Group provides a critical need for Francois and is therefore highly valued by him. Email is the medium that facilitates such communication. Whereas most teachers (HN56b; TL113; AS/HJ96; RL52; BK291) who refer to cluster groups mention mono-directional outward influences, Francois, like Maria, acknowledges his dependence on inward influences from his group, which he hopes to be able to reciprocate in the future.

> ***FP39:*** *We have … we have a meeting sort of once every two weeks where we see where we are, what assessments we want to do. Um … that sort of thing … touch base. More than that we pretty much chat once a week, twice a week informally.*

"How's it going? Have you done this? Where are you with this? Have you covered this? This seems to be a problem" and that sort of thing.

FP49b: *[…] I do communicate with one of the others … one of the teachers in the [partner school]. And then with our Cluster Group. The lady who heads that up is very helpful and I often bounce things off her and send her emails and that sort of thing.*

FP51: *Well, the Cluster Group is, you know, basically, you know we … we chat about the syllabus … where we're going, work load, you know exams and all of that. Um … but also, I … you know I must say, I've been very fortunate where … the people in the cluster have been very accommodating. As I say, I've made it very apparent to them I'm new to the IEB system so I'm totally naïve as to their requirements etcetera, etcetera so they basically hold my hand and help me through it.*

FP53: *[The Cluster Group is] [a]n email away … pretty much so. So they've all sort of said, you know, I … take project pieces for portfolios. I send them an email saying "Look, do you have any recommendations. Do you have a good project I can use?" Two days later I get a response with the project. Bang … that's what I use … with their memos etcetera, etcetera. So that's helped a lot. So you get an idea of what … they've done it for the last so many years. They know what the guidelines are etcetera. So they've been very helpful as far as that's concerned. So that's been fantastic.*

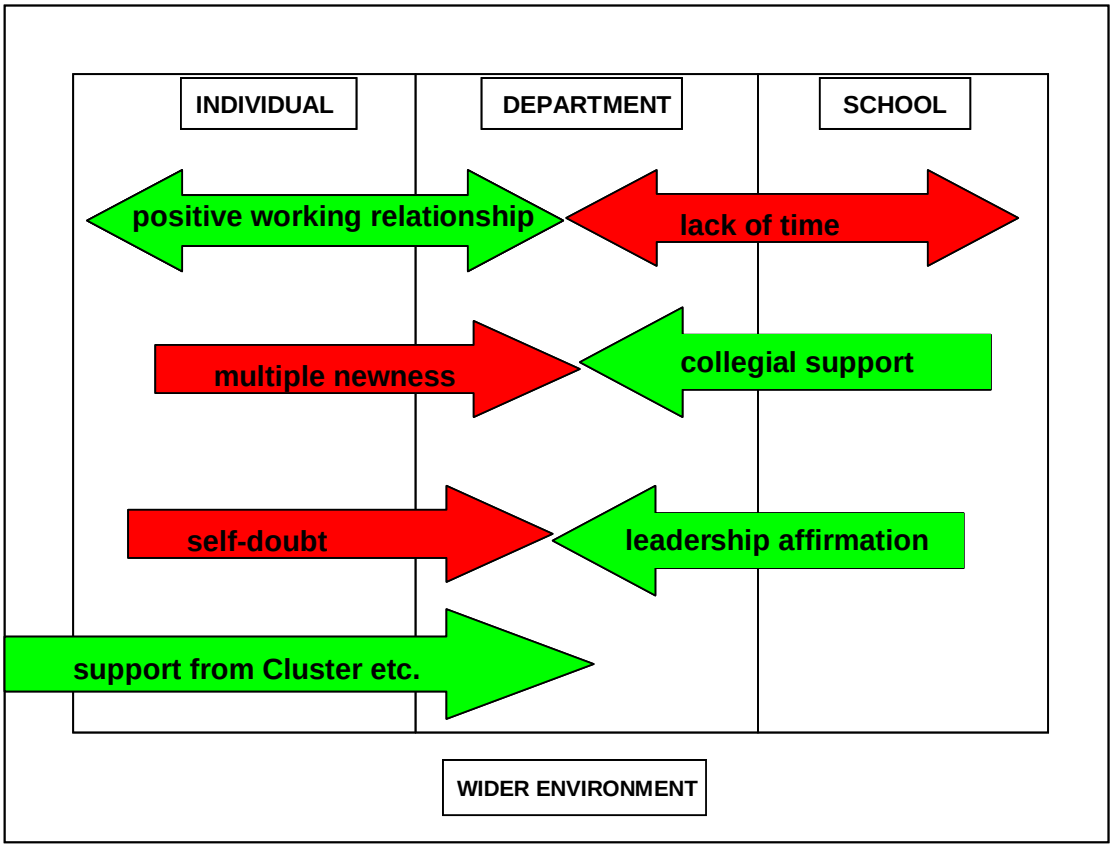
FP55: *Absolutely. Yes. You know, obviously it's a give-and-take situation so, you know, once … you know next year'll be our first official Matric group. So, I think, once that group's through then, I think, I'll be in a position where I can say to them, "Well, here's my suggestions. This is what I've done". Now that I've sort of got the run of the mill … got the syllabus sort of, I won't say totally covered, but I've covered some of it. But I have an understanding of what their expectations are … workload, content etcetera.*

Beyond education circles, Francois also has friends that he can draw on for ideas, and is conscious of the opportunities in the wider environment. However, although he has the creative ideas and the motivation, he is constrained by time. It is the syllabus that he would like to enhance through his creative ideas that is itself the constraint that prevents him implementing the ideas:

FP62/64: *Um …I'd like to get to [other partnerships], but again time constraints … it's just … it's a little difficult. Um … ideally … you know, I … I have two or three friends that are … are CA[9]s. So the idea is to get them more involved in … maybe coming and doing a section, telling the boys. So I'm quite keen to do that. It's just that I haven't got around to that because, as I said to you, the syllabus is just so … and to find time to do that. It's just the same as incorporating the computer software programme. There just hasn't been time to … to bring that in. So its just … eventually, I think we'll get to that where I'd like to say "Let's go on an Accounting outing and go to Ernest and Young or Price Waterhouse and go and have a look and see what accountants do all day … what their involvement is". […] You see we're lucky. I mean, there's … there's massive firms literally just in Sandton, just down the road that you can go and accommodate.*

5.4.6.4 Summary and preliminary findings: Francois

Figure 5.8: Collegial & professional interactions: Francois



[9] CA = Chartered Accountant

The pattern of factors that effect mutuality in the case of Francois is illustrated in Figure 5.8. Under his particular circumstances, Francois openly concedes his vulnerability and reliance on the support of others and gratefully accepts any advice or help that he can source. He receives unconditional support and affirmation from the school leadership, but ideally would prefer to work more closely with a mentor. Francois would also like to collaborate with his more experienced colleague on developing their classroom practice, to mutual benefit, but lack of time limits their co-operation to the administrative aspects of teaching. Instead, Francois relies on support from the Cluster Group, facilitated by access to email. The benefit is mono-directional at this stage, but he hopes to reciprocate when circumstances permit. Lack of time inhibits the realisation of his creative ideas.

5.4.7 Preliminary findings: collegial and professional interactions and their effect on teachers' practice

Collegial and professional interactions at Wilding College are mostly supportive and congenial as conveyed through both the words and the interactions of the participating teachers. In the case of Bronwyn and Ineke they speak openly about their departmental relationships and the benefits they derive from their interactions. Similarly, Richard describes a carefully crafted professional relationship with his colleague, Alena. Maria and Francois are both in challenging new situations as a result of their new areas and new roles and are grateful for the support and affirmation they receive from within and beyond the school. Logistical problems and teacher overload mean that Maria does not always receive the required output from all teachers in her team. Her co-opted colleagues are willing to follow her lead. Francois has self-doubts about his ability to understand and meet the requirements of his new role, but is affirmed by supportive leadership.

The case of the Physical Science teachers demonstrates how different perspectives within one department can be. While there is agreement that the modular system has its faults, the reasons for it and the way in which the

HODs as opposed to the teachers view the problems differ considerably. The analysis indicates the difference between assigning work to teams and collaborative practice. Demands made on teachers to innovate in their practice are not met with the resources that are deemed to be required to meet expectations. Teacher's perspectives are often dependent on their ranking within the department and communications from external entities are subject to interpretation.

The lack of a like-minded colleague seriously inhibits Henry's ability to share his creative ideas in a way that ensures their full development and evaluation in practice. This case calls into question the means that are available to schools of managing discordant relationships and also of ensuring that the wider goals of the new curriculum are met. However, as his was a single interview, it is acknowledged that another point of view in this particular situation may well reveal a different reality.

Although the presence of ICTs enables national intra-school networking, such as through the Life Sciences teachers' network, Wilding's ICT infrastructure has not been used as a shared resource repository, nor has it been used for collaboration with the partner schools. There is no centralised web site containing the resource links nor has the Thutong Education website10 been exploited for such a purpose. Having a centralised resource would boost sustainability of the Life Sciences network and reduce the load of individual teachers in organising received links. Nevertheless, this network and the Physical Science blog are the only examples of electronic networking that were mentioned by any of the interviewees. It is ironic that the benefits of sharing are not capitalised on, probably due to the lack of time, whereas invoking the use of a shared site would save teachers time. In contrast, all teachers, in all departments have access to the centralised IEB website which provides exemplars of examination papers, regulations etc. However, no link

[10] The Thutong Portal is the South African National education portal at http://www.thutong.doe.gov.za/ designed for sharing resources. Wilding teachers have been invited to contribute to this portal.

is apparent between the benefits of this facility and the potential of the Life Sciences network.

Taken together with the evidence of lack of time and stress evident in the previous chapter (MD29: Ch.4 Section 4.5.2.1, p.165) it appears that although the modular planning system as used by the Physical Science teachers is designed to save time, this end is not being achieved, nor is the design of the modules being optimised. Due to time constraints, this process of design, development, refinement and eventual implementation of a module appears to be inadequate. Teachers' familiarise themselves with the content, but fail to grapple with the strategies for implementation until difficulties arise. With modular design, the eventual workload does not decrease due to the need for each teacher to familiarise themselves with each module. There is a time benefit to teachers in preparing the modules, but this benefit is countered by the time it takes to familiarise themselves with the materials and to develop their own implementation strategies. Certain sections of the curriculum are new so that even with someone else putting together the module and teachers' discipline knowledge intact, the teaching content is still unfamiliar. The load is only unmanageable in terms of time.

The development process for modules emerges as inadequate. Design for learning appears to be an ad hoc rather than a strategic process. Whereas instructional design relies on design systems such as ADDIE11 there appears to be a lack of similar systems in this school12. It is in taking ownership of a module for delivery in their own classroom that the challenges arise for the teachers as described above by Thabo and Magriet. There is no evidence of professional learning opportunities to deal with curriculum change other than the Assessors' course.

[11] The ADDIE model is a basis for instructional design: Analysis, Design, Development, Implementation, Evaluation http://www.learning-theories.com/addie-model.html

[12] The Intel format (http://www.intel.com/education/teach/) has been used in certain learning areas (e.g. in History and by Maria in LO), but the small number of teachers who completed the course, together with staff turnover has reduced its impact considerably.

Although Henry and his colleagues also spread the load by using a modular planning system, there seems to be even less effective collaboration than amongst the Physical Science teachers. Instead of mandated changes being implemented through collaborative planning and shared practice, divergent mindsets dominate and negatively influence the possibility of any mutual benefit other than for administrative tasks. The disconvergence is such that Henry has to con his colleagues into trying something new. Classroom innovation is left to the individual, but when mutual benefit is not realised, the development of any innovation is blocked. This example points to systemic faults with testing, negotiating, validating and agreement on innovative practices before implementation occurs.

There is no lack of facilities or resources in Henry's case, but the under-use of such facilities, provided at considerable cost, would appear to be a management problem. Either, the facilities were provided without appropriate justification or their provision was not accompanied by appropriate teacher development in using such facilities. The fact that one teacher makes use of and advocates use of the facilities whilst others ignore it, if this is indeed the case, justifies the presence of the facilities. If the facilities are not used with all classes, then equity of delivery is undermined. Without extension of the innovation across the department equity cannot be achieved.

Over a lifetime of teaching for any individual there will be many ideas and influences that come and go and Henry provides examples of this. However, little evidence emerges of trends that have led to the sustainability of the innovations and it needs to be asked why this should be so. It is common knowledge that little has changed in the grammar of schooling since the late 19th Century, but the lack of sustainability of Henry's creative ideas demonstrates the power of disconvergence and the persistence of traditional methods. It is not the purpose of this study to evaluate each innovation and the possibility of an innovation not withstanding a thorough evaluation cannot be discounted. However, as the school lacks defined innovative practice

implementation and evaluation processes, innovation implementation defaults to an ad hoc basis.

Henry's case raises the question of mediation in relationships between leadership and teachers when clashes interfere with both the teacher's ability to teach and the school's ability to determine direction. How should creativity be channelled and how is compliance maintained when neither collaborative approaches nor systemic evaluation of innovations are present?

In this department and for this individual teacher in particular, widely disparate factors impact his ability to sustain innovative practices and given the stage of his career, he has lost the will to persist.

The amalgamation of History and Geography into Social Science and its subsequent splitting illustrates the effect of mandated indecision on innovation. Teachers developed cross-curricular modules, only to have to pull them apart again and the loss of impetus on innovative methods led to their apparent demise. In the example provided by Henry (Section 5.7.1 p.240), the innovation itself was apparently successful, but its sustainability was countered by other factors. Pressure of timetables and curricula forced reversion to old practices. Curricular thinking had progressed, but was in conflict with organisational thinking in the management of change. Although Henry challenges fundamental norms in his department and in the IEB user group, traditional thinking counters his approach in both cases.

5.5 Summary of Chapter 5

This Chapter has described the collegial and professional relationships between teachers within their departments, between teachers and the leadership and relationships beyond their departments and the school. The mutual benefit derived from positive relationships as well as the inhibiting effects of poor relationships are described. Against the background of

contextual interactions provided by Chapters 4 and 5, the next Chapter will deal with teacher innovation and ICTs.

Contents

Chapter 6: Findings: ICT interactions and their effect on teachers' ability to innovate

6.1. Introduction 269
6.2. Innovation and ICTs 269
6.3. ICTs and innovation at Wilding College 271
6.4. ICTs and innovation: introduction to the cases 273
6.4.1. ICTs and innovation: the case of Bronwyn & Ineke 274
6.4.2. ICTs and innovation: the case of Arthur et al. 286
6.4.3. ICTs and innovation: the case of Henry 310
6.4.4. ICTs and innovation: the case of Richard 321
6.4.5. ICTs and innovation: the case of Maria 330
6.4.6. ICTs and innovation: the case of Francois 333
6.4.7. Preliminary findings: ICT integration and innovation 339
6.5. Summary of Chapter 6 342

Chapter 6

Findings: ICT interactions and their effect on teachers' ability to innovate

6.1 Introduction

The previous two chapters answered the questions of how organisational interactions and how collegial and professional interactions influence teachers' ability to innovate. Against the background provided in these two chapters, this chapter will explore how the presence of ICTs affects teachers' ability to innovate. The chapter will analyse and describe teacher responses to the following question:

> *How do ICTs influence teachers' ability to innovate and to sustain innovation in practice?*

6.2 Innovation and ICTs

The literature review has shown the complex connectedness of interactions between ICTs and innovation. For teachers to be able to innovate with ICTs requires a focus on curricular goals, compatibility with assessment, teacher collaboration, and ongoing pedagogical and technical support. The provision of ICTs alone will not ensure that pedagogic innovation occurs if implementation is confined to adaptation of traditional teaching methods (Cuban 2001 p.134; Peck, Cuban & Kirkpatrick 2002, p.51) or because the ICTs are confined to inaccessible laboratories (Cuban 2001 p.163; Means *et al.* 1993, Ch.VIa para.2; Peck, Cuban & Kirkpatrick 2002, p.59). Time constraints, workload factors and competing educational priorities limit teachers' ability to innovate and need to be addressed (Peck, Cuban & Kirkpatrick 2002, p.53). Financial resources need to

be balanced between the provision of ICTs and technical support on the one hand and pedagogical support on the other (Anderson & Becker 2001, p.3).

A common problem is that the ICTs in themselves are seen as the innovation i.e. they are seen as a product innovation. The innovation needs to be the process innovation that comes with their use, i.e. they need to be perceived for their innovative potential. While teachers believe in the transformational potential of ICTs, their beliefs are tempered by caution arising from their need to focus on enhancing the learning process and support student understanding (Hennessy *et al. 2005*, p.181; Baggott la Velle *et al.* 2003, p.187; Rodrigo 2003, p.120). ICTs need to become an element of the curriculum (Huffman & Rickman 2004, p.282) and the innovation needs to take place in the pedagogical practice. However, as argued by Beetham and Sharpe (2007, p.2-3), the notion of pedagogy itself needs to be reconsidered in order to link technology and transformation.

Innovative pedagogical practices promote active and independent learning; encourage collaborative and project-based learning in real-world contexts; heighten sensitivity to individual needs and diversity; redefine traditional space and time learning configurations; and increase parent and community connections with the school (Mioduser et al 2003, p.26). ICTs therefore have the potential to play their part in teacher innovation in a number of ways:

- as the medium for generative learning experiences (Hokanson & Hooper 2000, p.533) and inquiry-based learning
- as the basis for collaborative interaction between teachers and between teachers and students
- by providing access to real-world contexts
- through supporting asynchronous time and space configurations as opposed to traditional school structures
- for communicating with the wider community

In order to realise the potential of ICTs, the planning and professional development for pedagogical change as well as the provision and maintenance of the ICT infrastructure are required (Venezky & Davis 2002, p.14; Staples, Pugach & Himes 2005, p.307). As argued by Venezky and Davis (2002, p.42-43) ICTs should be seen as part of a strategy for solving an important problem rather than as an end in itself.

Considerable time has lapsed since Fullan (1993, p.vii) called for an understanding of the totality of change brought about by innovation rather than studying the innovations themselves. However, as shown in the literature review aspects of change brought about by innovation with ICTs in schools are still not fully understood (see Ch.2, Section 2.4.4, pp.68).

In order to assist in understanding how teachers innovate with ICTs at Wilding College they were asked questions in the interviews regarding their interactions with ICTs. Their responses are described and analysed in the following section which is preceded by a brief outline of the ICT infrastructure and the climate for innovation that the ICTs present.

6.3 ICTs and innovation at Wilding College

Wilding College, as described in Chapter 1 (Ch.1 Section 1.2.4, p.7-8), has an excellent ICT infrastructure that, on the whole, is well maintained, is upgraded according to a technology plan and operates optimally other than when subject to outside problems such as power failures or connectivity failures from service providers. The group of partner schools operates from a central server site. Wilding College has some 200 PCs for academic use of which 120 are configured in class-size groups in the three labs and the library, another group is in a smaller hub and each of the 30 classrooms has between one and four PCs (2009 figures). Day-to-day support in application use is available in both the labs

and the library or remotely from the IT department. Learning design support is also provided by the teacher-librarian.

Standardisation in the provision of ICTs across the partnership had a limiting effect for a considerable period of time. The school shifted to one-size-fits-all solution for ease of management and control that, in reality, did not accommodate the variety in day-to-day classroom practice at the College. However, in 2008, specialised need was acknowledged and the trend started moving towards provision of ICTs according to specific subject department needs.

Some classrooms have multi-media projectors which at the time the data was collected (2007) had to be purchased from departmental operating budgets, but which now (2009) are provided by the IT Department according to need. Security is a major concern and an added expense that has to be factored in. All PCs are connected to the Internet and each teacher and student has their own email account and allocated space on the server as well as public space on the intranet. Standard Microsoft Office software applications as well as specialised applications are accessible including Google Earth, Multi-media Science School (MMSS) and a fourth generation web-based library OPAC. Over the past two years (2007-2009) the *Moodle*[1] learning management system has been piloted and its implementation is currently being accelerated.

The *Intel Teach to the Future*[2] ICT course was significant in developing Wilding teachers' ICTs skills within the context of an outcomes-based curriculum. Unlike the Assessors course which is mandatory for all teachers, the *Intel* course was offered on a voluntary basis in 2003. The course addressed classroom practice and used an underlying format that incorporated OBE methodology, resource-

[1] See http://moodle.org/
[2] See http://www.intel.com/education/teach/

based learning and ICT skills and was thus able to draw different changes together. The *Intel* format has subsequently been used successfully by teachers in different departments (e.g. History), including teachers who had not done the course, but who have gone on to develop their own units of work on the same basis. For *Intel*-trained teachers, the course was their first experience of outcome-based learning design. The course had a significant influence on the approach to ICTs of those who completed it. However, most of those teachers have left the school and the few that remain are among those that integrate ICTs comfortably into their classroom practices.

In terms of infrastructure, the potential (Hargreaves 2000, p.52) for innovation using ICTs at Wilding College is therefore significant. The pressures towards innovation exist through mandated changes and in particular the effects of the new curriculum and the change to an inclusive paradigm, as well as through the demands of the students and the workplace. The teachers' predispositions towards innovation vary as has been shown in the findings of the two previous chapters. In order to establish the effect of contextual factors on their ability to innovate in practice, their predisposition towards ICTs needs to be understood.

Some schools have managed to succeed in integrating ICTs into the curriculum, whilst others have failed despite the presence of enabling factors (Tearle 2003, p.267). In the case of Wilding College, the infrastructure alone is a highly enabling factor. The next section will therefore describe the responses of teachers in answer to questions regarding innovation and ICTs in order to ascertain how ICTs as an integral part of the context have affected teachers' ability to innovate.

6.4 ICTs and innovation: introduction to the cases

In order to establish the interactions between ICTs and innovation, teachers were asked similar questions regarding innovations with ICTs specifically as they were

asked regarding innovation in general (see Appendix 3.1, Teacher Questionnaire).

Not all questions were put to each teacher in this format as sometimes teachers might have already provided much of the answer in their response to another question. In other cases additional questions were asked to assist in understanding their responses. Evidence of patterns of convergence, mutuality and extensiveness were sought in the data provided. The interviews will therefore be described in sequence highlighting these emergent factors.

Teachers were asked what innovations in their departments involving ICTs had been significant to them and why. They provide evidence of either process innovation or product innovation or the interaction of both (Ch.2 Section 2.4, p.56). Positive influences on teachers' ability to innovate, constraints that limit them as well as the information literacy aspect of ICT integration were themes common to most interviewees.

6.4.1 ICTs and innovation: the case of Bronwyn and Ineke

Process innovation in response to the new curriculum was evident from the interview with the Life Sciences teachers. Bronwyn and Ineke also integrate information literacy into their learning design process. They are enabled by the provision of relevant resources, but constrained by limited access to facilities and unexpectedly biased towards alternative technologies.

6.4.1.1 Process innovation

Bronwyn provided the example of a project which had been significant to her. Her description of the learning processes indicates her understanding of generative use of ICTs. At the same time she describes using a blended learning technique in order for the students to be able to demonstrate their understanding.

In this instance, the research project culminates in writing by hand which has a number of purposes. Firstly, students have access to and research up-to-date information which is essential to the study of Life Sciences. Secondly, they have to interpret information into a conceptual mind map to show their understanding of the relatedness of the concepts. Thirdly, they use the mind-map as a basis of the write-up which is written under open-book classroom test conditions. This means they have to apply and evaluate information in order to understand the concepts. Lastly, the technique forces students away from copy-and-paste plagiarism. Bronwyn and Ineke describe how the project unfolded:

> ***BK145:*** *I think that Cancer project … puts everything into perspective. Where we've gone … where the children have been taught to go away from copy-&-paste, where they have to mind-map the information they get off the Internet and then be able to understand that before answering the questions. Because, you know what the first thing is they ask me? 'Why aren't they answering their questions on the computer?'*
>
> ***IG146:*** *Yes, we made them write them out …*
>
> ***BK147:*** *That was so powerful.*
>
> ***IG149:*** *It helps in terms of their planning and their organising their brains and their train of thought.*
>
> ***IG151:*** *And then they … and summarising and getting key points that they're going to talk about in their write-up.*
>
> ***BK153:*** *Yes, because they can't answer the questions …*
>
> ***IG154:*** *… until they understand …*
>
> ***BK155:*** *… without understanding, because you can't regurgitate. There's no regurgitation anymore.*

BK157: *… and [then we take them to the classroom where] they have to write it up under test conditions.*

IG58: *We marked their mind-maps, […], gave them feedback and they could bring their mind-maps to class, as well as their research and under test conditions they could sit with their information and we gave them a handout where they had to write up the information that they'd found under the headings we'd given them – by hand.*

BK159: *They didn't like it. They were out of their comfort zone.*

IG160 &162: *Completely. They hated it […] because they can't write and they can't read and they can't spell.*

BK163: *But some of them are getting it … you know, the [names students] … I mean it was … I said to Ineke 'It's mind-blowing what they have extracted from that small exercise'.*

BK165: *And again, you know, with that testicular cancer … again that was Ineke. We have to do something that is relevant to them. Because I suggested prostrate cancer because that's part of the Grade 12 syllabus and Ineke said 'no, we have to do something for them …'*

IG166: *… because boys of their age can get testicular cancer. It's rare, but it can start from 15 years old. And the best way of finding it is to do self-diagnosis, self-examination and I wanted them to be familiar with that procedure.*

IG168: *Yep, we describe that … self examination procedure.*

BK170 & 174: *I just said to Ineke "it's the most powerful bit of" … because we weren't involved. We were the facilitators. We never stood up and talked a thing about cancer. These boys and their answers … I said to Ineke … I was blown away by some of their answers. […] But it gives your … you know, like your [names student] … they did the most amazing stuff … a chance to actually fly, because they went into the detail that your … the other boys didn't do. In the end they said they enjoyed it … they didn't like the writing.*

Bronwyn and Ineke are clearly comfortable with integrating ICTs into their practice and have high expectations of the students' technical skills, assuming that their students are comfortable with standard application packages. They see ICTs first and foremost as student research tools. Whilst there has been some resistance from the students, their methods have succeeded and the overall standard of attainment is exceptional. Bronwyn and Ineke ensure that ICTs are used as powerful thinking tools (Prensky 2009, p.7): in their practice it is the guided interaction with information that enhances student understanding.

The factors that have converged to meet all the criteria for innovative integrated use of ICTs in this instance are as follows:

- Bronwyn is one of the few teachers who completed the initial *Intel Teach to the Future Course* and who still remains at the school, while Ineke has had considerable relevant private sector experience with ICTs and current resources.
- Bronwyn and Ineke have an openly collaborative relationship as indicated in the continual use of the first person plural 'we'. They agree that the bottom line is that they *'get on with each other'* (BK43: Ch.5 Section 5.5.1.1, p.216).
- They have high expectations of their students and design and facilitate the learning process.
- With the interests of the boys at heart, they personalise the learning to real-world student needs.
- Their methods support the notion of *"writing across the curriculum'"* (Smagorinsky 1995, p.160)
- Formative assessment occurred between completion of the mind-map and students writing the final report.
- Bronwyn makes regular use of the school library services and incorporates all forms of media in her classroom practice.

Writing skills, whilst taught in the English (Primary Language) classroom, are also accepted as their joint responsibility as Life Sciences teachers. Not all students are able to write well in Grade 10. Each individual learner researches and writes to the level of detail that they are capable of. However, with the extension of their methods from Grade 9 upwards, practice is expected to improve student writing over time. The fact that students struggle with writing does not deter these teachers nor inhibit the extension of the innovation within their department. At the same time they have found a way to avoid copy-&-paste plagiarism.

At the time of the interview, Bronwyn and Ineke were implementing their methodology in Grade 10 and subsequently used it from Grade 9 to Grade 12. In a second example, following Internet research, students had to submit their working documents for formative assessment before proceeding to build their models of the HIV virus. The most important impact of ICTs in this case is that students and teachers alike are exposed to the very latest research information on the HIV pandemic in a multi-media format. The teacher facilitates and guides the access, scaffolding the learning process at the same time.

6.4.1.2 Information literacy

Bronwyn co-taught the Grade 8 information skills module for two years. From this experience she developed high information literacy expectations for students and considerable comfort in working with information resources. We have collaborated on many research-based projects incorporating electronic and printed media and designed and co-taught together on some units and appreciation is expressed for this type of help:

> ***BK224:*** *I think, Ineke, you've hit the nail on the head, because I know, when I say to people, "you know, Mary will help you with anything" "Oh no, rubbish" and I say "What? Mary will help you and plan your lesson". I mean … you know that Grade 9 one we had on indigenous plants. And, I mean the way you did it and then you kept it and the next week we pulled out the same flip chart. It was so … it was so helpful and I've spoken to*

people and they don't know that they can use you! So I don't know if that's where you need to change a bit. I don't know if you need to change it too quickly because you need another librarian first. [Laughter]

BK228: *I know … it's critical … which is … you know that thing on [indigenous plants] I couldn't have done that without you saying 'let's do the Inspiration*[3] *… showing them how to make the notes.*

BK219/221: *I think it's frustrating that when you like want to get into a computer or want to get to computers … and I know we've [to MR] spoken about that as well … you can't have, you don't have access to them … because I still think the Computer Studies should be completely separate: they should have their own lab so that we have more access. I don't know, that's just my ideal world. That's why I'm often in the Library … which I actually prefer – I prefer that. There's more help here.*

Similarly, from her personal ICT experience, Ineke understands Web 2.0 implications and particularly how unreliable wiki-based information can be. They discuss student information literacy limitations:

IG182: *And it's also taught them things like you can't just go to the first website you see and accept that it's gospel. A lot of them don't know that Wikipedia, for instance, can be edited, by anyone and if someone brings me something printed off Wikipedia I always take it with a big pinch of salt. And I say to them "Well, do you know that this can be edited? If you wanted to go change the definition you could do it". So I think I'm teaching them a lot … that you need to look for credible websites. You can't just go to any website.*

BK183: *In fact, I penalise my class if they only have Wikipedia as their main source because I don't mind them using it as their starting point … going out from there. Some of them … most of them understand that now. I think you also explained to a lot of them.*

IG184: *If you do a search, a Google search, it's invariably one of your first two websites … is Wikipedia. So that's the one they tend to go to first. And they need to know that*

[3] *Inspiration* = visual thinking software www.inspiration.com

they must rather, in our case, maybe go to a medical website that's credible and that's … you know is from a credible source. That's quite important to me.

Ineke describes a Grade 10 peer evaluation session which I had observed at Bronwyn's recommendation:

IG187: *And they had to present and then they evaluated each other. Every child got a rubric for every child that was presenting and they had to evaluate each other and we took the average of all the evaluations as their final mark.*

BK188: *Mary saw some of those and I mean… that [names student] … I mean he didn't have a single note. Mary couldn't believe it. These were Grade 10 boys. Look, not all of them were that standard … a lot of them … a couple of them read.*

IG190: *… what I did with mine as well then. A lot of them came in with cue cards that they'd written out. I said to them "Why are you writing cue cards? Why don't you just print out your slides?" And I actually showed them on my screen how to print out handouts or 3 slides per page or you can make a notes [print] or whatever and they just didn't think about that. So here they're sitting writing out cue cards and I said "What a waste of time!"*

BK194: *No, I still make them … you know … like that thing on candida … I made them make a table and then I mark that they've done the table correctly on the computer. So they have to be able to do a table. I don't mind if it's in Word or Excel.*

IG195: *Graphs … we usually make them draw a graph … because they've got to plot their points and there's a… there's a whole sort of practical skills thing. And their prac exams are done mainly … graphs are done by hand … they have to be practised at that.*

IG197: *I use it lots for my teaching. Because I teach off PowerPoint most of the time, I'm on the Internet all the time getting especially visuals, diagrams, pictures off the Internet all the time. So I use it a lot for that.*

BK198: *And Ineke then … [to IG] that one with the antibiotics … And then Ineke did the extreme drug-resistant TB and Ineke lectured all the Grade 11's. So she doesn't just … didn't just keep it for herself.*

IG200: *I worked on antibiotics so I've worked with [?????] presentation together and delivered it to all the Grade 11s.*

BK201: *Ineke's the expert …*

The factors that have converged in this instance are:

- peer evaluation was used as the basis for summative assessment
- the students were required, *inter alia* to demonstrate interactive use of tools in their PowerPoint demonstrations consistent with core competencies (Ch. 2 Section 2.5.1, p.81)
- content was disseminated via peer presentation
- Social learning also occurred in that students demonstrated to one another what is possible with ICTs and the highly skilled influenced those with fewer skills.

As with the cancer project, Bronwyn and Ineke did not use ICTs for certain standard tasks that are generally accepted as ICT-based i.e. writing as explained above and graphing. Graphing is taught as a manual skill as students are required to draw graphs by hand in examinations. However, they do teach certain specific skills such as using table layouts. These are taught not only for the sake of the skill, but to scaffold, for example, the compare and contrast learning process. In each case, the decision to use ICTs or not is based on the most appropriate learning tool for the purpose or a blended approach to learning (Matheos, Daniel & McCalla c.2005, p.56; Singh 2003, p.52).

Their department is characterised by a co-operative common-purpose focus and this extends to their use of ICTs as both a teaching tool and as a professional

resource. At the same time they note resources that will be of interest to individual students. However, there is one strange anomaly in that although the information is gleaned from the Internet, Bronwyn hands it out in paper form rather than distributing it electronically indicating that she has not fully realised the potential of electronic sharing:

> ***IG208:*** *Very, absolutely … I'm on the Internet all the time … all the time.*
>
> ***BK209:*** *In fact I took an article for one of my Grade 12s […] about a new hormone because he was asking me about fat metabolism and why with one syndrome children have to have growth hormone. And I said "I've got just the article for you" and he said "that's just what I love". And I said "You will know about it because it's not part of the syllabus, but here's the article, read it, photostat it and so … I also do that for the boys.*
>
> ***IG210:*** *Bronwyn's always the one who goes through the newspapers, the magazines and collects stuff from there. I collect stuff off the Internet. And then we just share it all.*

6.4.1.3 Enablers and constraints

The Life Sciences curriculum is dependent on up-to-date resources to enable the teachers to contextualise student learning in real-world areas such as biotechnology and genetics. Access to print and electronic media is therefore critical. The teachers also need to maintain the currency of their own knowledge beyond the requirements of the curriculum. As HOD Bronwyn regularly requests materials to be purchased and responds positively to the library's SDI[4] service to teachers. Such access and the teachers' awareness of new developments beyond syllabus content stimulate the extension of student learning. The teachers are intermediaries between expert knowledge and student knowledge.

Bronwyn and Ineke agree that lack of access contributes to under-utilisation of ICTs, given that access to the labs is prioritised for computer studies. Ineke in

[4] SDI = Selective Dissemination of Information. This service is provided to all Wilding's teachers who make their interests known to me.

particular is constrained by this lack of access. Bronwyn speculates that even if she had the necessary computers in her classroom, support – or the lack of it – to keep the machines running optimally would be a constraint. The lab bottleneck occurs due to the simultaneous time-tabling of optional subjects such as IT[5], CAT, Life Sciences and Geography. Instead, these subjects compete for access in the remaining venue, the library which, on occasions, has to accommodate up to three classes at a time. The Science hub[6] lacks pedagogic support as well as on-hand technical support. Ineke describes the situation:

> ***IG232/234:*** *I think access is a huge problem because you can't get into the labs downstairs unless you book them out for the year at the beginning of the year, I think. Or unless you're lucky. I've tried to take my Grade 10s down there and every single time they are timetabled the same as [???]. That's it. […] You've got absolutely no chance of ever getting in there with them. So then, you use the Library, which is great or you can try the Science Computer hub which is not so great because the computers there aren't … well, the last time I used them they weren't up to scratch. I don't know if they've been changed now to XP or if they're working faster or whatever, but I don't go there anymore.*

> ***BK236:*** *You know, I was thinking if … even putting computers in the classroom won't solve the problem because we'll never have 25. I mean I've got 25 [boys] in my Grade 10 class. We'll never have 25 computers. I mean, it's just the logistics: who's going to look after them like you do? You phone, you have them repaired. I mean, we just wouldn't be able to have that. We won't have the time.*

Despite their familiarity with ICTs and their willingness to use it, they are unwilling to consider mobile technology as a solution to the access problem. Ineke believes that if mobile technologies were incorporated, teachers' lack of familiarity with the tools would be a constraint, while Bronwyn is influenced by student experiences in other countries:

> ***MR237:*** *And mobile technology? Do you think that that would that help at all?*

[5] Information Technology (IT) and Computer Applications & Technology (CAT)
[6] A small hub of 14 computers

BK238: *Ag … I don't think so. [to IG] Do you think so? The laptop?*

BK240: *I would be wary of that.*

IG241: *I think they can help, but the problem there would be teachers not being as comfortable or as familiar with them as the kids. So we would be almost back to where we were when we started introducing PCs and things like that ...*

IG242: *… and you'd have hesitance.*

BK244: *It was interesting … [a student] … he went [on exchange] to a school where it was all laptops. And he liked it of course because he loves his computers. But he said that as soon as the teacher's back was turned they were onto all sorts of things. That's why I like this. I like this set-up, where you can stand up and you can see what's going on. But we definitely need more, more of this facility [nods in direction of Library].*

Their reliance on technology requires that both teachers have a 'plan B' as the school and more recently, the whole country have been subject to lengthy power outages. They describe the effect of such beyond-control factors:

IG250: *Well, I print out can-slides so I can do chalk and talk if I have to. So I do always have to have a plan B. There's no doubt. And I've got everything on my flash disk and on my home computer as a back-up. So you have to have backup. That's the one thing when you are using technology and you have to have Plan B.*

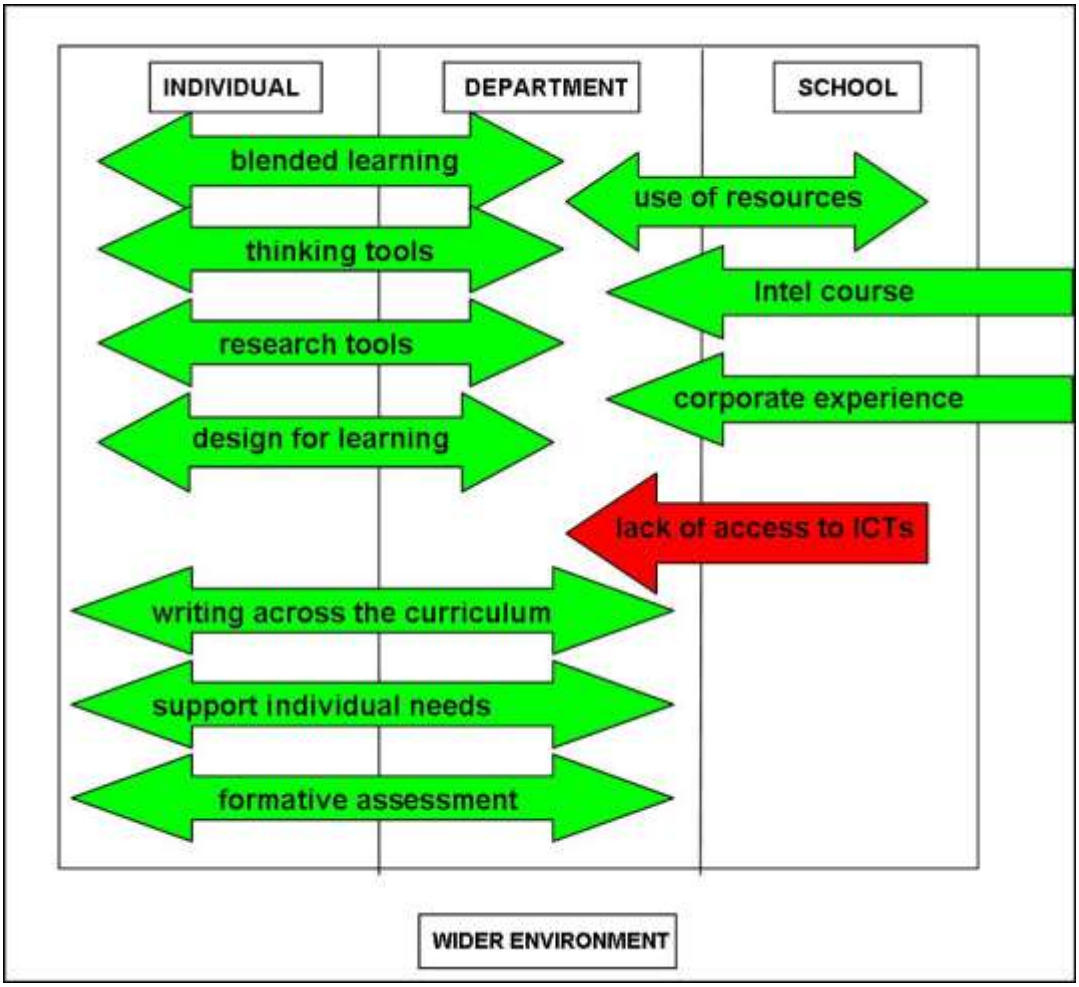
BK251: *Those two days*[7] *[sighing] … 'cause that's when they were doing the Cancer assignment and the research … [shrugs] it was the most helpless feeling. Ag … it was absolutely awful. And they were 'Ma'am, why are you teaching us something that we …' I had to go through the practicals before the pracs had been set up. I said, 'I'm sorry, but this is Plan B'. [laughter] So they even noticed! This is not the right order! [laughter]*

[7] BK refers here to the first major national power failure in 2006 when the school was without power for two days.

6.4.1.4 Summary & preliminary findings: Bronwyn & Ineke

The pattern of convergent and disconvergent factors that affect Bronwyn's and Ineke's use of ICTs are illustrated in Figure 6.1.

Figure 6.1: ICT factors: Bronwyn and Ineke



ICTs are integral to Bronwyn and Ineke's practice and from their entire description collaboration is essential to this process: they describe their common experiences rather than individual experiences. As the researcher, I got the sense that if I had interviewed them individually, I would have had identical stories. Their affinity for community-of-practice approaches is not limited to their partnership but extends beyond the department. Their focus is on student use of

ICTs rather than their own use of ICTs in that they continually refer to student learning examples rather than their own skills and use of ICTs.

Excellent collegial relationships; their common-purpose focus; teacher and student needs; available resources; and access to ICTs converge to sustain innovative momentum. Student competencies are addressed overtly through their methods which encourage active, research-based learning. Access to ICTs is critical and the teachers rely on the library for collaborative support in designing and co-teaching information skills as well as the provision of information resources. Bronwyn and Ineke serve as intermediaries and facilitators, avoiding plagiarism through detailed learning design, developing writing skills across the curriculum and ensuring that they focus on content that is of interest and appropriate to boys. Although they rely on ICTs, they prefer a blended approach. However, they are constrained by systemic issues: access to computers and a shortage of on-hand pedagogical support.

Despite their ability and willingness to use ICTs, they also show a surprising lack of willingness to consider mobile technology as an alternative form of access. The erratic electricity supply is a constraining factor beyond the power of the school. They have high expectations of students' ICT skills.

6.4.2 ICTs and innovation: the case of Arthur, Hennie, Magriet and Thabo

In this department, two pairs of teachers were interviewed. Unlike the differences between these pairs of teachers regarding organisational interactions, both pairs concur in the majority of their views concerning the impact of ICTs and how they have influenced innovation in their practice. There is a greater focus on product rather than process innovation, student information literacy levels are limiting and access is particularly constraining.

6.4.2.1 Process innovation

For Arthur and Hennie there are clear advantages to using ICTs as learning and as teaching tools. However, they prefer a blended learning approach, using ICTs when it is the most appropriate medium. The nature of the subject and its sub-disciplines determines the extent and manner in which they make use of ICTs. The four teachers share some of these uses:

> ***AS131/132:*** *I think that Chemistry has been really aided by strong visual aids. Um, we've used simple visual aids like [???] molecules which they really enjoyed. [???] But then, the problem with all of those visual aids, even the fancy expensive ones, is that they are very stationary, and that's not the way molecules behave. And some of the animations [???] for example we've used PHJ [?] which is a [???] website a fair bit, a similar sort of thing … and we've also done quite a few virtual experiments. Like we did some in Chemistry which is quite nice. What happens is [???] are really reactive [???] and you can do it virtually [???] not available [???]. So, those have been very nice. […] I use a projector and screen – generally. Sometimes the kids will work individually or in pairs on a desktop. Um … that's been very nice. We've also made a lot of use of some of the sections of … of Excel for their own lab reports. There have been times when we've spent quite a bit of time getting them to manipulate their data to get a straight line and it's very fast in Excel. "Try it – seven different ways".*
>
> *****
>
> ***MD149a:*** *Like I said, the multi-media. I mean, the pracs that are too dangerous for me in class they can see on the computer. The body, for example, for Natural Science, which I can't show them, unless it's a skeleton which doesn't have the same effect. They can see on the computer this heart pumping and where that molecule of blood goes. That helps amazingly.*
>
> *****
>
> ***MR224/226:*** *And if we look at each learning area requiring a different range of classroom strategies, do you think your specialist area as Science teachers has influenced your approach to ICTs, and if so, in what way?.*

TL228: *Ja, I think it has, because, I mean, as Magriet said earlier on, there are some of the experiments which we do not … we cannot do in class. They're too dangerous to do in class. So what we do is we go to the multi-media and then we do them there.*

MD230: *And then that stimulates every type of learner – the one that listens, the one that sees, the one that needs to write down, because they've got the worksheet with them. The one that needs to talk about it, because they work in groups of two people. So it works …*

MR231: *So that Multi-media Science really is the key to what you're doing?*

MD232/234: *Oh ja. That's the biggest, that's the biggest. That's our computer crunch … […] That's our computer crunch. That's what we use computers for. Multimedia.*

*****

AS148b: *The other factor though is sometimes the electronic gadgetry can actually get in the way and I've avoided some of it, so …*

HJ149: *Because its boys. They like the sort-of hands-on doing … getting the wow big stuff, doing it themselves in the old-fashioned way. There's lovely stuff on the market […] you know you get these [???] micro-kits with these tiny test tubes … and all these fancy … they're so cute … but its, you know, boys [resignedly] … so…*

AS150: *It doesn't go bang! [laughter]*

HJ151: *It doesn't go bang! … So they can't break these test tubes [chuckles]. So, for us, in that sense, we really make an effort to … to keep it hands-on, dirty, if you like.*

AS154/156: *But something like a photo gauge which is just a beam and … and it will time wherever you break that beam, is not a good thing to use in an introductory prac because the boys don't understand how it works. And it's an abstract measuring device. It's much better to get them a metre stick and a stop watch and design a prac on a big scale with toys … big and large toys […] rather than sophisticated air tracks and photo gauges and everything else which are much more precise but it's more abstract.*

*****

AS222b/230: *But video technology I want to introduce. We do a lot of measurements. We could make very good use of that way of measuring, which is very intelligent. There is no better way. You can measure the volume … the maximum volume of [???] because you just keep on videoing it … and scale. […] And that's not something you can do in real life. […] And so they've done some … they've made some very good use of it for research.*

MD236: *We have actually. [I was] there actually when Ian made the water … one of the boys video-taped*[8] *it for us and um we were able to get the whole explosion. We stopped it and we got this amazing photo. […] Now the kids often miss the flash of light because it's so quick. And because it was on video we could stop it exactly where we wanted and we got this amazing … the kids actually caught on to what we were talking about. But I don't use it that often.*

TL239 & 242: *Ja, that experiment doesn't always work, so once we've got it like now, then we've got it to show the boys, ja. […] There's a lot of energy which gets released there.*

From the above extracts it can be seen that the main uses that these four teachers make of ICTs are for the multi-media features which help to:

- demonstrate practical experiments that are dangerous (MD149a)
- demonstrate reactions that can be slowed down in order for students to better observe them (AS222b)
- demonstrate live action effectively such as the pumping heart (MD149a)
- to stimulate students with different types of learning styles (MD230-234)

There are clues that indicate that some of the methods they describe are still relatively traditional such as relying on worksheets (MD230-234) or the use of a projector and screen (AS131-132) which is a teacher-centred approach, but, as Arthur explains, it is only used for a short period at a time. Arthur and Hennie

[8] In this instance the student used his mobile phone to video the experiment.

are responsive to boys' affinity for hands-on as opposed to virtual experiments, which they have the resources to support.

The teaching of ICT skills is integrated into the units of work and relies in part on peer teaching:

> ***AS134:*** *About half of [the students] need to be taught [skills]. Certainly something like … um … plotting a straight line graph. Excel calls that a scatter graph. What they call an XY plot is not what we call an XY plot. It's two … its two sets of plots. So Excel's … the words they use are quite funny, especially in plotting graphs and [???], but …*
>
> ***HJ135:*** *But what I've found, Arthur, is that's not time consuming. The boys are so computer literate that you just actually show them once and tshweeee [gestures speed on keyboard] they teach each other and it's gone and then off they go.*
>
> ***MR136:*** *Oh, so you do find that. So they do have the competence. At what level are we talking here?*
>
> ***HJ137:*** *Grade 10, 11.*
>
> ***AS139:*** *That's about where it starts. Once you've shown them that it's not a big issue. And … and they show each other stuff and … someone will ask "how do I put a trend line in this" and you show the one then within 15 minutes the whole class will do it. [...] Well, its peer teaching.*

Application skills are conveyed through natural socio-constructivist methods: Hennie teaches the use of spreadsheets on a one-on-one need-to-know basis, which carries across the class through student-instigated peer-teaching. However, students' information literacy skills present problems, particularly to Magriet and Thabo.

6.4.2.2 Product innovation

Custom-purpose ICT hardware also influences teachers' ability to innovate. Here, the innovations are the ICTs themselves. By applying the tools, the teachers are able to change their practice or believe their practice will change if they were to acquire the tool. The *Mimeo* or *e-Beam* and the school administrative system are amongst the tools mentioned:

> ***MD 149b:*** *[…] And the other thing that I saw, which I desperately want, which was that thing in the staffroom there. They wrote on the board … and it gets immediately logged into the computer.*
>
> ***MD152:*** *That's amazing. I would die for something like that, because I make so many exercises on the board which I don't have time to go print on the computer. And then just to be able to open that the next day. That would be amazing. It would save so much time. It would save so much time, save so much time.*
>
> *****
>
> ***TL254:*** *Ja, ja, ja. As you were saying, like that board … Mimeo or something like that. I think those are the things to go for. What I like about that is that you can convert whatever you've written into Word and whoever has missed a lesson, you know, can actually catch up. You know, now when we were busy marking we find a learner has just written "I was not in when we were doing this and this or that". And we try to say, "Oh, Ok, the boy was not in" and you know ... And you try to explain maybe, but it will be so brief and short and you can just pull up that lesson and give it to the boy "This is what we've been doing and if you don't understand then I will show you".*

Magriet refers also to the administrative use of computers and how they have helped her and to the Internet as a teaching resource:

> ***MD156/158:*** *Because the computers make our work actually a lot less. I must say, that's the one part that I'm grateful for. It makes my work less, not more. [...] The mark book, the mark book. When I write everything in my mark book and my mark book gets stolen. There's all my marks … missing. Now, as I get them, I enter them in the computer. The*

computer works out my average, Pencil Box[9] work[s] out my class average, grade average, everything. It weights it differently for me, which would have taken me forever to do. [...] I use [a hand written mark book as well], because in the classroom, if I take marks, I don't have a computer next to me. So then I put it in my book. Tests, I immediately …

*****

MD245/247: *GCM! We can't live without it, I'm sorry. I can't. […] Without Pencil Box we'd be screwed. I mean, we can't, no way. […]*

TL248: *I think we have, sort of I don't know … if I were to go to another institution where these things are not there, what would I do. I'd have to now reinvent the wheel. But really I think …um … it sort of has become part of what I do.*

MD249: *Email. Every correspondence, every meeting is by email. If I don't read my emails for one day I'm out of the loop completely. Completely. So we can't. We cannot. I mean, we're a huge staff, so to get a message to every single person. We don't have intercoms so if someone looks for a boy, you're stuffed. Because they don't read the DRO[10]. That's why we have to use email. So [shrugs] it's … we can't. We can't do without email.*

*****

MD165b: *[…] And I mean, it's made my work less. Notes for example. I mean, stuff I can get off the Internet. It's so much better. If I had to go for books to find everything, it'd take me forever.*

In each of these cases it is the ICT tool that is the innovation, not the practice. The product innovation has a positive impact on the administrative process. The tools assist the teachers' practice but how they teach is not affected, although the *e-Beam* may in future prove to have evaluative potential. *Pencil Box*, the school administrative system, has helped save Magriet time in such tasks although lack of classroom access means that she needs to use a hand-written mark book as well. More recently (2009) the manual registration of students each day has

[9] *Pencil Box* is the administrative system used by the school
[10] DRO: Daily Routine Order or the regular means of communicating daily messages to students.

been replaced by an automated one on *Pencil Box*. Teachers are expected to register attendance during class time, but lacking a classroom PC, timeous and consistent registration is hindered.

The *Mimeo* or *e-Beam* has been demonstrated but not purchased, and Magriet envisages it as a panacea to her lack of time, while Thabo recognises its potential for supporting students who have missed lessons due to extra-curricular opportunities (sports matches, tours, community service, exchanges etc) that form part of the complex wider curriculum of the school. Used together with a webcam or microphone the *e-Beam* device had been evaluated and discussed as a means of caching lessons that are centred on the whiteboard. Apart from supporting absentees, the device is also envisaged as a means of recording and reviewing teaching practice or for broadcast of a lesson to classrooms elsewhere. Arthur has referred to the *e-Beam* as follows:

> *"It will take a while, but I believe that this could become an invaluable tool in teaching. I do not do power points* [sic]*, but I use my data projector for all sorts of things. This doubles the power of the data projector."*[11]

While it is hoped that the *e-Beam*, will enhance the teaching practice that derives from it, the anticipated time-saving may also be significant given the overload that teachers describe. Certain teachers had expressed interest in the device for these purposes when first investigated five years ago, but the decision was taken by the IT Director to reject it due to technical performance limitations relating to the quality of the whiteboard surface it projected onto. With this problem overcome by technological improvements, the *e-Beam* has been demonstrated again more recently and teachers are keen to purchase it, but restrictions on access to Web 2.0 resources such as *Flickr* to enhance its use are currently being debated. The real value of the device is that it may address systemic problems such as finding time to support absentees.

[11] Arthur (2009) Email to MR re *e-Beam*, 2nd April 2009

A further example of the impact of ICTs on her personally is Magriet's use of the Internet to find extracts that she can use as notes (MD165b, p.287). Her comparison of printed resources and electronic resources indicates her consideration of their time-related capacity and not their intrinsic value.

6.4.2.3 Information literacy

Magriet and Thabo describe the problems:

> ***TL167/169:*** *I think there are. You know lately, I when I bring my boys, I've been so disappointed about the quality of work which … which they submit. […] There's a lot of cut-and-pasting. A lot. And what the boys will do, immediately, one person will do something – cut-and-paste – whatever it is, and then quickly email a friend and they'll just change the names there and then they'll hand in the work. You know, if … OK. I would like them to research using Internet, whatever, but then at the end maybe I can ask them to write with their own hand, maybe it would be better. But, I find that a lot, a lot of my boys they just copy and paste.*
>
> ***MD170:*** *They just don't understand what we mean with 'your own words'. They think that if they change one word in the whole sentence it's their own work. They really don't … they think if they use this paragraph from this site and this paragraph, put them together and it's their own work. [shakes head]*
>
> ***MD173:*** *I mean if a kid that's on inclusion programme uses certain words that's quite a give-away. I mean, words I don't understand, so it's a give-away.*
>
> ***MD178/180:*** *I don't let my kids do assignments on the computer, from the Internet, unless it's like Multi-Media. But they don't … they never type stuff, like lab reports for me, from the Internet. We're not into lab reports as much in the senior phase. So, it's mostly juniors. […] It's hard for the seniors to copy and paste because it's … they can't just go into a site and find it. It's their own work, it has to be their own sums and their own … it has to be. But the juniors … ayyy!*

From these descriptions, three issues arise:

- although boys arrive in Grade 8 with technical competence, they lacking information literacy skills and therefore dependent on cut-and-paste techniques in research-based assignments
- secondly, the teachers appear to lack the methodology skills to address the problem, although the anti-plagiarism policy (Appendix 6.1) requires learning design intended to avoid such problems
- thirdly, research based assignments are avoided as a solution to the copy-and-paste problem

6.4.2.4 Enablers and constraints

There are a number of constraints common to all Physical Science teachers that impinge on their ability to integrate ICTs in the curriculum. These include access to the computer labs, maintenance of classroom PCs and a lack of sufficient funding for specialised equipment. The teachers describe their problems:

> ***AS144:*** *The [partner school] ha[s] got some quite nice data probes and we've looked at pricing them. And we've just … we've run out of budget. There's lots of very nice stuff out there that we'd like to buy.*
>
> ***HJ145:*** *Ja. [to Arthur] There's one thing that we must invest in, really, and that's quite a lot of money. There's a huge emphasis on … on … on energy in chemical reactions and the way we measure that is by temperature. And sometimes it's very difficult just with a thermometer. So I think those electronic probes and that device … it can't be that expensive … just two or three and I think that's something we must look at. […]*
>
> ***AS148a:*** *Budget factors are huge in terms of [???] what we plan to do. [A local] high school has a bigger slice of budget than we do. Let's get … its true. […]*
>
> *****
>
> ***AS170:*** *[…] The fact that we have only one data projector in the department is a crying shame because for 6 times R10 … R60,000 every lab could have one and then the access could be much, much better.*

*****

HJ209: *Money! [chuckles]*

ASF210: *Ja!*

HJ211: *Budget! [laughter] Did I say money! [laughter]*

AS212: *Yes! Resources. Um … with the amount of stuff that's out there … because sometimes you can search really hard and not find what you want, but you know it's there … you know it's there. Um … and finding stuff that's only 50% … you know … not there … [indicates wavering]*

*****

MD62: *Yes, I do [have a computer in the classroom] but it's broken [chuckles].*

TL63: *Basically, you don't have a computer in the classroom!*

MD165a: *It's the 4th [request for maintenance], but […]*

Arthur and Henry are frustrated by budgetary limitations that constrain their ability to use ICTs in the classroom. They draw comparisons with both the partner school, which has equipment that they lack and with a local publicly funded secondary school which they expect to have less resources. At the time of the interview only one Physical Science classroom had a projector. Part of the difficulty is the size of the department as the subject, although no longer compulsory, is a popular option taken by most boys. Given the number of classes per grade it is difficult to provide equitable access to classroom resources simultaneously. A partner school has such tools, but their department is not as extensive. A further constraint raised by Arthur is the sheer volume of resources that makes it difficult to source items that he knows exist but cannot locate. Although theoretically every classroom has at least one functioning computer, when interviewed, Thabo had no classroom computer and Magriet had

a malfunctioning one for which her requests for maintenance had apparently gone unheeded.

Access to the computer labs and inequitable provision of projectors are serious inhibitors to integrating ICTs into the curriculum over which Magriet and Thabo despair. They describe their frustrations:

> ***TL181:*** *And at times, like for example, I've got two Grade 9 classes, I'll come to book and find [the labs] fully booked for one. For the other I can book. And when you try to book the following week you find that, you know … [sigh] … things are just difficult to comprehend. OK. You've done this with this other group; you have to do this with the other group. I think we definitely need another … computer lab.*
> ***MR182:*** *So access is the problem?*
>
> ***MD183:*** *Mmm.*
>
> ***MR184****: Does that lack of access actually prevent you … ?*
>
> ***TL & MD185:*** *Yes, yes, definitely.*
>
> ***MR186:*** *… from doing what you want to? So it's a huge constraint on you?*
>
> ***MD187:*** *No, it definitely is.*
>
> ***TL188:*** *Ja. We either need another computer lab for the Computer Studies[12] and whatever …*
>
> ***MD189:*** *I think Computer Studies needs their own thing.*
>
> ***TL190:*** *… and then we can then use these ones which are here.*
>
> ***MD191:*** *That's a huge problem, because so many times I wanted to put them on Multi-media and …*

[12] Computer Studies is the former name of IT (Information Technology) and CAT (Computer Applications Technology), still commonly used to refer collectively to these two related subjects.

TL192: *… and they're blocked.*

MD193/195: *… there's no time. […] There's no solution.*

*****

MD199: *[…] And then he shows them the projector and then he works with the Multi-media with the whole class. So it's not you sitting on that computer, you there. It's a class thing. That helps a lot. And I know [a colleague], for example, uses PowerPoint; every lesson of hers is in PowerPoint. And I know the kids absolutely love it. They absolutely love it. But we don't have projectors [shrugs].*

TL200: *Why don't you have a projector?*
MD201: *In the classroom?*

TL205: *Ahhh! We ordered three years ago.*

MD206: *Three years ago? I don't remember when it was.*

MR207: *OK. So what you are saying to me then is there are things you want to do and things that you see some of your colleagues are doing …*

MD208: *… which I can't do [what my colleagues are doing even though I want to] …*

MR209*: … which you can't do. Where does that leave you?*

MD210: *Frustrated! I … after … I feel I can pull my hair out, because there's so much stuff I want to show them, but I can't, because either I can't get in to the computers and I can't do it in my classroom … so it's just not done. So everything is me teaching and then doing exercises, because I've got no computers.*

TL212/214/216: *Ja, it doesn't really frustrate me because I feel if I really wanted to use it, I would like swap with [the HOD]. But, I … I don't know … because these boys are … they learn differently, so that's why I try to book them, that each one has his own computer. I like projecting stuff and teaching from there, but I don't become frustrated when I don't have that. But I do when I come to book down here and find that there's no space … […] Yes, I can't get a booking. And in our department we … we work with time.*

> *If we say with this module you're taking two weeks and you're not done and the boys have to go to another class. You know, you feel frustrated, don't know what to do and there's nothing, just nothing you can do. You just come up with some other ways of teaching the boys. Ja, it's … the time frames are too closely packed. I remember when we started with those tests and pracs, you find that the date is set but you haven't covered half the work. […] Ja, it is, it is [a serious problem]. Some of them we have to cancel them. […]*

It is in this last extract that the wider implications of lack of access are revealed. Lab bookings are dependent on systemic factors which produce time-tabling clashes for optional subjects, resulting in inequitable access between subjects and within the same grade in the same subject. Thabo and Magriet are willing to change their practice to incorporate ICT based methodologies and desire to do so, but access limits them to traditional means. Thabo recognises that the students learn differently with ICTs and wants to use them to comply with the requirements of the modules as designed. However, the outcome of the lack of access is inconsistency or incompleteness of curriculum delivery.

For Arthur, money spent on digital projectors would be a good investment. As HOD, he is frustrated by the lack of equitable access to projectors for his whole department. The intention is that all Physical Science classrooms be equipped with four PCs for learner use and a multi-media PC, projector and screen for teacher use, but into the third year of the plan (2009) less than half the classrooms have this facility. So far, only one classroom has a projector, resulting in lack of equity in the teaching methods used between different classes. This situation comes about for three reasons. Firstly, digital projectors are costly and secondly a department has to justify to the IT Department that ICTs will be used before they are provided, which is difficult to do when the tools are unavailable. A third factor is the security of ICTs in the classrooms with a number of projectors having been stolen, despite their being fixed to the ceilings.

The security risk has become so acute that a moratorium[13] on the roll out of all technology was called until security could be further improved.

6.4.2.5 Factors influencing ICT use

Exposure to ICT developments, the nature of the subject and teacher beliefs all have a significant influence on these teachers use of ICTs. Whilst Magriet states directly that there is a single influence on her ICT development and that is myself as she has no time to discover new things beyond school, Arthur and Hennie pause for a considerable time before responding to the question on how their ICT-based innovations have come about.

> ***MD253:*** *The only influences I get from ICT are the ones that you bring into the staffroom. Seriously, I don't know people in the ICT world.*

In her comment (MD253) Magriet raises the question of how teachers are exposed to ICTs. While HODs might be exposed to ideas at conferences they attend, ordinary teachers are reliant on HODs or other colleagues. There does not appear to be any systematic exposure to ICT-related ideas, only ad hoc exposure.

> *****
>
> ***HJ159, 162:*** *Well, I think … it's available! [chuckles] And it's another type of resource. For me certainly is this MMSS, it's certainly something I cannot recreate in the classroom, something I can't in my wildest dreams actually have the boys design. Its just so wow for me to see visually! I think the fact that it's available and that specific programme is incredible. […] It requires very little from me, and I'm not just saying that I'm lazy and not doing anything. It's wonderful that it's something that's so brilliant that works and I don't have to do anything. I have to know how it works and know the content to explain, but it's just so wonderfully designed that it's … and every student can go about it at his own pace.*

[13] The moratorium ran from January to May 2009. The security operation at the school is massive, but it is still possible for undesirable elements to access the property. ICTs at schools across the province have been targeted by thieves.

> ***AS164:*** *Ja … and there are some … there are other websites. We've used quite a few websites, but there are too many. So it's sometimes a bit of a trouble [???] [to HJ] you know that Doppler effect which is very nice pictures of the object [???] speed [???] breaking the sound barrier and so on.*
>
> ***AS168:*** *Some people tend to dump a lot of stuff rather than [???] on the Internet [???] which has been a bit of a weakness because it's not always aligned with what should be taught. [Indicates levels] It's a higher rather than the low level [???] … um … and some people use it very, very well.*
>
> ***AS175:*** *Yes, I think there is a difference in the way that we approach it as chemists and as physicists and those are the two areas in our own subject. In chemistry we need it a lot more because molecules are so small and what do molecules do? We constantly have to go back to the sub-microscopic world whereas the physics is very hands-on, interactive. So we don't need it that much because we've already got a very good route in [???].*

The nature of the subject is a contributing factor in this instance, with the two sub-disciplines requiring different approaches to ICTs based on scale. Arthur and Hennie concede that it is probably the availability of the ICT hardware as well as the quality of the multi-media software that has sparked their use of ICTs to recreate virtual experiences otherwise not possible in the classroom. In this case, it is the convergence of the hardware and software together with the teachers' understanding of the consequent learning potential that sparks the change in practice. Apart from multi-media, there are specific websites that are valued resources. However, Arthur believes that the glut of websites encourages certain teachers to dump inappropriate information onto the students.

Hennie holds distinct views on the significance of ICTs and Arthur concurs that ICTs are but one of a range of tools available to teachers. Although they both refer to student learning, they describe ICTs as teaching tools over which they have control, rather than as learner-controlled tools:

HJ196: *It's difficult because it's got its place, but I don't want it to … to over-rule my teaching and what I do in the classroom. But it's a very, very fundamental useful tool. But it's actually … but I tend to use it when I feel that "this tool will help me with this", but not as the only means. Having a data projector and that projector and this is how we do it, or computers or cameras or whatever … [shakes head negatively] … for me I'd like to use it and I'd like our department to do that [turns to AS] just to … when the message … when learning is required, what's the best tool to accomplish that learning and if it's ICTs, fantastic, but its not the only tool.*

AS197: *I think Hennie's right. Another very useful piece … another weapon in the armoury. I have a very strong aversion to lessons by PowerPoint, because I think that … [nods] almost always, it's just another way of putting sage centre stage.*

AS201: *You see, whiteboards or Smart Boards – Smart Boards – they've got their use but I've got a data projector and I use the data projector every single day, but very seldom will it be on for more than a few minutes in a lesson, because its there to make a point and when the point's made then you move on and you do whatever else. Ja, so Smart Boards are useful, but um … a conventional Smart Board is far too expensive. I don't think its resources well-spent and it's got the danger of being a new tool and you want to play with it while you do this. I think overheads[14] did exactly the same 25 years ago or whenever they were introduced. Um … I can remember teachers who sat down at the overhead and wrote on them. It wasn't good teaching. So, I think …*

HJ202: *[to AS] If you say it's 'not good teaching' … I mean, if that's the only thing you do …*
AS203: *… then … that would be better …*

HJ204: *… But if there's this one lesson and you've got this … you want to plot this graph and you know that this is fantastic and there's this machine can do it for you …*

AS205: *… by all means. Absolutely perfect. So, it's another resource to use when you need it, when it's the best …*

HJ206: *Don't you think – it's just occurred to me that … it's very individual. Because I … I can think of some members of staff who would love doing it because the [???] next year*

[14] Overheads = OHPs or overhead projectors

the lesson plan is done and it's OK and its fine and I've done this. But my teaching style is every year … I never do the same thing. Maybe I'm just stupid and wasting a lot of time that I complain I don't have, but I hardly ever [...] there's never the same lesson done in the same way. Does that make sense? I would know that this prac works very well, but even then I would change the chemicals or write something different, "let's try it". But I think where the interactive whiteboard has got this advantage is that you don't have to re-plan lessons, but the disadvantage is that you don't grow as a teacher, I think. Well, you might use it, sorry, to actually add stuff, because I know you can do that, but it's … I don't know …

***AS207:** But if it's a different class and you've got a different relationship you probably need a slightly different style.*

In this interaction between Arthur and Hennie, they both reveal the extent of the influence of their beliefs about ICTs and their potential in the classroom. Arthur is averse to what he perceives to be pre-prepared lessons delivered through PowerPoint, implying the presence of projectors and multi-media PCs for teacher-centred delivery. This is an oblique reference to a colleague who bases her lessons on PowerPoint presentations. A spirited discussion ensues in which each stand their ground. Hennie chuckles as electronic whiteboards are mentioned as part of this teaching method, implying reservations that he has about this technology and how his colleague uses it. He challenges Arthur on the point of good teaching, to which Arthur responds by reiterating his point on ICTs as just another tool in the teacher's armoury, again focusing on teacher-centred use. Hennie at first reveals a naïve understanding of a PowerPoint as a means of locking in a lesson for perpetuity. However, he then admits his lack of logic. It would appear that he has a bias that he cannot explain or justify fully. Arthur concludes the discussion on this point, attributing choice of strategy to the complexities brought about by the inter-relationships between a teacher and each different class. This interchange reveals that although the teachers are comfortable with certain technologies, they take time to rationalise those that they are not familiar or comfortable with themselves.

Use of ICTs as a communication device and link to real-world contexts has been limited to project work[15]. It has not been used at all for curricular purposes (e.g. for online collaborative projects), except in individual project work in which, even if suggestions have been given, students have not always made use of expert contacts:

> ***AS218:*** *I've suggested that and I've found the boys very reticent. I've given them a name. The Grade 10 projects …*
>
> ***HJ219:*** *[…] The Grade 10 project … […] yes, we do that a lot. I've given them names and other peoples' telephone numbers and they do contact them by email, by phone. Yes. Not as the syllabus, but as the wow stuff, additional things.*
>
> ***HJ221:*** *Yes, [projects are] not prescribed. It's a free market. They can do whatever they like. We encourage anything as long as it's new to them. Even if it's something I've seen before but it's new to this boy and he's designed his telephone or a camera. It's new to him and whatever technology he's used.*

Project-based work is used, inter-alia, to encourage innovation amongst the students. Hennie's use of the expression *'the wow stuff'* (HJ219) in referring to project-based work implies that the Physical Science curriculum (or syllabus content as he calls it) is less interesting to the students than self-directed project-based work. The Grade 10 projects were introduced more than 20 years ago, but are still successfully sustained and over the years some of the school's students have achieved recognition nationally and internationally at science fairs. The question arises of whether the formal curriculum offers less than what the students are able to learn by themselves if such independent learning is indeed *'the wow stuff'* (HJ 219) that interests boys.

[15] Each grade 10 student has to complete a major investigative project either individually or in a group.

6.4.2.6 Discontinuation of innovation

One discontinued innovation[16] was an integrated cross-curricular module developed together with the Geography department at the inception of the new Natural Science curriculum.

> ***AS183:*** *We've actually developed a very nice module that involved looking at rocks using microscopes as well etc. which was very nicely integrated, [???] but I think we've kind of lost some integration [in the Natural Sciences] as other people have taken the module over.*
>
> ***AS185:*** *[…] … in that particular module, just because the next person took it over.*
>
> ***HJ186:*** *[to AS] But, I think what Mary was saying was working with the Geography … a bit of Geography in and …*
>
> ***AS187:*** *Which there should be, you see, in the department of Natural Science. […]*
>
> ***HJ189:*** *There's a lot of common ground. There's a water module that we created and I think [the Geographers are] doing it in Grade 10 as well, the whole cycle, the whole water cycle. And in Grade 10 we do the water cycle now again. So, there's lots of scope.*
>
> ***AS191:*** *We did, for one year, have the Geography department in the Natural Science department. That was very … um … [long pause].*
>
> ***AS193:*** *[It did not continue …] it was time-table and [other factors] … mainly time-table. The person involved was very keen to continue. Also, we were slightly over-resourced in Natural Science, so that was the main reason. So that was a real thing.*

In this instance the innovation involved the cross-curricular collaboration, co-teaching in each others territory as well as a new area of curriculum. However, the innovation was not institutionalised due partly to systemic factors, with staff changes resulting from the scrapping of Physical Science as a compulsory

[16] This section is included here as the response was provided in relation to ICTs, although it is not only ICT related.

subject in the school. This change impacted the ratio between student numbers and teachers and, where a Geography teacher had originally been drawn in to assist in teaching this module, the arrangement had to fall away. A further reason was intimated, but not fully or comfortably revealed. The interplay between staffing ratios and other factors might have been used to weigh each against the other in the decision to discontinue the module. In this case, the relationships between departments as well as between individuals within or across departments weighed more strongly than the advantages that the integration initiative might have offered to student learning. Relationship management thus emerges as a factor in sustainability.

6.4.2.7 Intra-departmental collaboration in ICT use

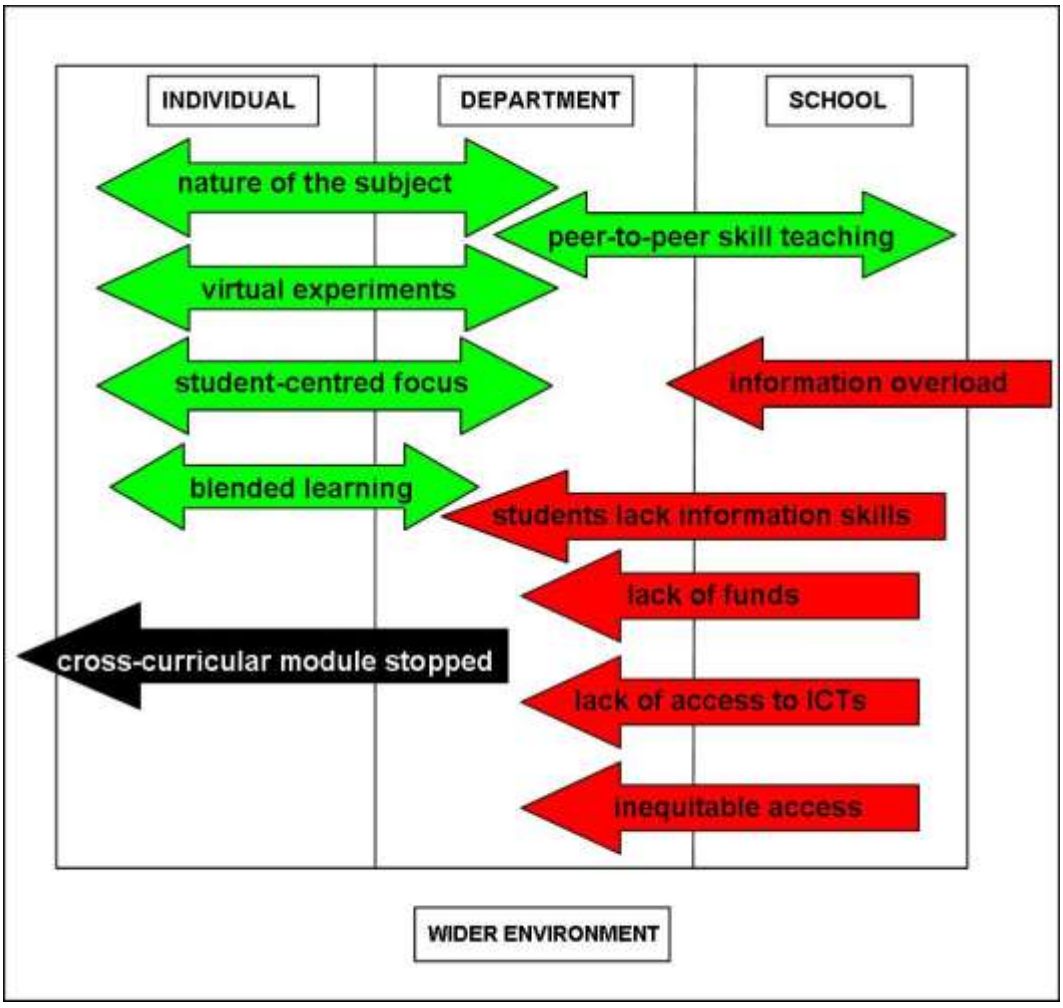
In answer to the question of how they work together as a department in integrating ICTs, unlike in the Life Sciences department which is characterised by a transparent commonality of being, in their department, according to Magriet, there is little perceived intra-departmental collaborative support beyond administrative tasks. Her evidence corroborates the point Arthur and Hennie raise (AS28/30: Ch.5 Section 5.6.1, p.224) regarding relationships in the development of modules. There is support for day-to-day administrative tasks but, it would appear, no curriculum support or professional learning support:

> ***MD218:*** *I don't know whether this is an example, but like Hennie knew for this one programme, we would all need it. So, he went and booked eight lessons. And then I just said "Fine. Eight lessons. I need Tuesday. You need Thursday, you need Wednesday and" … so he goes ahead and booked ten lessons, because there's no time and you just pick which one's you want. I think that's basically as much as it goes.*
>
> ***TL219:*** *Yes, as a department I think, we …*
>
> ***MD220****: … that's how far it goes.*

6.4.2.8 Summary and preliminary findings: Arthur and Hennie, Thabo and Magriet

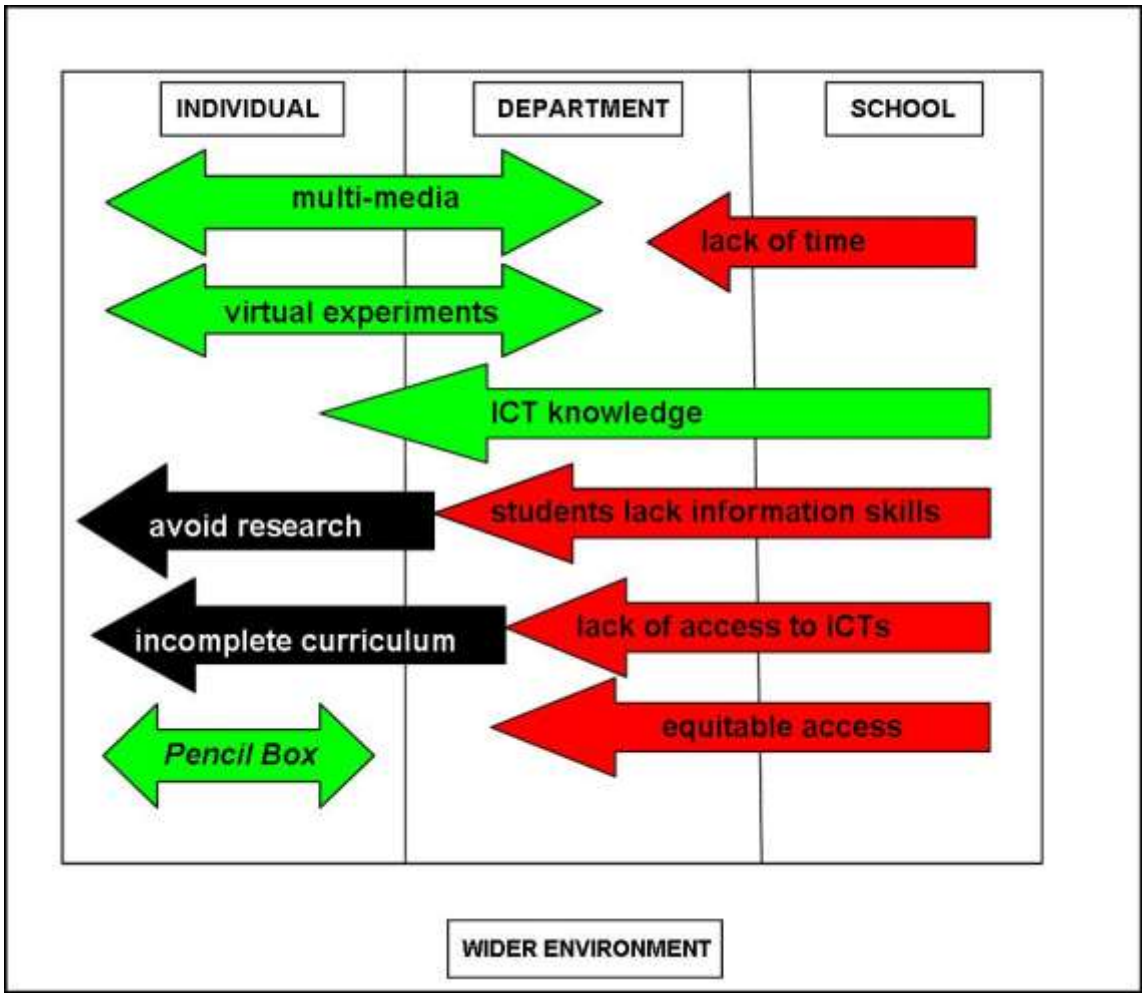
The patterns of convergent and disconvergent factors that affect Arthur's and Hennie's use of ICTs are illustrated in Figure 6.2 and those of Thabo and Magriet are illustrated in Figure 6.3.

Figure 6.2 ICTs and innovation: Arthur and Hennie



Four perspectives are provided in this case in that two interviews were conducted, each with two participants involving ordinary teachers and HODs. While each teacher expressed dependence on ICTs as integral to their practice and they share common views on the impact of ICTs on their curriculum, there is variation in their views on the impact of ICTs on their practice.

Figure 6.3: ICTs and innovation: Thabo and Magriet



Use of ICTs is influenced by the individual teacher's beliefs, their ICT proficiency compared to that of their students, and the grade-level and character of the specific class they are teaching. Multi-media provide a significant resource for Physical science in that it has capacities that are an improvement on real experiments, although the contradiction is that boys prefer the messy, hands-on approach. Whilst the boys have a natural affinity for technology, such as described in their peer teaching of Excel skills, they also have hands-on needs that are counter-intuitive to sophisticated technologies. All four teachers concur on the advantages of multi-media projection as well as the limitations of being without it. ICTs are perceived as classroom tools over which teachers have

control or for student use in functional or reproductive learning tasks (Brackett 2000, p.3), but not transformative tasks. These uses contrast with Arthur's focus on student-centred learning (AS9/11: Ch.4, Section 4.5.2.2, p.167). There is inconsistency between the Life Sciences and Physical Sciences approach to graphing and the use of ICTs for the purpose.

However, disconvergent factors such as budget limitations; the security risk; information overload; serious access limitations; the provision, on-hand support for and maintenance of ICTs; and the decision making process for ICTs undermine integrated use of ICTs in the curriculum and, in some cases, limit the planned delivery of the curriculum.

Reliance on the administrative system, perceived by Magriet and Thabo as a significant ICT innovation and considerable time-saver, is undermined by the fact that neither has a functioning PC in the classroom and requests for maintenance are apparently not always met.

Students manifest a lack of information literacy which presents problems in research-based tasks, particularly for Thabo who uses ICTs regularly for resource-based learning. While Thabo is disappointed by what the students produce, Magriet ignores research-based tasks altogether. Both teachers are aware of what the boys are doing, but do not appear to have the pedagogical means to counter it. It is apparent from their interchange that scaffolding of the learning process is lacking when students are required to do research using the Internet. Although the school has developed an anti-plagiarism policy that specifies the need to design learning experiences that avoid cut-and-paste plagiarism, the mandate does not ensure that the actual change happens. Bronwyn and Ineke had pointed out that boys did not like their methodology, but by scaffolding the process they were able to ensure that the desired learning

outcomes were achieved. If Magriet and Thabo were exposed to their methodology they may be able to address these problems.

The discontinuation of a cross-curricular module leads to the question of where responsibility lies for relationship management and what resources are at an HODs disposal for ensuring that student learning interests prevail.

6.4.3 ICTs and innovation: the case of Henry

Few teachers raised the presence of ICTs in response to the question of how mandated changes had impacted their classroom practice as described in Chapter 4. However, Henry recognised the potential of ICTs to help achieve mandated change and stated that his classroom was well-equipped for the purposes, describing it as a *'fancy lab'*. He has access to not only ICT resources, but other resources too and is completely satisfied with what is provided. He is comfortable with the idea of experimentation and change, as well as with the ICTs themselves.

6.4.3.1 Process innovation

The greatest significance of ICTs to Henry is the real-time factor that access to the Internet allows. He provides examples that illustrate this point:

> ***HN81:*** *Ja, the real live, real time, real time weather, real time volcanoes, earthquakes, that kind of stuff … so we used to say "Go and write us an assignment on Vesuvius or Etna or Mount St Helens or whatever". Now we say to them "I wonder where the greatest volcanic activity is this week?" They all look at you "No, there've been no volcanoes this week". "Go to the Internet and find out. There've actually been about 40 volcanic eruptions this week. Or earthquakes or whatever …" I explain to them … something like that tsunami was the most amazing real-time experience because you walked into class - and obviously that happened during the holidays – but … um … everyone wanted to talk about it and <u>everything</u> was still in real time mode although it was two weeks later that we walked into class.*

HN83a: *… and imagine if it had been in real real-time. In fact, on the day it happened it was still possible to look at the Internet and see where it had hit already and where it was still going to hit … which is incredible. Now that kind of stuff … um, tracking Katrina … tracking Katrina was just the most amazing thing because you had George Bush standing up there saying this is, you know, not going to happen and we sitting in the classroom saying "George Bush, you're a bloody idiot because it quite clearly is going to happen" and all that kind of stuff. Katrina was the most amazing real-time stuff […]*

HN83b: *[…] and what it allows you to do is that this is exciting 'cause you're now teaching thunderstorms to the kids. So you teach thunderstorms at the time of year i.e. now until February when there are going to be thunderstorms. So you teach in the classroom, you look at it on the weather radar and then you go outside and watch the same storm in real time. So the real real-time learning is a massive boost for Geography. Um … and obviously coupled then with things like Al Gore's movie*[17] *and that kind of thing. You watch Al Gore's movie and then you enrich that with saying "Well, what is the CO^2 value in the atmosphere now? You know Al Gore's movie is now two years old." "Gee, it's a 10% increase in two years. That's actually scary stuff." Or sea level change that you can see all the graphs ticking up. And the guys … you know, scientists who say this is … this is a slow process look like they're going to be wrong. I think everybody just about knows that global warming is real. But, they engage directly with it. It affects their lives. I always say to the Geography students: "Geography's about your lives, History is about dead people". And that's a serious point because the Internet allows us to engage directly with it. That's a huge [???]. And that … having a digital projector in the classroom to look at the stuff as it happens.*

HN119: *[…] What … what is interesting is that more and more I'm getting asked, as the geographer, about things that affect [the school]: the lightning conductor, the general weather and that kind of thing. Now none of that would have happened without computers. I mean, people would ask me "Oh. You're the geographer. What will the weather be like?" and I would give them my amateur opinion, but now I can give them a pretty professional one. And say, for instance, lightning predictions … now that appears to have nothing to do with education, but integrate that with … with … we're going to do it by cell phones and so on and we have a system whereby if the alarm goes off the alarm will get to the alert level and then come to the Geography department for us to say if this is a real or not real or whatever. Now the kids are, I'm sure, going to tap into that. That's*

[17] Gore, A. (2006) *An Inconvenient Truth (*documentary on climate change)

going to have some strong educational spin-off. And there are all sorts of things of that nature. There's a lot of integrated thinking going on informally because of those kinds of things. But we've lost integrated thinking for various reasons.

These examples of seismic and weather events illustrate the impact of real-time access to ICTs. The new curriculum has the flexibility to incorporate global or local events i.e. transformative learning is possible and happening through the use of ICTs. Technological advances such as the school's lightning warning system[18] enable real-time learning in the broader curriculum.

Having access to ICT resources in the classroom is a critical factor in Henry's ability to respond to student needs, particularly in providing instant answers to students questions. He is comfortable with admitting in conversations with students that he does not know all the answers: student questions are valued. Here, the presence of ICTs aligns with his thinking about his classroom practice. ICTs also enable formative assessment of draft student work:

HN85a: *Ja. The … the accessibility … mid … mid-lesson somebody will ask a question and I'll say "I dunno. Let's check the Internet". So you just put in a Google search, carry on with the lesson, then you check the answer and you tell the kids. So just having one computer in the classroom for Geography is a massive boost and I suspect that that's not happening a lot in the other Geography classrooms. And this is going … "there's the worksheet" [gestures]. Kids don't ask their own questions, they answer teacher's questions. Whereas in my class I take more and more and more liberty with the questions they ask. I just give the kids balls straight back at them. […]*

HN85b: *Then also the manipulating of the kids work itself is important. They can email me stuff … first drafts … big gain you know if first drafts come through email. I comment on it [???] and email it back to them and the [???] draft comes in two days later. [???] That kind of stuff is very useful.*

[18] The school is in one of the highest lightning incidence areas in the world, a fact established by Schonland between 1955 and 1960. See: http://janus.lib.cam.ac.uk. Given the extent of the playing fields and numbers of students involved in sports in the afternoons when summer storms are most likely to occur, protection from such weather extremes are essential.

6.4.3.2 Product innovation

Henry has little interest in teacher-centred technology such as the *e-Beam* and electronic whiteboard (EWB[19]). He would prefer to have networked PCs in order for students to participate actively in lessons. He shares his opinion on these technologies:

> ***HN88:*** *The classroom … an interesting thing about that is Smartboard technology doesn't excite me that much partly because of price so that that other thing which goes in the corner of the board … [e-Beam]*

> ***HN90:*** *… which can't do quite as much as a Smartboard but does about 99% of what a Smartboard does [and] is much more attractive. But that kind of technology enhances the management of teacher-centred learning. It doesn't do a lot for learner-centred learning and … um … that's why it doesn't excite me that much as a technology. When you're in teacher-centred learning it's nice to have but I don't see it as dramatically enhancing learning until that is networked and then you can say to the child "Don't come up … don't come write on the board" as we used to say, "but just sit on your computer and show the class what your thinking is. You know, just draw a diagram." So often you get a situation where a kid comes asks a question by drawing a diagram. Now that kind of thing you can improve dramatically with Smart Board technology. I mean it has to be there in a way that the kids can all contribute to that. So your little local … local area networks that talk to each other which the Apple had very easily … automatically like apples on a string …they all talk to [each] other. […]*

6.4.3.3 Information literacy

Henry, like Thabo and Magriet, is also concerned with how students interrogate the Internet, decrying their lack of information literacy:

> ***HN27:*** *Yes, that breaking down into smaller questions is to me … so fundamental to education. I don't know if you've seen the quotes I've got above my board. My first one is Piaget "Intelligence is what you use when you don't know what to do" and the second one is "Dare to be wrong". The third one is "You only learn by answering your own*

[19] Although his preference would be for a less costly *e-Beam*, he accepted an EWB when it was offered. This situation came about as EWBs were passed as an approved technology, ordered and then homes had to be found for them i.e. decisions on purchase were not driven by need.

questions or by teaching somebody else". And the fourth one is that "The best way to have good ideas is to have lots of ideas". And then I've also got Einstein's "The problems of today are not solved with the thinking that created them". So those quotes summarise the way I see things and we are not generally using our resources to match those ideals. […]

HN23b/25: *[…] [my approach] manages the question they ask of the Internet. And that's why, one of the reasons why, I think [it] works so well when it's working because they're not wasting time. But, um … when I invigilate other classes in here [...] walking around looking at what they're doing, it's still the shot-gun. This is the topic. Then they get 25,000 replies and they read the one at the top of the list and that's it [...] instead of asking a specific question which is very, very focused. So we can do a lot, lot better at managing [how students use the Internet].*

HN27-31: *[…] By the time they get to Grade 10, that kind of approach they should fully understand, but they don't. If you give them a topic to research they don't automatically break it down. They sit and look at it until you tell them where to go. And that I find scary. So the whole … and I think that comes out of if you go back … if you go right back to really … there's this whole big thing about teaching them to think in prep school. [...]. Imagine if we had those kids coming into Grade 10 – 15 or 16 year-olds – where we didn't have to teach them the content of South Africa. We can now talk about development and those kind of things. It would be a totally different thing. And that's where I think we're missing out. You know, technology of all … technology in its broadest … in its broadest sense.*

Information literacy skills are introduced into his Grade 8 curriculum through resource-based learning strategies. Henry has developed a specific methodology for students to use to interrogate information. He is critical of other teachers who he believes do not employ and support question-based methodologies. His views correlate with my observations on this matter. Although all students are provided with a short intensive course in information literacy at the start of Grade 8, there is no process to ensure that the skills and the tools that they are introduced to are used and built upon by teachers across the curriculum, although support for this purpose is readily available.

Higher order thinking skills are discussed in HOD meetings and in other forums (e.g. the Assessors' course). Henry makes two observations about thinking skills. Firstly, he firmly believes that the development of thinking skills underlies students' use of information. Secondly, in his opinion, it is critical that these skills are imbued at the right stage of a student's development. He advocates a stronger focus on basic content in preparatory schools, with thinking skills introduced at a later developmental stage. Further, he points out that the school is not using its ICTs to help develop such skills in students. To Henry, ICTs are key to helping the school achieve its wider goals such as developing the thinking curriculum.

6.4.3.4 Enablers and constraints

Henry highlights a fundamental difference between the school's ICT policy and teachers. There has been a greater focus on limiting and controlling access to information rather than developing ICTs as learning tools with most of the IT budget committed to technological implementation and very little on pedagogical support (Anderson & Becker 2001, p.3). A further example is that the mobile phone policy bans their presence in the classroom rather than exploiting their potential. Like Arthur and Hennie (AS 233/HJ 234), Henry criticises limitations set by the school on mobile phone use:

> ***AS233:*** *Boys use a lot of cell phones to record experiments. In many of my Matric experiments …*
>
> ***HJ234:*** *Stop watches. I don't order stop watches any more. Don't tell [the principal] Actually, tell him. I think … we're so stupid in banning this tool. [laughter]*
>
> ***HN17c:*** *[…] I think there's a technology where the power is not being harnessed because we say "Ah, cell phones are bad". Fountain pens were banned when they were first introduced. And what do we do? We ban cell phones, instead of saying "What is the power of this thing? What can we do with it?" […]*

Henry is the only teacher to provide evidence of attempted use of social networking tools with students, online access to which is also restricted:

> ***HN19b:*** *[…] [The students are] talking to each other all the time. […] But, let's use Mxit. Let's get … the power of co-ed without having to put them in the same classroom where they're going to disrupt each other. Um … you know, let's … let's put out this thing that the Science Department does: the question of the week. It goes out … it gets put in hard copy and gets stuck up on the Science walls and the guy who sends in the best answer wins a prize. Why aren't we doing that on cell-phones? And you'd get a far wider response. Um … so, ja, in terms of change I think, we've missed out big time. I think the way that computers have come in we've missed out because we haven't managed the process. The kids are accessing the Internet and they are learning stuff.*
>
> *****
>
> ***HN23:*** *No, we've over-managed the access, but we've under-managed the learning tool … um … in the sense that … ja … I mean you understand exactly what I'm saying.*
>
> *****
>
> ***HN17d:*** *[…] and um… you know that kind of thing. I don't know if you know I had a … an internal Blog on my… with year's Grade 12s Geographers.*
>
> ***HN19a:*** *[...] Now, as long as I was driving it, it worked brilliantly, but the moment I pulled back and said "Guys, just keep going" the questions just stopped. And the discussion stopped. I would, if I'd logged them all in said: "Right, we're going to talk today about this, and I'm going to give you marks for the questions you ask", then they were there and their inter-reaction was phenomenal. […] And you put in a question … um … a climatology question say "What is going to be the first impact of global warming?" They all then send their answers to each other and that. And you do get a few side conversations going, but it had to be driven by me to work. Now, I think there is a world, a whole world waiting there where we can teach the kids how to use that to their own advantage as they … I mean, they know it already. […]*

The blog that Henry created for classroom use ran on the Intranet only. However, the limitations of the use of this technology arose as much from student factors as well as policy factors. To succeed, use had to be driven by Henry

himself or it had to be marks-driven and did not occur as a natural consequence of students embracing social networking beyond the classroom. There is a contradiction here, in that while on the one hand he describes students' natural affinity for using social networking tools, on the other he identifies student indifference to applying the tools in the classroom.

While Henry is a constant user of ICT his enthusiasm and ideas do not reach across his department and he appears to be out on a limb. His beliefs about geographers influence his opinion and he has made it his mission to keep his colleagues informed of developments in the hope that, in time, they will use ICTs in the same way as he does. In this case, Henry is the teacher that champions ICT use, but lack of like-minded responses to ICTs thwarts more extensive use across the department. Henry explains the link between ICTs and geographers:

> ***MR105:*** *Do you think the fact that you're a Geography teacher … influences your approach to ICTs?*
>
> ***HN106:*** *Oh ja, I mean geographers … um … are big picture people and I think, you know, that's acknowledged … that scares the geographers [here] because they haven't integrated their big picture view of the world which obviously the Internet lends itself to. […]*
>
> ***HN108a:*** *Ja, absolutely … so it's the big picture thing that allows one to access the Internet. It's about modelling. Um … all of those things that geographers … Geographers are by far the biggest users of computers in the real world, by far ... in terms … in terms of academic use. […] Um … so the … the world of geographic skill has invaded all other worlds through GIS[20] and that influences the way geographers think about things and do things. […]*
>
> ***HN108b:*** *[…] I mean, access to Google Earth changes the way one looks at things. And I think <u>that</u> is… that having … we've only just now in the last three months had Google Earth made available on computers. Because of the over-control, we weren't*

[20] GIS: Geographic Information Systems (see http://www.gis.com/)

allowed to have it. So, we now have one computer in each classroom that accesses Google Earth. Um … I think I'm still the only one that's using it. What I am doing is downloading pictures off Google Earth, giving it to the other teachers [???]. [...] They don't go looking for interesting stuff. When I give them stuff, they're very interested. So, in that sense, the geography has impacted on all of this. More the ICT on Geography, than Geography on ICT and the department as a whole, although my approach as the geography … big picture, looking for knowledge, looking for connections. It's as it's always been … well, I've only used it in that sense.

In his response to the question on how he would rate the significance of ICTs compared to other changes at Wilding Henry, like Ineke, expresses the belief that the use of ICTs is far below the potential, given the network. To rectify this would require a radical change in systemic factors which he no longer has the energy to strive for. Henry explains:

HN110/112: *I think that we've done about 20% of what we could have done, given the network that we've got. Um … […] Because of everything we've said earlier about the way we approach computers and that … and … and … you know that blogging thing … we could have revolutionised the way we taught. "Kids, don't come to school today. Let's all stay at home and we'll talk by computers; not because we're lazy about coming to school or producing our homework [???] or anything, but because it creates a record of what our conversation is". You get … and you're forced to think about what you're doing. You're not just going to … and this is why the kids are so into Mxit. Because it's intellectually stimulating. Even if they're just exchanging humorous trivia, it's intellectually stimulating and we are missing out massively on the potential of the network […] Do any of [the computers] talk to each other? Not … not as far as I know.*

HN116: *I mean there is an opportunity waiting to be explored. So we're way, way short of where we could be. There is none of the … I mean we're talking outside of the computer department. I don't know what's happened there. There's none of … imagine if we could get a debate going on why gravity's important among the Grade 10s in the Science department. And then they teach gravity. That comes after. So I really believe 20% is a fair figure … potential compared to what we've achieved.*

> ***HN121:*** *I don't think so. Um … if I was 40 I would probably approach it far more aggressively and make it happen, but at this stage of my life I tend to think it's not worth the effort that's necessary to get it to happen. But also, we are locked into such a model that you've actually got to just about tear the buildings down and start again, let alone … let alone the management structure of the school in order to make real learning happen. And that is a frustration … […] But within … within the learning model that we've got, it comes down to individual enthusiasm, and while I have the enthusiasm I personally [???] classroom.*

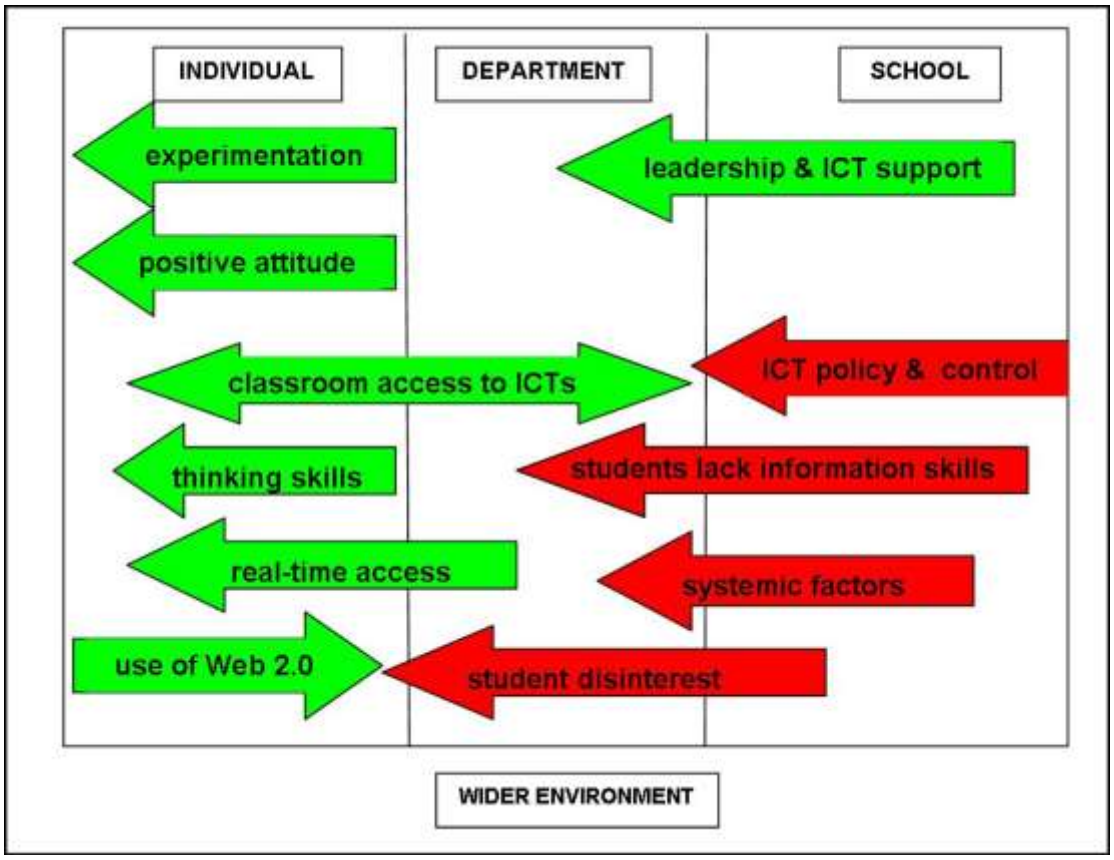
Whilst Henry acknowledges the support of individuals in the school leadership and the IT department, he believes that the ICT policy and the learning model as implemented in the school limit innovative use. The example he provides of restrictions on Google Earth illustrates technology-based rather than curriculum-based decision-making, although bandwidth is a very real factor. Part of the problem is that there is no access to social networking technologies (blogs, wikis etc) and students are not permitted to publish their work to the Internet via the school network. Students use their own mobile devices for social interaction, but are prevented from using them as learning tools.

6.4.3.5 Summary and preliminary findings: Henry

The pattern of convergent and disconvergent factors that affect Henry's use of ICTs are illustrated in Figure 6.4.

Henry is enabled in his innovative use of ICTs through his comfort with technology and his approach to constructing knowledge. Classroom access to ICTs allows him to incorporate real-time global or local events or conditions into his practice. In this case, the nature of the subject, his enthusiasm for his subject, the presence of ICTs and his ability to exploit opportunity timeously converge to allow real-time learning experiences. Lacking ICTs, such experiences could not have occurred.

Figure 6.4: ICTs and innovation: Henry



Despite the convergence of many factors in enabling his innovative use of ICTs, disconvergent factors limit the extension of his innovations on a broader front. Whilst he acknowledges the support of the current leadership as well as the support of individuals in the IT department who help facilitate his incorporation of ICTs into his practice, technology-based rather than curriculum-based decisions frustrate him. There is a contradiction between students' social networking skills based on mobile technology and their inability to work co-operatively in the classroom. Students need extrinsic motivation to use social-networking tools for school purposes. Access to online social networking tools is prohibited and students are unable to publish their work via the school network. His thinking is out of alignment with that of his colleagues in his department and his championing of ICTs therefore goes partly unheeded and limits extensiveness.

He is also critical of other teachers' shot-gun approach to research which adversely affects students' information literacy abilities.

Henry describes a mismatch between the capability of the network and how it is used for learning. He concurs with Arthur and Richard that access to ICTs is over-managed whilst learning is under-managed and that the school is locked into a model that is limited by systemic factors. Henry describes not only what is, but what he would like to see. His creative thinking continues through the interview which he uses as an opportunity to share ideas. He believes that his ideas are ahead of the school's thinking, but he cannot progress further personally because of the policy and systems that control the use of ICTs.

Systemic factors are the greatest constraint to Henry's ability to innovate with ICTs and relationship factors curb the influence that his creative thinking might have had. Age and experience resign him to the problems rather than encourage him to contribute to a solution.

When Henry refers to his practice he uses the singular "I" and when referring to the school he uses "we". He speaks either for himself or for the school, but not for his department, illustrating the lack of alignment with his department's thinking.

6.4.4 ICTs and innovation: the case of Richard

There is contradiction in the case of Richard in that, despite his affinity for innovation with ICTs, his goals are constrained by student-related factors as well as fellow-teachers in the practical component and by limited information literacy skills in the theoretical. The school's approach to ICTs also has a limiting effect.

6.4.4.1 Process innovation

Richard is a highly competent user of ICTs with responsibility, *inter alia*, for the school website. He has introduced Computer Art (RL20a: Ch.4 Section 4.5.4.2, p.188) into the IEB curriculum nationally. However, contrary to expectations of students as digital natives (Prensky 2001, p.1) his students have not taken to Computer Art as anticipated. Richard describes his dilemma in detail and offers possible reasons for the lack of success with the medium:

> ***RL77:*** *It's definitely something in the way they use it. Obviously it's not being … something's wrong. I mean I also did … I gave a course on teaching the IEB teachers. So one would have thought there would have been more IEB schools using … well, pushing that area in the arts and there have been – slowly. As I said, there were these two girls last year and a couple of schools have done computer art now. But it didn't … most teachers when I'd finished my demonstration and presentation I felt were scared. And I tried to take away the fear. My whole point of the demonstration was to show teachers that they don't need … I gave them techniques on how to teach without knowing anything, without knowing any software. How … that was my problem when I started teaching … um … using more sophisticated tools than chalk … was how do you teach something if you don't know how to use it? How would you teach how to drive a car if you don't know how to drive a car? So that was my problem. That's what I tried to teach the teachers. So I developed techniques for that because obviously … teaching, you … I think you learn more because now you've got a lot of people teaching you back … students teaching you back. And I think if you can just motivate it and use it and that was a technique I came across quite early in my teaching of computer art. Because, as I say, I started it, but it doesn't mean that you know everything. Even today, even now, the students will come and teach me. And that's what … but the teachers didn't quite get it … I felt [laughs]. But there has been a gradual increase of teachers now allowing students … like I was discussing at the last conference … the one teacher came and said I should come and do a demonstration at their school because they don't know anything how to teach them … ja, and to me that's just fear, I suppose. That's what I was just talking about … you've got to lose that. <u>And</u> if you're interested, then you just do it. I feel it's <u>essential</u> that those things are taught, that's why I offer it. But I have allowed this window, this door and … um … you know, the student is really, they just can't get it. I don't know what you do. My technique at the moment is now really going … because I'm now like going like I would go with … I suppose as if I was teaching Grade 4 [laughs]. So*

far, that's the speed I'm working at now with this technology. So we've had to go really slowly.

RL79: *It's not only what I have time for, it's not what I believe in teaching. I don't believe in teaching applications. I'm still trying to find a way of solving that problem. For me it's basically the students don't have the background. Um … and I don't know if they see the worth of the tool – technology. Either it's that or … the technology, the Internet, the computer is outdated already. Computers and PCs need to be thrown away – basically - in education. So, it could be that and that the new tool is the cell phone.*

*****

RL83: *[…] I went to a conference on communications in Africa. [...] They made … one of the statements that struck me was Africa […]. But they were saying that Africa has the highest sophistication of cell phones. [...] There's a guy who's come out here promoting some … I think it's like a Mxit kind of thing. But he was saying exactly … they want this market because Africa is … has the most sophisticated … uses the cell phone in the most sophisticated way [...] compared to American and the Europeans.*

RL85: *[...] phones are becoming more … Internet based as well. So you're going to have more and more of that kind … but I personally haven't yet seen a way of being creative on it. You can be creative with it, but not on it … in it [laughs]. You know, I think it then goes into the field of programming and that's where I would go, but it would move away from what I teach.*

Richard is surprised and disappointed at the resistance to computer art from his students as well as from teachers at other schools. His personal experience with the medium has been extensive and he has run a course in computer art for IEB teachers i.e. his level of innovation has extended to professional training of teachers from other schools. He identifies that *'something's wrong'*, and suggests theories for what that might be. However, Richard also imposes self-constraints in that he does not believe in teaching applications. His methods encompass the acceptance that teachers can learn much from their students and he tries to transmit the concept of fearlessness of the unknown to other teachers, but with little apparent success. In this case, his difficulty in sustaining the

innovation arises from the distance between his own creative ability and that of his students and colleagues. The innovation has extended to the highest level and the ICTs are accessible, but the perceived benefits are not yet mutual and sustainability of the innovation is very tentative.

6.4.4.2 Factors influencing ICT use

In response to the question about the significance of ICTs compared to other changes at the school Richard contextualises ICTs, suggesting that there are a number of issues:

> ***RL91/93:*** *It'll be interesting … I think it's … I think there's a lack of [use]. I think traditionally in schools there's always been … it comes from the education and training. There's always been a lack of how one would use … um … equipment and what it is … and I think you basically summed it up when you sent around that document. For me, I sort of agreed with it. […] The [document] where you[21] basically said the administrators of the network can control the managers … um … through [laughter]. So I think we're at that place, we're at that point. You know, I don't think we've moved … and I think we're there, ja. So, it's like, I think, traditionally you had your accountants controlling managers. […] And I think now what's happening is that accountants still have their power, but the network administrators … I think can control the way that education … the use of the tool. And I think that is … and management doesn't understand that yet, in this environment.*

> ***RL95:*** *Well, obviously … you see, this is why one wonders if it is a tool that getting outdated and outmoded. The network has become so restrictive that its almost redundant … um … through security on the one level and on the other level its … um … in an environment, in a school like this where possibly there's such a huge usage … um … and I'm not too sure what … its obviously just got to do with money … one needs a broader band or something … but the bandwidth is too small. So, for example, when one is researching … I think when you ask students … not just researching … and to go on and to get information using the technology available, I think the educationalists need to sit down and try it themselves first, in the class, with the students. I know I've done that –*

[21] The article that Richard refers to is one that I circulated but which I have been unable to trace again. The article, as far as I recollect, is one that intimates that schools are under the control of ICT managers.

often - and I can understand why they go berserk. It's like watching paint dry. It's really frustrating, so ...

RL97: *[…] Now I'm talking about more the loading of … of information. So we're talking … even test. So if you sit and you're sitting with the student and you set them a task, sit with them and try and do the same task, it's so frustrating. Now working … and I found this right from … because I used to actually run a network at the last school I was at … except I ran it. It's always been an issue, this bandwidth issue. Its money versus who's going to put it in and who's going to pay and management normally doesn't see the value in it and they'd rather have another rugby field and another rugby ball because there you can fill your numbers because there you can see what you're doing whereas this is invisible. So why should you plough too much finances in? And I was quite … [this school] obviously ploughs millions into it … meant to be cutting edge, etcetera … of education. But it hasn't taken off that way and also … because of things like that … one is restrictiveness. The other is the bandwidth. It just doesn't load, it doesn't work fast enough. And I know about schools and models. I was involved with all that many years ago. [...] I've sort of been through that route and it still hasn't taken off. Is it just because its not management driven – which is, to answer your question, I don't know. Or, is it because it's redundant already? That I don't know either … um … but I'm open to both possibilities [laughs].*

The disconvergent issues that Richard raises are fundamental:

- the basic understanding of what a computer is and how it can be used in schools
- the predominance of the technical view rather than the educational view
- lack of understanding of the problem on the part of the school leadership: the use of ICTs is not driven by the leadership
- whether the PC itself is outdated
- restrictions on the network that inhibit the educational purpose that it is intended to serve
- lack of understanding of the reality of classroom use by the network administrators and

- competing priorities.

6.4.4.3 Intra-departmental collaboration in the use of ICTs

In response to the question regarding working together with others in the use of ICTs, Richard re-iterates what he said earlier (RL24-28 Ch.5 Section 5.8.1, p.247) about his collaborative relationship with his colleague. Good relationships are essential to the successful functioning of a department. An earlier experiment by the school with different roles had proved unsuccessful and been dropped in favour of a single HOD:

> ***RL87:*** *[…] I think if you're working with somebody who you relate to it works well, the system works well. The system didn't work well when she had less time, when she … when she was made HOD of Arts & Culture or something. Then the system didn't work because there were no guide … no leadership. So I think it works well when there's a leadership … because then we were two leaders trying to lead and we were walking with one foot forward … [laughs] … strapped at the ankle, going nowhere. One going that way, one going that way [gestures left and right].*

6.4.4.4 Enablers and constraints

Student application skills do not meet the expectations that Richard has of them. While the students come from privileged backgrounds and have access to a range of sophisticated technology, Richard claims that students still do not know how to apply them appropriately:

> ***RL68:*** *[…] the parents are normally providing and with all these modern gadgets which are quite costly. But what you find – I find – is that in actual fact the students don't know how to use those tools still. […] And I thought that this would get <u>better</u>. You know, when I started teaching computer art which is most probably about 15 years ago, maybe longer … that … I thought in about 5 or 6 years time these kids will be coming through and they will already know everything and I'll … you know … won't need to teach them silly basic stuff. […] I try and teach the thinking skills behind it. We try and get over the software. […] I find that the students are still coming through without the basics […]. So*

I think, if you speak to most students, they've got them at home, they've got them in the education environment, but they don't <u>really</u> know what they're supposed to do with it.

Similarly, Richard finds that students lack information literacy. His views concur with those of Bronwyn, Ineke, Thabo, Magriet and Henry as well as my observations. Richard finds this particularly evident in their Internet searches for the theory component:

RL73/75: *But even for the theory there's a lot of Internet research. […] And they're quite naïve about … seeking out information around the Internet which is shocking. […] I don't like to call it research because it's not really research, but their seeking of information, images and information. Um … which is very poorly done, poorly understood. Working in documents, text documents which is the lowest level of working possibly with the computer. They struggle … they seem to struggle. […] Ja, so the technology … I don't know where it's … where it's going to run. I've had to change my technique with the Grade 10s from last year, this year already … last year … last year I had 100% drop out in computer art. That was merely my misunderstanding, I think. Because I thought … […] My misunderstanding of the level of their understanding of the tool. Because I tried to get away from all the software teaching and moved towards the creative teaching too quickly. And … it just never finished … the whole class just dropped out. […]*

Richard eventually concedes that he misunderstands students' levels of understanding.

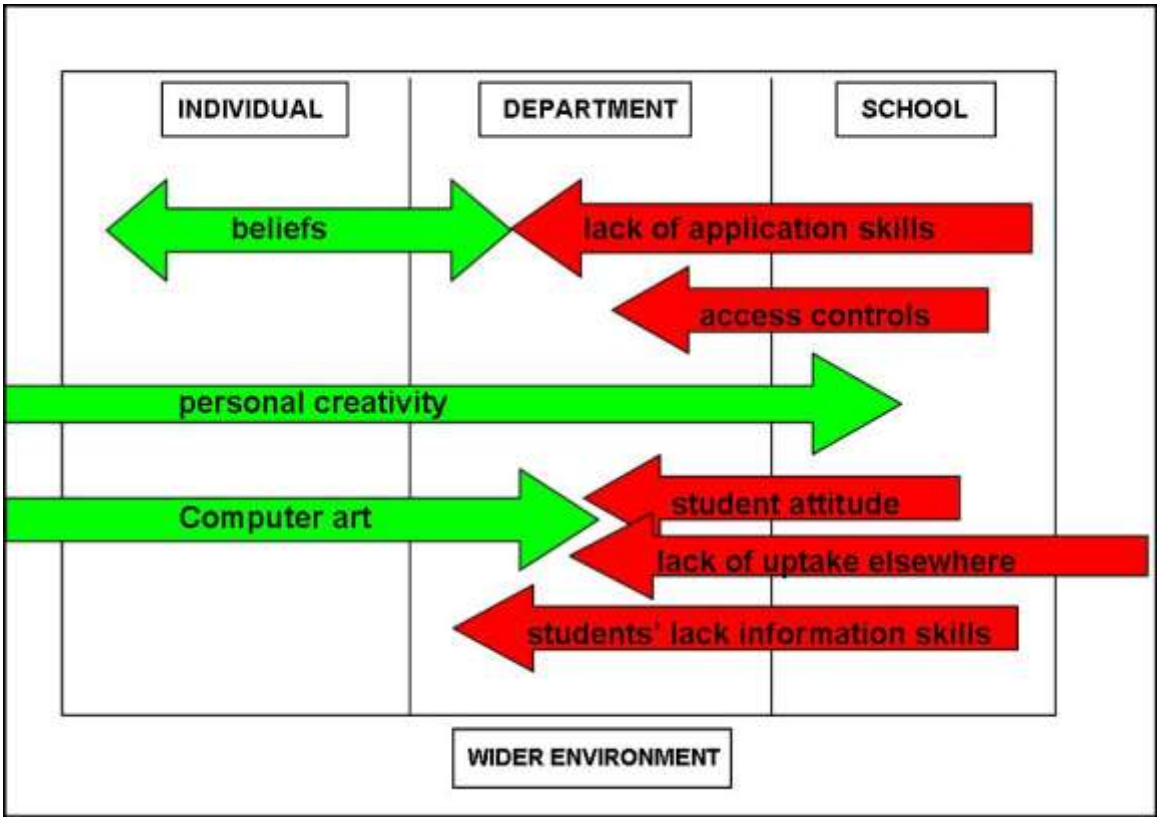
6.4.4.5 Summary and preliminary findings: Richard

The pattern of convergent and disconvergent factors that affect Henry's use of ICTs are illustrated in Figure 6.5.

Richard is highly competent in his personal use of ICTs and a creative innovator in the classroom. He has wide experience of ICTs, including experience of managing a network. However, he is frustrated by apparent student disinterest in

using ICTs as a creative medium in Art and by lack of open and consistent access to information. Richard also suggests that these factors are linked in that access control inhibits learning to the extent that students are turning to their own mobile technology for solutions. What this might indicate is a developing disjuncture between what is now a traditional provision of ICTs to schools and a more flexible mobile future that needs to be factored into long term planning. It is therefore possible that students' increased reliance on their own mobile technology is driven by their frustrations with access to information as this disconvergence occurs in all learning areas and not just in Art. However, difficulties associated with student learning may also be a factor in this particular case. Whilst there is convergence of a creative mind and provision of ICTs, the potential is countered by disconvergent factors and sustainability is tentative.

Figure 6.5: ICTs and innovation: Richard



The question that arises in Richard's mind is whether students have now gone beyond the personal computer as a tool and have, instead, a greater affinity for mobile technology that does not offer the necessary scale for computer art. There is a parallel between Richard's belief and what Henry finds with his students' apparent disinterest in using social networking tools in the classroom. Both teachers link this resistance to the influence of mobile technology. However, while Richard is disappointed in his students' attitude towards computer art, his view contrasts with that of Bronwyn and Ineke who believe that the effects of ICTs are very visible in the products of student learning. Secondly, although Henry and Richard concur on social networking and mobile technologies, Henry's use of ICTs for real-time learning parallel those of Bronwyn and Ineke suggesting that there is still very much a need for 'traditional' PCs. The variation is in the nature of the subject and the degree of specialised tools that each requires. The tendency is to refer to ICTs in schools in generic terms, whereas each subject area requires a different set of tools and a customised response to its needs.

Similar to his colleagues, Richard makes the assumption that students acquire information literacy skills elsewhere. This is a further fundamental point which begs the question of what can be assumed of student skills, particularly as they reach high school, and what has to be specifically taught. If lack of information literacy, for instance, is recognised by almost all teachers, where does the responsibility lie for rectifying this situation? Information literacy is embedded in the critical outcomes of the curriculum and needs therefore to be incorporated in every subject. It would appear that the requirement is being embedded without the scaffolding of the complex skills that comprise information literacy.

6.4.5 ICTs and innovation: the case of Maria

For Maria, process innovation is essential due to the nature and circumstances of the subject. She is reliant on the integration of information literacy skills in certain modules.

6.4.5.1 Process innovation and information literacy

Although she experiences logistical challenges in delivering the LO curriculum across the entire school, Maria embraces the idea of ICTs as part of the solution, particularly for Grade 8 and 9 students. She is influenced by the expertise of others and expresses keenness to experiment herself:

> ***MW158:*** *I want to use it more. I know I can and I want to use it, especially in LO, I think I can definitely.*

> ***MW162:*** *I think its right at the forefront, at the top, honestly. Um … I think its something that the teachers must and should use more and its there and it's available, I think, and there are people who can help us. […] [T]here are people in place like yourself etcetera who we can approach to help us if we don't know how.*

Maria is modest about her own abilities and acknowledges that it is through collaboration that she is able to integrate ICTs into the LO curriculum. Through our working together in the information literacy course she experienced the extent of students' PowerPoint technical skills. The methodology we use relies on customised templates to scaffold the learning process. Rather than teach applications the acquisition of technical skills is integrated into tasks using templates that require e.g. text-box controls, hyperlinks and inserting graphics. Research skills and presentation skills are also built into the task. The design of the tasks is originally based on a format gleaned from the *Intel Teach-to-the-Future* course. Initially, I would do most of the skills teaching, but Maria now facilitates the classes on her own. Maria describes the positive response of the

boys to the variety that these methods provide and the benefit to student learning:

> ***MW130/134:*** *Oh … OK. So that's been a huge … that AIDS brochure has been fantastic. Then obviously your … the presentations, but that wasn't what … but, you know for B2K, that you did with the Grade 8s. Then also last year we did a very nice project on religion … the religious leaders that they actually saved into Assignments. You know, that was also … I think it was … I can't remember if that was a PowerPoint? […] But that was very good. But I think I've still got a way to go with the IT.*
>
> ***MW140:*** *I had to do HIV AIDS with my Grade and I approached [laughter] this phenomenal lady. Mary, I have learnt so much from you and you have never had a moment when you couldn't find a solution for me. So, I don't know if I can talk to you personally, but every time I have approached you, you have made a plan. Um… that religious project was huge and you had that Intel thing set out and they … it was fantastic, so … and the AIDS brochure and the B2K project presentation … I don't know where you get all your ideas from. But anyway, you have been a life-saver to me.*
>
> ***MW142:*** *Yes, it does, it does [make a difference]. Um … I do believe, you know, if you vary the way you teach or facilitate teaching to happen, it benefits the boys. That goes back to the question you asked me just now. I think it helps them if there is a bit of a variety. You know, they expect entertainment 24 hours a day which we can't accommodate them. And I … I do get … I do resist that at times. I think, you know, you can't be entertained all the time. But that variety and the … to ask them to do something in a different way, in a different format, that definitely, I think sparks something in many of them.*

6.4.5.2 Constraints

Lack of access to the labs inhibits Maria's further use of ICTs. She identifies projectors and electronic whiteboards as possible classroom solutions, but graciously concedes that, although the lack of such tools in her classroom limits her, the school has more ICTs and better circumstances than most other schools:

MW166: *Ja, well. Maybe we're restricted, logistically, by the fact that we have only two computer rooms that's allocated to the teachers which I can fully understand. I don't know if we'll reach the stage where we'll have more teachers fully equipped with Smart boards and projectors because I think that's a fantastic way to go. And we're so privileged that we do have, that we do have that. I met a lady on Friday from Pietersburg. She teaches Grade 8s. She's got 60 learners in her class, who cannot … most of them cannot understand English yet and she's got to teach them Afrikaans. She at least knows a little bit of Sepedi. So she does three languages to 60 children in a classroom. And I just realised again, we are really privileged. We might moan now and again that some of our classes are big etcetera, but we've got so much that others do not have and I think we must really use that.*

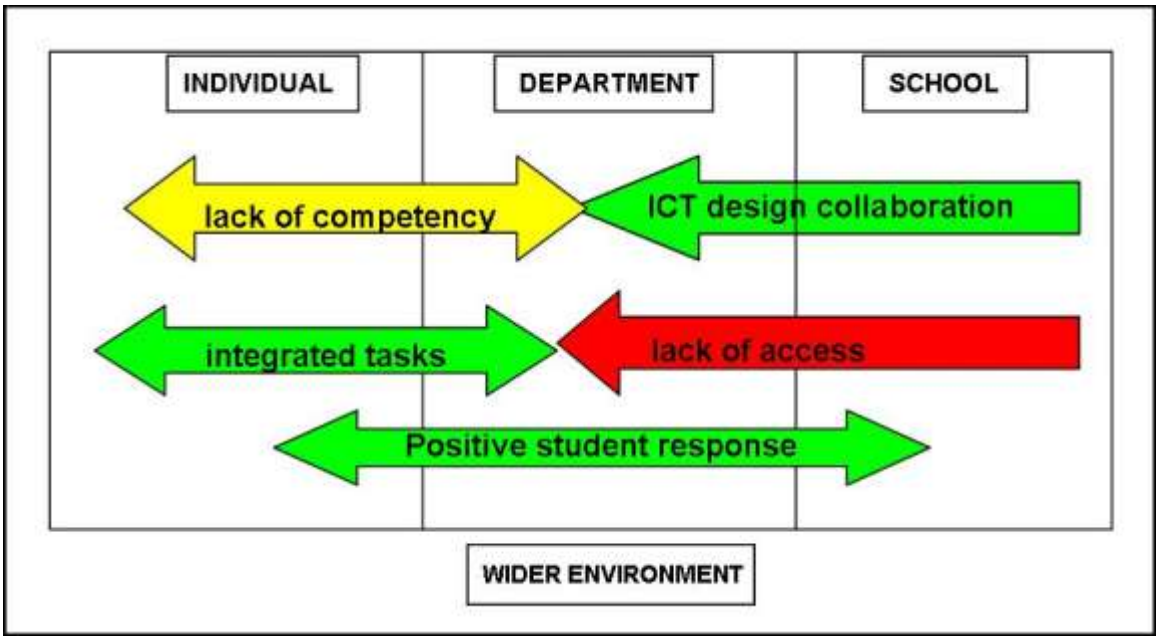
MW168: *Ja, ja. So, the fact … look, I was so inspired after the B2K presentations, so maybe the fact that I don't have the projector in my classroom can be seen as a bit of an inhibition. So, I think that would be more the fact that we don't have a projector in all the classrooms or a Smart board in all the classrooms or whatever. But, you can always make a plan. You know, its not, I think, a train smash at this stage. The biggest problem is that when you want to take your kids to the computer room, you are not always able to do that. But you can also understand that. It's not … its one of those things. I mean, its not … we do have the facilities, its just that there's a big need, maybe.*

6.4.5.3 Summary and preliminary findings: Maria

The pattern of convergent and disconvergent factors that affect Maria's use of ICTs are illustrated in Figure 6.6.

Maria rates ICT use at the forefront of change and has a positive attitude towards them. Although her own skills are limited, she is aware of what can be achieved through using ICTs through her willingness to work collaboratively. She is confident in her students' ability to use ICTs, if not in her own competency. Maria invites collaboration and is grateful for what she has learnt from colleagues in different departments. She believes that with the available support there is no excuse for any teacher to not use ICTs. Access to the labs is, however, a constraint, particularly as she has expended effort in designing ICT-based tasks.

Figure 6.6: ICTs and innovation: Maria



.

6.4.6 ICTs and innovation: the case of Francois

While Francois' aim is process innovation the beliefs he shares relate to product innovation. Systemic constraints play a significant role in the case of Francois.

6.4.6.1 Product innovation

Francois believes that the socio-economic status of the students drives ICT-based innovation at the school. His use of language (*'alarming'*, *'frightening'* and *'terrible'*) conveys his view of the school's and the teachers' race to keep up with technology. Francois shares his beliefs and suggests some solutions to the dilemma:

> ***FP88:*** *I'd probably say … I think there is a huge significance to using [ICTs]. Um … you know if you look at what is available as such and then … the jargon that the boys have got as far as … it's just frightening, it's alarming. And I suppose … you know, to an extent … you … it's terrible to think that it's all a race and you've got to keep up and provide them with that all the time etcetera, etcetera. But I think realistically that's what it is.*

FP90: *Well, [its] terrible in the sense that … well I wouldn't say terrible … I just think its great having those things and being exposed and all of that. But it's time-consuming too from the point of view as I mentioned. I mean, take the software programme. I need to go … I need to go and do a course to become literate in that. Um … you can't be expected to teach that if you're not literate … if you're not literate in the subject at all. And you've got to provide the service etcetera, etcetera. So that … that's difficult. I find that hugely daunting. That, you know, well … time, time's the biggest thing [juggles hands]. It's the biggest constraint. And the matter of extending yourself and learning something else … it's fantastic. But within the broader [school] community I think it's essential. You have to, being the school we are and the community we service. It's essential, it's a necessity.*

FP106/108: *The need is there [for laptops]. Definitely. Definitely. […] Absolutely. Absolutely. And I think also, you know, just going with the way time … things are moving – um portfolios, projects, etcetera, etcetera – you know, if you could do a lot of that in class as opposed to sending them home, I think that could be a solution too. Because I think the boys are feeling the pressure just as much as we are.*

FP110*: [The pressure] [i]n terms of workload and expectations and being compliant as such [gestures " "]. You know, the lingo for Grade 11s at the moment is "You know. Job. Prospects for the future. Subject choices. Are my marks sufficient?" So I think they're feeling those pressures and, you know, are they sufficient? And if you provide a service where the boys are certified in Pastel, as an example – an accounting software programme – by the time they leave Matric, then it's … its another big tick on their CV, which makes it so much more marketable. So that's the big need as far as I'm concerned. You know, for instance if we could have, you know – coming back to that – having a classroom that's set up for that … is compatible, Wi-fi, computers … everybody brings their notebook. "And for the next two weeks we're in this classroom. We're doing our software package and your projects come in at the same time. And at the end of it you're getting a certificate which you can apply to that software package. You're killing two birds with one stone".*

FP112: *Ja. […] So that to me is just hugely beneficial. But when we get to that stage, it'll be great.*

FP114: *[…] It's just the exposure to … access to the software programme for the boys and giving them the exposure and the time to do it is … is the biggest … the biggest thing.*

6.4.6.2 Constraints

The use of ICTs is mandated in Accounting as students are required to be able use an Accounting software package. However, an overloaded curriculum and lack of access inhibit the use of ICTs in this learning area. Francois explains the particular problems associated with his subject:

FP12: *We're scurrying … trying to say "What do we leave. What can we give them for self-study", just to [get] through the syllabus. That's it. And not to mention doing the software packages.*

*****

FP68-76: *[…] Well, I keep coming back to the software programme. We went and purchased the software programme with the intention of getting it going or showing them some exposure in the classroom. Um … we canned the idea. We lost the computers. […] Well, the software programme we bought initially couldn't be uploaded on the system because we'd have to get them … um user rights or something. So it means that … not just accessing that software but they'd be able to access more documents on the network. […] Yes, it's like an admin rights issue […] that was supposed to be a problem. And to order a … a sort of a dumping ground to store that … that software in and for them to use it, it was going to be too expensive. So they've chucked that idea and they've bought other accounting software now. So, ja, so it's been a bit of a process to get that. And, I'm not au fait with the software programme so it's a matter of being retrained and a whole new approach. […] Yes, yes [other schools have used the previous software]. And that seemed to be no problem. Now, whether they've got it installed on just isolated computers in the classrooms, I'm not sure. So, we just need to have a look … But, I mean, the software programme that the school's acquired is great. Um … it's just a matter of finding time. So the idea now is we're probably playing with boys running a six-weeks … a six-week course on Saturday mornings. And then they'll get a certificate that they're competent and that sort of thing. So that's the other alternative because syllabus-wise there's no time to fit it in. We could actually give up six*

full days to get on top of the software package, to introduce them to it. […] So, ja, it's a difficult one.

*****

FP92: *[…] I mean, for instance, you know, I talk about booking the Computer Lab for 3 days of … computer training on the accounting package. You can't do that. Because Computer studies … or, ja Computer Studies, that's what it's called. That's their … that's their classroom. So that's not practical either.]*

Accounting requires ICT-based methodology and specialised software, but in seeking to use it Francois has been thwarted by factors beyond his control. Specific software was purchased and he inherited a complement of 30 recycled computers adequate for running that software which would have worked perfectly as a stand alone system for the purpose as it does in other schools. However, school policy dictates that all computers must be linked to the network. The conflict could not be resolved and the Accounting department lost the computers in the classroom and their ability to teach with the most appropriate software. Instead, the software was changed. Francois and his colleague were required to retrain on the alternative software and now need to queue for an in-demand lab venue instead of a having a dedicated cost-effective facility. Francois' frustration is glimpsed in his words *'so they've chucked the idea'*: he is it at the mercy of the system.

Francois' frustration emerges again with the few options available to him. In response to the dilemma, with some irony, he considers a 'tour'[22] solution as a possibility for working with his students over an extended period of time. This is a further example of systemic factors inhibiting mandated curricular change. The system creates the problem, but the teacher has to find a creative solution out of necessity:

[22] A tour is a diarised event, planned in co-operation with other departments, which takes the whole Grade or part of a Grade out of the classroom for a full day. Typically it is an actual day-tour, but FP suggests the idea to solve the access problem.

FP78/80: *Absolutely! Look, it's something that has to happen. I mean, we have to … but before the boys finish Matric they have to have had some exposure to a computer programme somewhere along the line. So, you know, there's … trying to get our head around what is the best option with everything that takes place … sports-wise, culturally, to say to the boys "Now, you need to give up your Saturday mornings or Friday afternoons or something like that to come and learn a computer programme" … it's a bit difficult. You know, and it's not one of those where you can probably say "Let's do a crash course for a full day". So, I'm at the point where I'm about to say "Well, you're going on an Accounting tour. Let's just do our computer department – for 3 days". And they get a crash course on it. [laughter] You know, it's almost getting to that situation [throws up hands] just to give them the exposure and some sort of feed back … […] so, ja. It's a difficult one at this stage.*

*****

FP96: *That's [access is] the problem. Absolutely.*

Student factors also provide a point of conflict:

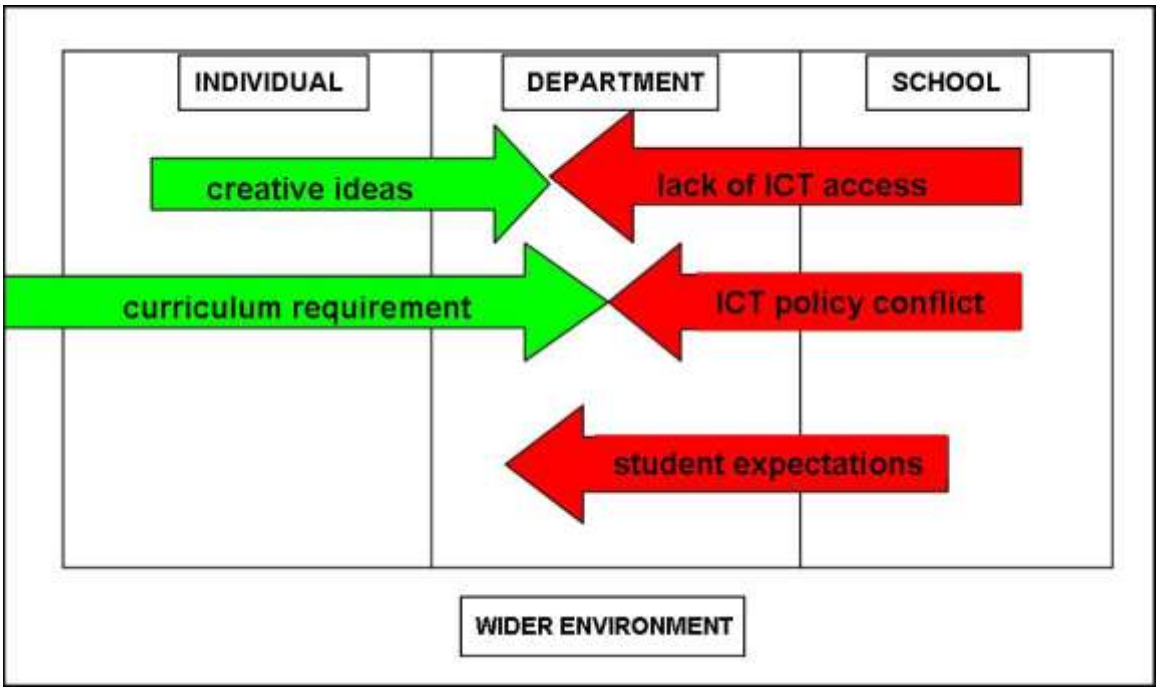
FP4: *[…] And also now, with the boys being so computer-literate as they are, they can't understand why they've got to do written work. Their theory is that it should all be done on computer which is what happens out there. So … so that's very interesting trying to incorporate the computer side and give them the foundations of … 'cos computers … you tell them the figures and it does it all for you automatically for you. You tell it it's an invoice and it gets put it in the right places. And that's what the boys don't understand. They need to understand <u>why</u> an invoice is put in those places not just assume that it's happened. So that's been a difficult one for them, to get across. […]*

6.4.6.3 Summary and preliminary findings: Francois

Access to ICTs is critical to Francois' practice, yet access is restricted by systemic factors. With his creative solution curtailed by the IT management he has instead, to achieve his curricular goals with the standard ICT configuration, to consider running a course for his students during the school holidays as well as incur the expense of changing to a less effective software package. He has a clear vision of the way forward, but is constrained in what he has to do because

policy does not match his curricular needs. Student expectations are that their course should be delivered entirely via ICTs and they appear to miss the point of learning principles. Francois offers an alternative solution that would require a change in the grammar of schooling: dedicated access for a two-week module in his subject. In this case necessity would be the driver of innovation. He also provides constructive suggestions on how the school might solve the problems he and others face.

Figure 6.7: ICTs and innovation: Francois



Francois envisions the laptop as a prerequisite, together with a wireless network, as a viable alternative within 5-10 years in Accountancy. He further suggests that the need for laptops[23] exists across the curriculum, arising particularly from project-based work and assessment portfolio requirements and that the school should respond to that need. Intertwined with the curricular needs are the demands of the job market and enabling students with specific work-place skills.

[23] At the time of the interview alternative smaller-scale mobile technologies such as i-Phones were not yet as prevalent as they have become in the interim.

In Francois' case, the conflict between policy and practice is blatant and an innovative solution has been curtailed by technology-based rather than curriculum-based decisions. Creative energy has to be directed at countering policy-based decisions instead of at the curriculum. Francois overcomes the limiting factors to do with the newness aspects of his role and there is convergence of opportunity, vision, physical facility and need, but disconvergent factors predominate.

6.4.7 Preliminary findings: ICT integration and innovation

ICTs at Wilding College serve four purposes: as a teaching tool, as a student learning tool, to support the wider curriculum and as an administrative tool for teachers. The intention of the use of the ICT tool in the curriculum varies according to the nature of the subject. In Accounting, ICT use in the curriculum is a practical necessity, while in LO Maria uses ICTs experimentally in developing her curriculum to suit student interests. For Henry, Bronwyn and Ineke, use of ICTs is integral to their practice, while for Richard ICTs are fundamental to the specialised sub-discipline of Computer Art. In Physical Science there is more emphasis on ICTs (and projectors in particular) as demonstration tools and on multi-media as a learning resource.

Teachers rating of the use or significance of ICTs in comparison to other changes at Wilding College were varied and unpredictable. It is apparent that most teachers saw ICTs as a significant means of meeting the requirements of the new curriculum in either productive or generative ways. However, despite the presence of an extensive network of computers, they were constrained by systemic factors such as the timetable which impacts access to the labs, inequitable distribution of ICT resources or teaching overload. ICT competency levels were not a factor with only Maria indicating any limitations to her ICT competency, although this did not deter her.

The interactions between different factors were similar in a few cases, but varied overall. Convergent and divergent interactions with ICTs are identified and summarised in Tables 6.1 (convergent) and 6.2 (disconvergent). The factors included in the table are those mentioned in the extracts above and are intended to show the varying array of positive and negative factors from the above data that converge in the innovative use of ICTs. The table refers only to factors that were indicated by the teachers and is therefore not exhaustive. The tables therefore give an indication of the array of factors rather than an absolute measure.

Tables 6.1 and 6.2 indicate that the convergent and disconvergent factors interplay in different ways for each teacher. The nature of the subject, a focus on student-centred use and curricular goals are predominant convergent factors. Accessibility and lack of information literacy are dominant disconvergent factors. For Bronwyn and Ineke there is strong positive convergence and few disconvergent factors. In contrast, for Magriet and Thabo there are more disconvergent factors and less convergent factors. In a few instances, such as Richard's case, the teachers' intentions are positive, but other factors negate them. The intensity of the factor is indicated in the text.

Teachers' means of acquiring ICT skills influences their use of ICTs. In two cases (Ineke and Richard) their use of ICTs outside of school purposes has had a significant influence on their approach to ICTs in the curriculum, although their application is different. In contrast, Magriet has, since her appointment, been totally dependent on input from the school in developing her knowledge of ICTs, while Henry's curiosity led him into curricular use of ICTs through school-based and corporate contacts. Bronwyn and Arthur are among the few remaining teachers who completed the *Intel* course in 2003.

Table 6.1: Convergent factors between ICTs and innovative practice

Key: x = factor, **x** = intended, but not achieved, O = opposite factor to X							
	BK & IG	**AS & HJ**	**MD & TL**	**HN**	**RL**	**MW**	**FP**
Positive convergence							
Nature of subject	**xx**	**xx**	**xx**	**x**	**x**	**x**	**x**
Access to resources	**xx**	**xx**	**xx**	**x**			
Real-world contexts	**xx**	**xx**		**x**			**x**
Real-time learning	**xx**			**x**			
Adaptation to student needs	**xx**						
Incorporate wider curriculum				**x**			
Use of ICT student centred	**xx**	**xx**		**x**	**x**	**x**	**x**
Focus on curricular goals	**xx**	**xx**	**x**	**x**	**x**	**x**	**x**
Generative use of ICTs	**xx**			**x**	**x**	**x**	
Compatibility with assessment	**xx**			**x**			
Incorporates formative assessment	**xx**			**x**			
Value of *Pencil Box*			**xx**				
High expectations of student skills	**xx**	**xx**			**x**		
Peer teaching	**xx**	**xx**					
Use of mind-maps or concept maps	**xx**					**xx**	
Cross-curricular involvement				**x**			
Core competency skills	**xx**						
Powerful thinking tool	**xx**			**x**			
Blended learning	**xx**	**xx**					
Writing across the curriculum	**xx**						
ICTs as research tools	**xx**		**xx**	**x**	**x**	**x**	
Multi-media/Virtual environment		**xx**	**xx**	**x**	**x**		
Video technology incorporated		**xx**	**x**				
Use of specialised tools		**xx**		**x**	**x**		**x**
Positive attitude to mobile technology	**O**	**xx**		**x**	**x**		**x**
Student factors (positive)	**xx**						
Collaboration made explicit	**xx**					**x**	
Use of social networking tools				**x**			
Leadership support				**x**			

ICTs are sometimes seen as product innovations e.g. digital projectors or the *e-Beam* device. Some teachers find that student application skills are below expectations and assume that students acquire such skills naturally or they are

taught elsewhere. Students' lack of such skills and their lack of information literacy skills appear to be matters in need of addressing. In all cases, the focus of ICTs is on curricular goals and Wilding College teachers see ICTs as tools that enable them to innovate in delivering the requirements of the new curriculum. However, the problem of access is a serious deterrent to teacher intent and alternatives to the current traditional model of ICT delivery based on current grammar of schooling factors will need to be considered.

Table 6.2: Disconvergent factors between ICTs and innovative practice

Key: x = factor, **x** = intended, but not achieved, O = opposite factor to X							
Disconvergent factors	**BK & IG**	**AS & HJ**	**MD & TL**	**HN**	**RL**	**MW**	**FP**
Information literacy level of students	**xx**	**xx**	**xx**	**x**	**x**		
Conflict with technology-based decisions				**x**			**x**
Incomplete curriculum delivery			**x**				**x**
Accessibility issues	**xx**	**xx**	**xx**	**x**	**x**	**x**	**x**
Workload			**x**				**x**
Financial issues		**xx**			**x**		
Lack of technical support			**x**				
Lack of pedagogical support	**x**		**x**	**x**			
Lack of bandwidth				**x**	**x**		
Teacher overload			**x**				**x**
Student factors (negative)	**x**			**x**	**x**		**x**
Inequitable distribution or resources		**xx**	**xx**				
Size of department		**xx**					
Information overload		**x**					

6.5 Summary of Chapter 6

This chapter has described and illustrated the findings related to the question of how the presence of ICTs affects teachers' ability to innovate. The chapter has

provided a brief overview of the expectations of ICTs from the literature, described the infrastructure of ICTs at Wilding College, introduced the cases and then taken each case in turn in order to show the differing contextual effects. These effects were illustrated for each teacher or pair of teachers interviewed and summarised in tables. The next chapter will describe the findings from the data obtained from the interviews with members of the leadership of the school.

Contents

Chapter 7: Findings: School leadership and its effect on teachers' ability to innovate

7.1. Introduction 345
7.2. ICTs, innovation and school leadership 345
7.3. School leadership and ICT management at Wilding College .. 346
7.4. ICTs, innovation and school leadership 347
7.4.1. Leadership perceptions of ICTs 348
7.4.2. Curriculum change 350
7.4.3. Curriculum innovation 354
7.4.4. Working together 356
7.4.5. ICTs and innovation 358
7.4.6. Constraints to ICT integration 361
7.4.7. Encouraging teachers to integrate ICTs 364
7.4.8. Perceptions of the future 366
7.4.9. Preliminary findings: school leadership 368
7.5. Summary of Chapter 7 371

Chapter 7

Findings: school leadership and its effect on teachers' ability to innovate

7.1 Introduction

The previous three chapters provided teacher perspectives on organisational interactions, collegial and professional interactions and ICT interactions and their influence on teachers' ability to innovate. Against the background provided in these three chapters, this chapter will now describe the findings that emerged from the analysis of the interviews with three member of the school leadership. The question that this chapter addresses is therefore:

> *How do leadership interactions influence teachers' ability to innovate and to sustain innovation in practice?*

7.2 ICTs, innovation and school leadership

According to the literature, the involvement of school leadership in the integration of ICTs is critical (Breuleux 2002, p.7; Otto & Albion 2002 p.1; Sharma 2005, p.53; Staples et al 2005 p.301). Alongside alignment with the curriculum and mission, school leadership is the key to integrating ICTs in a school. The school leadership needs to identify and determine how technology growth and development goals will serve curricular goals, with each intertwined in reciprocal supportive roles (Staples, Pugach & Himes 2005, p.306-307).

The school leadership also needs to understand the difference between traditional and productive use of technology and the differing implications of each. Acquisition of ICTs is fundamental, but should not be privileged over professional development; rather they should be planned for and happen simultaneously (Staples et al 2005, p.306). This point is emphasised by Staples et al (2005, p.305-306) in their call for *"a nuanced understanding of*

what it means to provide leadership and professional development at a school site". The beliefs that the leadership holds have a significant impact on the culture that supports the creative integration of ICTs for teaching and learning and determine the interpretation of the vision for learning through either action or inaction (Otto & Albion 2002, p.3-4). Their arguments support the contention that the resulting school culture has a greater effect on the adoption of ICTs by teachers than the influence of ICTs on educational reform.

Mandated change is conveyed and communicated by the leadership through top-down procedures, but actual implementation occurs though bottom-up innovation in day-to-day practice. In order for mandated change to succeed various conditions are required. These conditions include supportive leadership; collaborative teams rather than strongly hierarchical structures; access to resources; effective group processes and decision-making practices; a clear outline of organisational goals and objectives; mutual concern for quality; and positive support (Sharma 2005, p.54-56). Whilst resources are essential to innovation, an abundance of resources does not guarantee innovation: group processes and mutual concern are far more important.

The structures that govern the leadership and ICT leadership in particular at Wilding College will now be explained.

7.3 School leadership and ICT management at Wilding College

The executive leadership team at Wilding College consists of a principal and three deputy principals. The three deputies each have responsibility for one of three areas: administration, student affairs and academic. The academic role incorporates responsibility for ICTs. An executive committee consists of the principal and the deputies together with eleven other key staff members. The academic Heads of Department, including the teacher-librarian as HOD (Resources), report to the academic deputy and the House Directors who oversee the tutor system and pastoral care of students report to the student

affairs deputy. Various committees that meet 1-3 times in each of the three terms serve the partnership of schools. The partnership Technology Committee was established in 2007 and comprises the IT Director together with the academic deputy and one other representative from each of the partner schools. Any decision on new technology has first to be approved by this committee.

Given the emphasis in the literature on the importance of the leadership role in ICT integration and in innovation, three members of Wilding College's executive leadership were interviewed. They were interviewed for the following reasons:

- to provide a further perspective and one that is integral to the context
- to establish their understanding of and involvement in ICT integration at the school given the emphasis on the critical roles of leadership in the literature as outlined above
- to seek convergence between their perspectives and those of the teachers.

For ethical reasons the contributions of these three members will not be identified with any particular role due to the sample number relative to the leadership team size; instead their views will be compared and contrasted generically between each other and with those of the teachers using the notation LA, LB and LC. The findings from the analysis of the data gleaned in these three interviews follows.

7.4 ICTs, innovation and school leadership

During the data-collection phase for this study, changes were happening in the leadership structure of Wilding College. Interviews were eventually held with three people, including previous and present incumbents. Questions put to the leadership were aligned to the questions posed to the teachers but, given the nature of the different roles, were not identical. The interviews were overall less structured than the teacher interviews in that their purpose was to

understand and explore the leadership perceptions of and involvement in ICT integration and innovation in the school as a whole. The interviews were therefore guided by the questions in Appendix 3.2, Leadership questionnaire. The findings will be reported in terms of themes that emerged from the analysis:

- Leadership perceptions of ICTs
- Curriculum change
- Curriculum innovation
- Working together
- ICTs and innovation
- Constraints to ICT integration
- Encouraging teachers to integrate ICTs
- Perceptions of the future

These themes will be discussed in turn in Sections 7.4.1 to 7.4.8.

7.4.1 Leadership perceptions of ICTs

ICTs are one of many competing priorities at Wilding College. The broader curriculum is based on six 'pillars': Academics, Culture, Service, Sport, Spiritual and Leadership. LB contextualises the significance of ICTs in the school in the following extracts, providing both a current and an historical perspective:

> ***LB65:*** *Ja, ja … [long pause] from the school's perspective as a whole … big picture … OK ... What I think we've achieved … I think of what we've achieved as a school, I wouldn't rank ICT in the top three I don't think. I'd put … service, inclusion, leadership, those kind of aspects as higher profile than ICTs.*
>
> ***LB69:*** *[...] If I go back to whenever we were talking about the laptop programme. I think then, if you were to ask people about Wilding College and technology, I think we would have been right there. I seem to remember writing things in an article [...] in the mid-90's. I think it's taken a back seat to what we've done.*
>
> *****
>
> ***LB101:*** *I think it's an ongoing debate. I think we have had debate in the College about learning 'cause it's the big thing. You know, what's the point of this stuff if it*

> *doesn't enhance learning? I mean, why bother? You know … But, there's a lot … a long way to go, for sure. [...] I'm not sure that what happens in our classrooms today, if the learning is any better than it was five years ago. I'm not sure.*

Whether there has been an improvement in learning in classrooms is an unknown factor. How then could such an improvement be measured? As Pang, Kim & Kim ask (2001, p.1) "*Are the indicators specific enough to measure what to measure?"* This is again similar to Bronwyn's lack of a benchmark (BK2: Ch.4 Section 4.4.6, p.151) in evaluating their curriculum units. How do you measure if there is no benchmark against which to measure? A benchmark therefore needs to be established through trial and error. LB suggests that an evaluation should be run for each ICT product innovation provided in order to establish what is effective:

> ***LB103:*** *[Pause] … I'm not sure how you judge whether it's any better, because it's very difficult. If I go back to that black box thing that I'm often talking about these days, what actually happens in the classroom … it's really hard to find out … actually, actually. [...] but what actually happens in the black box intrigues me. And that's why I think our focus has been on values and beliefs. So if you believe technology can make a difference, it's going to make a difference in your classroom. If you don't, it's not, no matter what you've got, whatever hardware you've got. It's not going to make a difference. [...] I suspect that it hasn't had the impact in the classroom that we would have liked, that we would like it to have. When we look across the board and you see that a kid is doing all of these things, I think it is watered down [...] But then it's just a feeling I have, nothing … no data to back that up, actually.*
>
> *****
>
> ***LB147:*** *[...] What would be interesting now is … OK, so you've got this projector in the classroom, and you've got this fancy machine … what's happened? You know, How's it changed your teaching … from the kids' perspective? Is it any better? Or, is it just instead of the teacher drawing whatever on the board, it's now ooh, here's a picture. What's the difference? Are the kids more involved and stuff? I'd be interested.*

The beliefs that the leadership holds have a significant effect on how ICTs are integrated into the learning process (Otto & Albion 2002 p.3-4). LB advocates that belief in technology will assist teachers in integrating ICTs, but that the

assumption should not be made that any change is necessarily an improvement:

> ***LB55**: […] whereas what you're actually doing in the classroom might actually be worse than what you were doing before.*

It is apparent from the above views that during LB's incumbency the school has gone through a cycle of implementation of ICTs beginning with excitement at the potential of the new, then plateauing into the realisation that there is more to ICT implementation than *'the wow factor'* and now, finally recognising the need to come to terms with the improvement in student learning. In the context of the holistic school programme ICTs have found a balanced place rather than a central place. The new curriculum has provided the opportunity for an evaluation of the role of ICTs as described in the next section.

7.4.2 Curriculum change

The immensity of the new curriculum, its impact and its implications for teachers and students alike are described by LA using words that evoke strong emotions such as *'crisis point', 'critical', 'a lot of stress'* and *'gravity … has hit home'*. LA recognises the complexity of the institution and concedes that '*something's got to give, somewhere'*. LA describes the situation in these two extracts:

> ***LA8:** Well, we're at an interesting point because I think we're at a crisis point with the new curriculum Grade 12 coming in, in 2008. Because suddenly the gravity of this new curriculum is … has hit home, I think, to all teachers and they … they're clearly struggling, which is understandable, because we are, as an institution, trying to juggle a very rich programme beyond the classroom. [...] Something's got to give somewhere, because we can't keep it all afloat any more [...]. The boys are being stretched far too thin. [...] Add onto that all of the increased demands of the new curriculum – and they are increased demands. Every single subject it's more and more and more and more, not less and less. We're having to re-look very carefully now exactly how we're going to go forward and manage a holistic education programme, but still to be able to do justice to all the things that we think are important. And in the academic arena I think our first point of call is to start macro-planning which we haven't done yet as a school [...] particularly at the FET level. We*

have not macro-planned because we've kind of done lots of micro and meso and different departments are at different places, different teachers are at different places with the new curriculum.

*****

LA33: *[...] And it's … its resulting in a lot of stress in three main subject areas we've identified now through the IEB: Mathematics, Physical Science, Life Science. Those are all experiencing syllabus overload, where the new syllabus has just gone over the top with content. Instead of reducing the content, they've added a whole lot of new – exciting content, given. But what's the point of skimming over the surface of a whole lot of content when the FET is designed to drill down into depth of knowledge and understanding? So that's been the debate and the … and the frustration is that there's been such a lot of bulk of content that you've … you've only been able to skim over the surface of it and not really engage with the content the way we should be at FET level.*

The critical situation is ascribed to three interacting factors: an overload of content within the curricula; the fact that few teachers had attended the Assessors' course; and that curriculum planning at the macro level had not occurred. LA acknowledges the overload and resultant stress that the teachers are under, as expressed openly by Magriet (MD29 Ch. 4 Section 4.5.2, p.165). An underlying problem is that the school is lacking the inter-departmental co-operation that would allow such macro-planning, which concurs with what was found in the cases of Arthur and of Henry. LA describes the critical role of inter-departmental curriculum mapping:

LA10: *Yes. Ja. That curriculum mapping for me is critical … critical … so that we can start to identify those areas of overlap … of overlap where we can start saying "hang on a minute, you can help me with this assessment item and I can help you". And hopefully also reduce the load then on the boys at the same time because they … they're going to be in an increasingly difficult position. We've seen it already in the Grade 10s and 11s where they have this assessment overload and I'm not talking about the … the traditional summative assessment stuff, because that's quite well managed as we can see now in our exam timetable. Its … it's the formative assessment stuff where every department is just loading on more and more and more and more assessment items. Because its good and we need to be doing it, but hang on a minute, we're not looking at … between the departments, how we can actually help one another.*

From these responses it is clear that LA not only recognises the immensity of the impact of the curriculum and its effect on teachers, but also has empathy for the situation that the teachers (and the boys) are in. LA admits that the teachers are insufficiently trained in the pedagogical aspects of delivering the new curriculum. He pins his hopes on the forthcoming Assessors' course as a potential breakthrough in the impasse and hopes that more collaboration will result. He suggests curriculum mapping as a solution, but does not suggest how this process will happen. LA believes that more and more workshops will also assist:

> ***LA43**: I think the biggest thing for me has been the realisation that before we can really launch further with this whole thing is that we've got a whole critical mass of teachers that haven't been trained properly for the new curriculum so my first priority has been to say "OK. Let's make this assessors' course happen and let's actually get everybody like-minded". Because we've … we've got people all over the place in terms of their journey … you know, it is a journey and the enlightened few who've seen the light and seen the road ahead and been through … one way or another either as IEB examiners or having done the assessors course and suddenly they see "Ah, the penny's dropped. This is what it's all about". And trying to be almost lone voices in the wilderness. And as we get more and more through the system and on board we'll be able to do more and more in terms of working with staff and HOD forum and what have you and having workshops and design workshops and collaborative workshops between subjects. [...] So there's a level at which we can all work together and then at a certain level we split up. But you can't do that until … actually the teachers have been through the assessors and seen what it's all about, seen why.*

However, although LA recognises that such pedagogical workshops are the way forward, as the findings have shown, teachers have no remaining capacity (IG336 Ch.4 Section 4.5.1.4, p.160; MD11/25 Ch.4 Section 4.5.2.1, p.163) to incorporate such workshops, which links to LA's statement that *'something's got to give'*.

The clues as to how this situation has come about are contained in this extract:

> ***LA45:*** *To me, this assessors' course is the beginning of the changing of the mindset. [...] [Those who have done it] keep saying "I can now understand what these people have … have spoken about all of the time". Because once you do assessors it opens up that whole world of what we're really trying to achieve … you know … with it. And we've pretty much gone the route of saying "OK, here's a new outcomes based curriculum. We're … we've always been in this "We're OK Jack mode". We've tried to fit a new curriculum over an old. It's what we've been doing. And we've done it very successfully. Why? Because we've got good teachers. And … and they … their classroom practice has been superb. It's been ahead of itself. So what we've said here is "Because we know we've been ahead of ourselves, we've been doing all these good practices, let's just take this new curriculum and overlay it on top of what we've already been doing". But actually that's not … that's only a short term fix. To really do justice to what the whole new curriculum is about, you've got to pull right back, go back to the start and actually work from that level and build it up again. [...] In your design as a teacher … you're now not a teacher, you're actually a designer. It's your most important role. You're facilitating the classroom. That's not terribly challenging. You're facilitating discussion amongst children and you're guiding and … you're not the fount of all knowledge. You're simply managing a group and they're discovering their own learning, but where you are critical as a professional is in your design. And that's going to make or break teachers in the future. And until you understand the principles of good design, designing up from your outcomes, from your assessment standards … if you're just sommer[1] designing, and trying to patch everything in … [???] you're not doing it correctly and you'll never see the beauty and the cleverness in the new curriculum. Because it is a very clever curriculum. It's very clever. It's been well thought out. It really has. Its sound, it's very, very sound.*

The first clue is apparent in the fact that the school was satisfied that with its high level of achievement, the implications of the new curriculum were not fully understood and that the *'hubris born of success'* (Collins 2009[2]) or complacency occurred. Accordingly, it was assumed that the new curriculum could be overlain over the old. Bronwyn had realised that this would not work as expressed in her words in describing how she started again from scratch *'we're like first year teachers again'* (BK2/4 Ch.4 Section 4.5.1.1, p.154). These words were also echoed by Arthur (AS38 Ch.4, Section 4.5.2.3, p.173).

[1] Sommer = Afrikaans word often used colloquially in South African English to mean 'just simply'.
[2] Collins, J. (2008) How the mighty fall. *When the rhetoric of success ("We're successful because we do these specific things") replaces penetrating understanding and insight ("We're successful because we* understand why *we do these specific things and under what conditions they would no longer work"), decline will very likely follow.* This comment is taken from the synopsis of the book at http://theleanthinker.com. This point came up for discussion in a start-of-term workshop, August 2009.

The second clue is contained in LA's reference to learning design as a critical aspect of the new role of teachers i.e. their role is not just facilitation but to design for and scaffold the learning process, which is what Beetham and Sharpe advocate (2007, p.8) in their call for a rethink of the implications of pedagogy. The fundamental change is the paradigm shift that underlies innovative thinking about the curriculum.

LB believes that teachers are conservative and tend to fall back on what they are familiar with. On this point he concurs with Arthur (AS11b Ch.4 Section 4.5.2.1, p.164) who indicated that this is indeed what happens when teachers do not understand the requirements of the new curriculum:

> ***LB49:*** *[ ] … but maybe teachers as a whole are … are pretty conservative … in … in that, so one tends to fall back on other stuff. But sure, but I think they … they need to be shown I think …*

There is convergence between the leadership view expressed here on the magnitude of the new curriculum and the views of the teachers expressed throughout Chapter 4. The next section explains the curriculum innovations that the leadership was aware of.

7.4.3 Curriculum innovation

On arrival at the school LC's expectations of what might have been happening in both ICT integration and curriculum development exceeded what he actually encountered. He describes the school at the time as totally without innovation (LC26) and that he was *'absolutely gob-smacked with the lack of any form of educational creativity on the staff'*, attributing this problem, in his opinion, to the exclusivity of the former student selection process. This confirms what Henry complained of (HN33c: Ch.4 Section 4.5.3, p.176), although the time periods are different. A further factor was the apparent lack of educational debate in the HOD forum at that time. However, LC believes that ICTs have been a huge part of developing the curriculum, beginning with the introduction of the laptop programme and the network and then continuing with the provision of a PC for each classroom.

LC provides two gauges of the degree of development through which the school has progressed. The first is a measure of curriculum (LC24) and the second a measure of inclusion (LC32):

> ***LC24:*** *…and in terms of curriculum. I remember my first ever HOD meeting here where the curriculum here was just buying whatever the text book was that whoever thought that we should be teaching and everyone was just following that textbook. There was no sense of having to create your own … curriculum.*

> ***LC32:*** *They were all just doing … more or less … and, you see, the really clever kids … that's why I virtually understood what had happened. Because, they were choosing the kids, 80 from a 1,000 that would come into Grade 8 and the kids were really clever. So you could get passable results without doing anything with them. They just used to do quite well.*

LA was not aware of any particular innovations that had resulted from the implementation of the new curriculum. There was *'nothing that stands out particularly'* (LA21). Instead he was aware of small incremental steps or a change of emphasis, described as follows:

> ***LA21:*** *Nothing that stands out particularly. You know there, there a number of sort of, smaller things. I don't know if I'd even call them innovations … trying a few odds and ends differently, but nothing major in terms of what we haven't done before. Maybe a shift in emphasis and balance …. but nothing new, per se, that's come, you know, brand new, that we've never done before. We've maybe done something before, but not, you know, spent a lot of time on it. And now, maybe it's strengthened and we're doing a lot more of it. [...] values arena, is quite a different place because its been strengthened tremendously to be on a par with knowledge and theory, whereas before, it was theory and you did a little bit of prac to back up the theory.*

The question that arises here is, if innovations are occurring, how are they being communicated either upwards or laterally between departments in order to share and diffuse ideas of what works and what does not. As the findings in Chapters 4-6 have shown, the teachers all provide some evidence of what they consider to be innovations in their practice but, in this instance, the leadership was either unaware of them, did not consider the innovations of significance or possibly they did not come to mind at the time.

Diffusing information about teacher innovation is essential if there is to be wider benefit, therefore how teachers work together needs to be understood. The next section explains the leadership perceptions of how teachers work together.

7.4.4 Working together

According to LA there has been co-operation within large departments where each teacher has taken on responsibility for a particular grade or section and there has also been more co-operation than previously within the clusters. LA believes that the Cluster Groups, especially the active ones, play a role in alerting teachers to new innovations, which has been significant in his own subject area. LA is aware that subject-specific email networks, the IEB and the national assessment body have also contributed to the dissemination of ideas.

In referring to internal team-work, LA is describing essentially the module system of load sharing that the larger departments use, as referred to by almost all teachers interviewed:

> ***LA27:*** *I've observed different departments working differently and being in different places. But, in terms of broaching the new curriculum, the teamwork and not only within the team of teachers here at the school, but within our Cluster Group as well … so I've seen cluster groups operating more effectively … where it's not only the Wilding teachers who are saying "Hang on a minute, we're all at sixes and sevens with this new thing, we try to help one another, but actually, lets go beyond the schools and actually start working with teachers within our Cluster because this ones got a worksheet, this ones got an idea that's worked". And so they have worked more collaboratively.*

> ***LA29:*** *And I think the key has been within bigger departments where different teachers have taken on different grades and been responsible for a grade as the innovator of that … for that grade. [...] [T]hey've been the person driving the development within that grade. So last year Grade 10 was brand new, the first new Grade 10. This year it's been Grade 11, but that doesn't mean that Grade 10 was packed away. So whoever was doing last's years Grade 10 had to revisit it and evaluate what worked well and what didn't and fix it up and get better. Because it's*

> *not a quick fix, you know. We're going to be hammering away at this for the next five, six years … minimum before we're quite comfortable with it. Ja. And as we become comfortable don't forget the state keeps pulling the rug out from under our feet and saying "Well, we've had a rethink so … we've changed again".*

Two levels of co-operation are described in the above extract. The first is intra-departmental and the second is at Cluster Group level. HODs alone attend the Cluster meetings. There is no evidence of inter-departmental co-operation at teacher level other than what was described in Chapter 5 (AS119 Section 5.6.2, p.228) and both of these initiatives failed albeit for different reasons. The question that arises is how teachers understand each other's curriculum in order to be able to initiate a sharing process[3].

At the end of LA27 he refers to teachers working *'more collaboratively'*. The level of collaboration referred to here appears to consist of sharing resources but not true collaboration in terms of a community of practice (Wenger 2008, p.2) that would allow a cross-departmental free-flow of ideas between individuals.

LA refers also to the evaluation that is necessary for each new unit of work in order for the unit developer to understand what worked well. However, as indicated in Chapter 4, teachers lack a benchmark (BK2/4: Ch.4 Section 4.5.1.1, p.154) against which to evaluate and lacking time, an intended evaluation does not always proceed as planned (AS 28/30 and TL62: Ch.5 Section 5.6.1, p.224, 225). If evaluation occurs it is after the learning event; relies on 'gut-feel' or 'ad hoc' rather than an empirical process; and is not secured within a systematic learning design process. Having such measures in place might assist in making collaboration become more effective.

The next section will describe leadership perceptions of ICTs in the context of innovation at the school.

[3] An example of the paucity of inter-departmental understanding is evidenced in a recent informal conversation with Richard. I referred to a teacher in another department. Richard had no idea who I was referring to. While this is very likely to be an exception, not everyone has the chance to work across departments as I do in my role, which made me realise the uniqueness of my situation. It cannot be assumed that each teacher knows another well enough to be able to sit down and work with them without having some form of established relationship.

7.4.5 ICTs and innovation

Developments in ICT innovation are described by the leadership in terms of the ICTs themselves, but not in terms of their innovative use (LB41). The improvements in service include the number of labs and computers (LA105/106), the speed of the network (LA105/106) and the original laptop programme for teachers (LB29). The *Pencil Box* administration system (MD 156: Ch.6 Section 6.4.2.2, p.291) has been upgraded to align reporting to new ways of assessment (LC 106). Specialised software has been purchased for certain departments e.g. graphing packages for Mathematics (LC74). Developments also include later improvements such as the introduction of the first electronic whiteboard and a tablet laptop (LB29).

However, there is little evidence of supporting teachers in the innovative use of ICTs other than providing the tools as innovations in themselves. LA responded with the following examples which relate to software. His view concurs with teacher-mentioned uses, but still does not refer to the innovative use of the ICTs in the learning process or what teachers are doing differently with ICTs:

> ***LA108:*** *I see some departments using quite specific software, like the Accounting stuff, the QuickBooks stuff that we're trying … that we're having such trouble with now, the Multi-media Science in the sciences certainly. It was hardly used when I arrived here and it was the very beginning, the very first programme and every … you know, they've bought more and more sophisticated stuff.*

A further example provided is the research tasks that students undertake and the difficulties, such as plagiarism that arise with that type of use, which concurs with what Thabo complained of (TL167/169 Ch.6 Section 6.4.2.3, p. 294):

> ***LA112:*** *I think certainly the way that they're doing their research now on the Internet particularly has got better and better. Because I know, that when … when I came here it was just a sort of … quite a loose open thing. "Ja, if you want to go onto a couple of websites and you know". Now I've seen departments actually, when they give a task actually list. "Go … try these websites". You know, they've actually focused in on a particular few that they know will help them with a particular task and*

what have you. It's not this loose general thing "Oh, and go onto the World Wide Web". You know. That, I think is, in terms of Internet-based research has been a lot better. But, of course, now we're grappling with all of the difficulties with the plagiarism of the Internet based research and what have you. We're trying to get our heads around that with various strategies, because that has been a … become a huge thing … a huge, huge thing. So I think that's our challenge with … with what the boys are doing now.

Here again, access to the Internet is the product innovation. The learning process, while there has been some improvements in approach, is not described as a scaffolded process that ensures understanding which is the intention of the anti-plagiarism policy (Appendix 6.1).

LB concedes that there is tension between the ICT hardware and its use. The impact on the educational process has been less than anticipated and instead, the focus has been on getting the hardware right:

LB35: *OK. I think we've struggled with that. I would say if you go back to the laptop programme: that was our high point in terms of teacher usage of technology in terms of staff development …*

LB41: *[...]… but in terms of the impact it has on the educational process – which I guess is where we … what we've got to get to here … I think we've still got a long way to go in terms of how we use the stuff that's available to impact on the learning of children, rather than seeing it as just a demo in the classroom or seeing it as a computer room so you go to the computer room and take your class there and do stuff. I don't think it's really had the impact I would like it to have on the learning of the children … would be my take. I mean, its quite complicated … I think … in terms of how one best uses technology to improve learning and we've been a bit hindered by the old curriculum so the new curriculum has lots of opportunity …whether we've got the teachers who can do that is interesting. [...]*

LB43: *OK. I think there's always a tension between the hardware side and the use of it. I know that maybe [we've] focused too much on the hardware, but trying to get that right has been a priority.*

LA also concedes that there is scope for more generative use of ICTs by students, but the teachers' ability to implement creative ideas in this respect is constrained by the overload that the new curriculum has brought:

> ***MR121:*** *[...] but we're not actually looking at a more creative level of work yet? From your observation?*
>
> ***LA122:*** *I think there's lots of scope … scope for that, but I don't see it. I don't see it. I think we're also in a … at a threshold where there's lots … I'm aware of bubbling under the surface waiting to break free … lots of ideas and excitement from different quarters, but I'm … I haven't seen the output yet.*
>
> ***MR123:*** *What do you think holds that back?*
>
> ***LA124:*** *A combination of things. Um … teacher fatigue … just where the teachers are just keeping their head above water with this new curriculum and the planning and the … what have you. They're half getting into all of these exciting areas … and then hitting their heads against the wall and just finding that there are barriers to them moving forward with … with these things and so there's not enough energy to go around. They're so exhausted with trying to keep up with the new curriculum that the bit of energy they've got to put into that and then they hit a barrier and it just kills it straight away. So, I think … I think teachers right now are stretched to the limit so that creative energy is ebbing at a bit of a low as they try to cope with implementing the new syllabus. They're just surviving that.*

A '*Catch-22*'[4] situation arises here in that teachers need the space and time to develop creative ideas in order to be able to implement the new curriculum. However, even though they have the tools at their disposal, they are unable to find that time. Instead, they are bound into the rut of traditional ways while they try and implement the new curriculum as a single entity. The leadership acknowledges the situation, but as yet a solution to the problem is not forthcoming.

LB gets to the heart of the matter in this extract, encapsulating perfectly the conundrum in the intertwining of ICTs and the learning process:

[4] A "Catch 22 situation" is one in which: no matter which way you go, there is an undesired result or outcome (www.answerbag.com). The expression originates in the 1961 book of the same title: Heller, J. (1961) Catch-22. New York: Simon & Schuster

> ***MR46:*** *And what do you think the challenge is there? Is the challenge the technology or is the challenge really changing the curriculum?*
>
> ***LB47:*** *I think its both. I think … before … you've got to know what the technology can do. But you've got to have a good understanding of the curriculum to know how you can best use the technology once you know what the technology can do. So, I'm not convinced that at this stage we know enough about what the technology can do and because the curriculum's changing, its kind of hard to know how best to use the technology.*

Despite the extensive ICT infrastructure, the school is still unsure of what the technology can do. The question here is how the school discovers what the technology can do in terms of what the curriculum requires.

Apart from the constraints on innovation identified in this section, there are further constraints that the leadership is aware of. These will now be described.

7.4.6 Constraints to ICT integration

LC outlines the development of the ICT infrastructure at Wilding and the political battles that ensued from development of the partnership (LC96). He identifies cost and technical back-up as ongoing issues (*'are always issues'*) while *'the rest is just like any learning: its people stuff, its relationship stuff'* (LC96).

Whilst there are good working relationships between the network management and the academic staff, there are unresolved and fundamental differences between them in outlook and in the decision making processes that affect classroom practice. LB sums up the problem and provides an example:

> ***LB121/123:*** *They still don't really understand what we're talking about in terms of learning. [...] We want the learning to work. They want the machines to work.*
>
> ***LB125/127:*** *[I've] got XP, but nobody else … I don't know why I got it, but anyway … there has to be a hierarchy in the network [peoples] ideas. So the [principal] get[s] in*

first and then the deputies and then the guys who really use it the most don't get it at all. . Whereas teachers … we know the guy in the black box is the one who's done everything, that's the person who needs to get the stuff. We need to get it to him ... use it on whatever they want, we need to get it to him and … and it's one of those ironies that we … we struggle with every time we meet. [...] And it's a relationship thing. We've worked hard on it, hey? [...] And that's the tension that's always going to be there. So a network guy will not understand it seems to me. He doesn't even believe that! He doesn't believe that's the way, actually.

The options available to schools are to choose between technological expertise in running the ICT infrastructure and educational expertise in supporting the pedagogical aspects of ICT integration or, alternatively to find the balance. It would appear from the above, that this balance had not yet been established at the time of the interviews. Currently, whilst there have been improvements brought about through the recently-formed partnership ICT Committee, fundamental differences still remain.

There are specific systemic limitations in the provision of ICTs at Wilding College. LA identifies these in the following extract:

LA129: *[...] You know, the biggest fear is the network security: that there's going to be hacking in … stuffs going to go down … you know. It's going to get lost. It's going to be abused. It's going to get hacked into. And of course that's a very real threat because you know, all the time the network is exposed to that and so very often its quite difficult to bring in something new because it doesn't quite configure with the way that our system's firewall is set up to prevent the hacking. It doesn't allow us then a lot of freedom to experiment with new stuff in that way. So, I think it's that give-and-take and that yo-yoing backwards and forwards. [...] So we've got a huge problem there.*

MR130: *So, in fact what we're looking at is possibly the need for creative … creative or innovative solutions to those sorts of problems.*

LA131: *Ja. And they're quite difficult ones to grapple with. Because, I mean … sometimes it means that perhaps some of the machines need to stand alone, come out of the network, then that's logistically a problem, because you take systems out of the network … it means that centrally you can't then control them anymore from the … you know, centralised network administration. So you've got a group of machines*

sitting somewhere [...] where you have to physically send somebody when there's a problem because you can't, from the network administration system, track and log and re … because you can do all the re-ghosting and everything from a central location – apparently – because our system is sophisticated. But, when you pull them out of a networked environment, it puts a whole new dimension on it.

MR132: *Is it too sophisticated for our needs?*

LA135: *Well, it's hugely sophisticated because … that's … that's what, I think, allows it to be run by a relatively small department [...] is … is its sophistication because its techno … you know, it is sophisticated it means that a small group can run it quite efficiently. You've basically got one administrator and one technician who's running out and doing stuff when … when you can't do it from the desktop.*

The evidence here suggests that while the network is run with remarkable efficiency given its size and use, the result is that it limits the learning purposes which it is designed to serve. It is accepted that security is a real risk, but there is as much danger in students hacking out to use the Internet as they need to for curriculum purposes, as there is a danger of outsiders hacking in for arbitrary reasons. Richard had raised the point of these limitations on access (RL95 Ch 4. p.48) in describing the ensuing problems as *'like watching paint dry'*. My observations in the Library have confirmed this. The challenge is to find the balance and to work from customised need rather than from a generic network perspective.

Cost was a factor in the decision to end the laptop programme in the late 1990s. Whilst the cost of the original set of laptops for staff was carried by parents' association funding, the programme was scrapped because it was unviable in terms of the costs to students at that time. Funding remains a constraining factor in providing, maintaining and upgrading the network and ICT infrastructure. However, consideration does not appear to have been given to the idea of less costly alternatives. The cost of ever more powerful mobile technology is decreasing and it is becoming more common to find students with Internet enabled technology in their pockets[5].

[5] I have observed students in the Library by-passing the network to make use of their own more efficient mobile technology.

Although there is consistent support for the ICT infrastructure itself, the leaders were questioned on how they supported or encouraged teachers to make use of it.

7.4.7 Encouraging teachers to integrate ICTs

The onus is on school leadership to support the parallel development of curricular and ICT goals. The extensive infrastructure is evidence that the ICT provision goals have been supported. The curricular goals are being accelerated with the Assessors' course. However, no evidence was forthcoming of support for teachers in achieving pedagogical goals through the use of ICTs. The *Intel Teach to the Future* course was run on a voluntary attendance basis in 2003 and attended by a number of teachers from the partnership schools. However, in 2008 it was offered again in one of the partner schools on a voluntary attendance basis. No Wilding College teachers attended this later course[6]. LB has run workshops in his department and for the IEB in using what he terms *'package-related software'* (LB97) to encourage the use of ICTs. He has also provided laptops for teachers in the occasional instance or specialised software for specific departments. However, besides this technological support, there is no further evidence from either leader of pedagogical support for teachers in the use of ICTs. Although a comfortable user of ICTs, LB has not capitalised on his ability beyond his own subject department in order to help teachers change their practice. He explains:

> ***LB89/91:*** *I've done lots of workshops, but its more to do with examining stuff, new curriculum [...] not necessarily how one uses say, computer stuff in the new curriculum. We're still trying to get a handle on the new curriculum itself.*

In his response LC indicates that he understands the potential for using *Pencil Box* for its value-added features[7], yet predicts that it will be a further decade before this value is realised:

[6] Confirmed by telephone with course facilitator July 2009
[7] Lewis, J. (1999) Leading the learning community – a new role for teachers. Handout from the author, 2001. In this paper Lewis describes the development of the *Schoolmate* learning management system

> ***LC54:*** *Well, right across the departments in recent years we have been trying to get the whole reporting and recording of the learning … and we're still not even close to where we should be. That process has started and it's being done by all of them. So I would think in ten years from now, this place will be doing some extraordinary stuff in terms of how it's recording and reporting on each individual in a different way.*

LC has ensured that departments such as Music and Science have received specialised ICT equipment such as simulators, but is unsure if they are being used. He refers to it in this extract:

> ***LC56:*** *She also bought all that software in the Science department where you could do … any form of simulation with various physics and chemistry bits of learning in the curriculum. And I don't know if they use … I know its here … I know we've got it and I'm not quite sure where we are so I can't keep contact. But we have got very high-tech capacity in terms of that. [...]*

Two questions arise. If the equipment is bought and possibly not used, is it bought in response to need or as a *'nice-to-have'*? Secondly, if, as LC states, he is unsure if it used, how is the use of such ICTs evaluated and reported? The question of evaluation is tricky. Prior evaluation of any ICT from a functional perspective is common sense; however, without pedagogical evaluation once implemented, it is impossible to judge the effect on student learning or to establish if the effect is even positive or negative. Pedagogical evaluation should be conducted in terms of the identified need or purpose and that need should arise from the design of the learning process, not only from the teaching process.

Although his role in ICTs is pivotal, LA admits that he is not up to date with technological developments and devolves that role:

> ***LA153/155****: I don't think I'm very good in that arena to be quite honest with you. I am a bit of a dinosaur with ICT, I feel. I'm excited by new technologies and new innovations and things that are happening, but I don't think … I think I err on the side … I don't think I keep myself abreast of all those things [...] so I don't think I'm the best person. I know who is* [laughter] *… and I think I'm good at supporting …*

based on her innovative practice at Noumea School in Sydney, Australia. See http://www.schoolmate.net.au/ . Schoolmate was introduced by me to the Wilding leadership in 2001.

> ***LA157/159**: … but I don't think I'm the person to bring the message to the school, just because I'm … I acknowledge that I'm not in the best position to. And I don't put myself in the best position to. [...] That's it, that's it. So, I'm not going to be the best, but I will support the best. That's how I see my role then. Not to … to actually be out there getting all the information and the ideas, but being able to put weight behind the person who is.*

The situation that arises here is that while the ICT role within the leadership portfolio is specified, the ICT role within the teacher-librarian portfolio (i.e. the participant-researcher's role) referred to in the words *"I know who is"* (LA153) is assumed, with a consequent disjuncture between expectation and responsibility in terms of workload.

The beliefs that the leadership holds have a significant impact on the culture that supports the creative integration of ICTs for teaching and learning and determine the interpretation of the vision for learning through either action or inaction (Otto & Albion 2002, p.3-4). In the light of this statement, the leadership was asked about their vision for education.

7.4.8 Perceptions of the future

In order to establish what vision for the future that the leadership might have they were asked the broad question "What should education look like?" While LC focused on the potential of the HODs at the time, LA provided a broader view. These are their views:

> ***LC98/102:** I think that finally it's there because there's probably even more energy in the departments. There are a lot of very exciting people in the departments and so I think its not us against them it's just how do we co-ordinate all this? You see, again, it's not possible without IT [??] because it's too complicated. There's too much stuff. And so, without our IT we'd not be able to structure it and manage it. But we have all that, its all in place. [...] But I think, if you look at the HODs [...] Certainly, in the group, there's enough in the group now to self-manage so I do not think … I think they'll continue to initiate new things. [...] It's just an unbelievable bunch of innovators … and that wasn't there, and now it is, now you can't stop it. So I'm going to be very excited to see what they do in the next 5 or 10 years.*

If Wilding's HODs are an '*unbelievable bunch of innovators'*, then there should be ample evidence of this. However, little evidence could be provided by the leadership as to what pedagogic innovations had occurred. The evidence of pockets of innovation, although not consistent across departments was found to exist from the teacher interviews, therefore it appears that insufficient evidence is being communicated transparently.

LA responded to the same question in the following way:

> ***LA172/174:*** *Quite wild and woolly. But seriously quite wild and woolly. Not as structured as I think we're used to it, you know. Our model has been a very structured educational model and I think the way it should be looking more and more is less structured … um … quite fragmented in a way. On the outside it probably would appear more disorganised because of the fact we're dealing with this multi-level learning environment where we've got learners working semi-individually at different levels, different stages of their journey within the classroom … um … engaging in a variety of different activities within one learning environment. Um … I think we really need to look at this whole moving from classroom to classroom in a timetabled manner. It's … its not … it's not going to work for us into the future. I can see that. I can see we're going to hit a crisis soon where our very structured timetable day of moving from classroom to classroom to classroom is no longer going to work … um … and the new curriculum almost seems to start warning us that that's not going to be [...] We're going to become in the high school more like preparatory school teachers. The group on the mat … a group at the computers, a group up at the board with the teacher, a group working on their own in tutorials. There're going to be … pockets of learning happening all over the place. [...] No, that excites me. That excites me a lot, it really does. Um … It's a … but, the transition is a very difficult transition because the model that has worked so well for so many years <u>is</u> so entrenched. I know that even when we just try and break free a little bit from a timetabled day to try a timetable … whoa, it's difficult! It's <u>difficult</u>! And until we start making that more and more common practice we're not going to let go of this safe, timetabled, structured learning place that we're in. And yet I can see that it's … it's not … it's not going to be helping us in the future. Ja …*

With these words LA concedes that the structure of the school and the needs of the learners and the curriculum are in conflict. He confirms the obstacles that were raised as *'grammar of schooling'* factors (Ch.2, Section 2.4.6, p.75) and acknowledges the necessity to address these issues.

7.4.9 Summary and preliminary findings: school leadership

The intention of this chapter has been to establish an understanding of the extent of the involvement in ICTs of the leadership; to discover if and where there is convergence between the views of the leadership on ICT integration and those of the teachers; and to provide a further perspective that is integral to the context of the school. Table 7.1 (p.355) summarises the factors raised by the leadership according to the themes and shows where there is convergence with the teachers' views. Certain factors were present in the school and others were identified by the leadership as not present (e.g. curriculum mapping). The purpose of the table is to give a summary and not an absolute measure given the complex inter-relatedness of the issues. Where individual teacher's views differed, these are indicated as such.

LB and LC provided a relatively historical perspective in that they were able to describe the position from which not only the school ICTs, but the school itself moved. This position reflected the *'hubris born of success'* (footnote 2, p.345). That there has been significant movement is evident. However, the movement appears to have been largely in the provision of ICTs as tools to enable practice rather than in the development of a changed pedagogy through the use of ICTs. This concomitant development of the pedagogical aspects has not, according to the evidence, occurred. This correlates with the findings of the teachers' views in Chapters 4 and 6.

The curriculum crisis as LA terms it is acknowledged and was due to have been addressed through the Assessors' course and macro-planning. However, although most teachers have now completed the Assessors' course, the macro-planning process has only just begun (July 2009). Design of learning processes is proposed as part of the solution.

Table 7.1: Convergence between leadership and teacher roles

Factor	Present	Not present	Convergence with teacher views	Disconvergence with teacher views
Leadership perceptions				
importance of ICTs	X		X	
importance of ICT pedagogy	X		X	
benchmark		X	X	
Curriculum Change				
content overload	X		X	
assessors' course		X	?	
macro planning		X	X	
inter-departmental co-operation		X	X	
learning design		X	X	X
complacency	X			X
fall-back on familiar	X		X	
Curriculum innovation				
lack of teacher capacity	X		X	
need for workshops		X	X	
no history of innovation	X		X	X
inclusive practice	X		X	
incremental steps	X		X	
Working together				
external co-operation	X		X	X
internal co-operation	X		X	X
knowledge of each others curriculum		X	X	
ICTs & innovation				
evaluation		X	X	
learning design process		X	X	X
ICT development				
connectivity	X		X	
improved access	X		X	X
improved efficiency	X		X	X
user support	X			X
research skills (students)		X	X	
application skills (students)	?		X	X
Constraints				
cost	X		X	
perceptual differences IT Dept	X		X	
security	X			X
Encouragement to use ICTs				
Intel course	X			X
Pencil Box added value	X		X	
support role	X		X	X

Whilst LC claimed that prior to the mid-1990s there was no innovation at Wilding, this is not correlated by any other view, although Arthur's evidence

(AS11b: Ch.4, Section 4.5.2.1, p.164) indicated that, faced with the challenges of the new curriculum, teachers may also resort to the familiar rather explore the new. Secondly, the fact that communication that enables diffusion of innovation is limited, may be a contributing factor. The diffusion of innovation or at least innovative ideas is premised on such communication which needs to be part of a community of practice or culture of collaborative sharing. The leadership findings show that intra-departmental communication is happening and there is sharing between clusters, but there is no apparent inter-departmental collaboration. Evaluation of innovations is raised. Evaluation should be part of any development process but there does not appear to be any model or means in place to either evaluate an innovation or share the results of the evaluation. If evaluation occurs, for whom is the evaluation intended?

The innovation that the leadership is aware of, apart from the provision of ICTs, is described as small incremental steps rather than wholesale innovation. This is consistent with Whitehurst's (2009, p.1) description of incremental change and Clarke *et al*.'s findings (2000, p.6-7).

ICT innovations specifically, from the leadership perspective, have been limited to the provision of the hardware and the occasional intra-departmental workshop. There is tension between the provision of hardware and its use. While the anti-plagiarism policy requires a scaffolded learning process, there is no evidence of this process occurring. On the other hand, the curriculum overload is recognised as a deterrent to creative use of ICTs.

The *Intel Teach-to-the Future* course was offered recently to the partnership schools on a voluntary attendance basis, but no Wilding teachers attended. Given that so few teachers have completed their assessor's portfolios and the *Intel* course also requires attendees to produce a portfolio, it may have been avoided for this reason.

The perceptual difference between the needs of the academic teachers and the technical expertise of the IT Director is acknowledged as a significant

constraint by all three leaders. This dichotomy is being addressed in part through the partnership IT Committee, but also needs to be taken up as a separate issue at leadership level.

LA's description of the future that he envisions is one that should be debated and explored as offering the release for, as he expresses it *'something's got to give'* (LA8 p.6) LA is clearly aware of the problems that the teachers face and the need to find a solution. There is convergence between the leadership perceptions of what was happening at the time of the interviews and those of the teachers. There is disconvergence between the leadership perceptions of ICTs as tools or innovations within themselves and the needs of the teachers in the classrooms. Improving lateral inter-departmental communication and collaboration opportunities as well as hierarchical communication channels would enable the diffusion of innovative ideas and support extensiveness of teacher innovation.

7.5 Summary of Chapter 7

This chapter has provided the leadership perspective on teachers' ability to innovate in their classroom practice and on their ability to innovate with ICTs in particular. The chapter provided a brief overview of the literature that links leadership, ICTs and innovation. It described the school leadership and ICT management structures at Wilding College. The chapter then used the themes evident from the data analysis to describe the perceptions of the school leadership and their support for innovative use of ICTs in the school and drew preliminary conclusions. The next chapter will draw together the findings of Chapters 4 to 7 with the literature reviewed in Chapter 2 and offer conclusions to the study and recommendations.

Contents

Chapter 8: Discussion of findings; conclusions and recommendations

8.1. Introduction 373
8.2. Synoptic overview of the study 373
8.3. Discussion of the findings from a theoretical perspective 380
8.3.1. The study of complex contexts 381
8.3.1.1. The context of Wilding College 381
8.3.1.2. Complexity & the context of Wilding College 382
8.3.2. Innovation 384
8.3.3. Professional learning 388
8.4. Discussion of the findings from an empirical point of view 390
8.4.1. The effect of organisational interactions 389
8.4.2. The effect of collegial and professional interactions 394
8.4.3. The effect of ICTs on teachers' ability to innovate 400
8.4.3.1. From an organisational perspective 400
8.4.3.2. From a pedagogic perspective 402
8.4.3.3. From a relationship perspective 404
8.4.4. The effect of leadership interactions 405
8.5. The effect of context on teachers' ability to innovate with ICTs 409
8.6. Conclusions 411
8.7. Reflection 412
8.7.1. Methodological reflection 412
8.7.2. Scientific reflection 414
8.7.3. Substantive reflection 415
8.7.4. Personal reflection 416
8.8. Recommendations 416
8.8.1. Recommendations for policy and practice 417
8.8.2. Recommendations for further research 418
8.9. Limitations of the study 418
8.10. Conclusion 419

Chapter 8

Discussion of the findings; conclusions and recommendations

8.1 Introduction

This Chapter begins with a synopsis of the research presented in this study. Following the synopsis the findings that emerged in Chapters 4 to 8 will be discussed with reference to the literature reviewed in Chapter 2 and with reference to the conceptual framework that has underpinned the study. This discussion will take two viewpoints. The first viewpoint is the theoretical perspective in which the findings will be discussed in terms of theory. Thereafter, the main findings will be discussed and concluded in answer to the sub-questions and the empirical evidence gleaned in response to these questions. The Chapter will conclude with recommendations for further research and a reflection on the study.

8.2 Synoptic overview of the study

This study has described and documented the interaction between secondary school teachers and their context as they respond to multiple simultaneous changes in the school environment by innovating in their classroom practice, including innovating with information and communication technologies (ICTs). These interactions have been analysed and described in terms of three critical processes: convergence, mutuality and extensiveness.

8.2.1 Chapter 1

Chapter 1 provided a background to the study from five different perspectives that form the context of the school that is the subject of this case study. These perspectives are the educational-cultural perspective; the national policy perspective; the technology transformation perspective; the school perspective and the researcher's perspective. These perspectives were

distilled into a focus that encapsulated the research problem. The problem was identified from my personal experience as a participant-researcher at Wilding College and from calls for research into contextual factors such as those made by Breuleux (2001, p.7) and Windschitl (1998, p.28). The problem was to understand how complex contextual factors influenced teacher innovation in secondary schools and innovation with ICTs in particular. These contextual interactions were examined in terms of three critical processes: convergence, mutuality and extensiveness as defined by Sherry and Gibson (2005, p.6) which permeate the boundaries between different levels of a school system and are therefore essential to the sustainability of innovations. The research question that derived from this problem was:

> *How do teachers innovate in the face of complex, simultaneous and ongoing changes and, in particular, how do they innovate with ICTs amidst such changes?*

This question was broken down into four sub-questions that were each dealt with separately in Chapters 4 to 7.

Chapter 1 also provided an overview of the scope of the study, the research methodology and the issues of trustworthiness, ethical considerations, limitations of the study and an introduction to the literature.

8.2.2 Chapter 2

Chapter 2 drew together the literature from different perspectives. These perspectives were the ICT perspective, complexity perspective and the innovation perspective. The literature review was able to show the inter-relationships between these differing perspectives. Embedded in the review were complexities within the use of the terminology themselves. An understanding of these perspectives is fundamental to understanding what comprises context in a 21st Century school.

From the ICT perspective the review followed a pathway through functional and integrative practice to transformative practice borrowing from Brackett's terminology (2000, p.3). Intertwined with this perspective was the transformation perspective which relates to the top-down processes of educational reform (Glatter *et al.* 2005, p.390; Hargreaves 2000, p.54) and the bottom-up processes of changes or innovations that teachers need to make in their practice to respond to such reforms. Criteria for 21st Century student competencies (OECD 2005, p.10-15) need to be met with similar competencies on the part of teachers.

However, as Fullan indicated (1991, p.4), teachers do not resist change for the sake of it, but rather because they cannot make sense of it. The work of Tearle (2004) and others on ICT integration emphasised the focus on pedagogical factors and the need for professional learning support for teachers. Hargreaves and Goodson (2006, p.4) pointed out the complexity of secondary schools in particular and the difficulties teachers face in sustaining innovation in the face of such complexity. Scrimshaw (2003, p.93) locates ICT integration within curriculum innovation. The innovation pathway led through the work of Cros (2000) and into the diffusion of innovations (Rogers 1995; Venezky & Davis 2002) and the need to understand human interactions and the means of communication through networks (Steiner 2004) and communities of practice (Senge 1990; Wenger 1998; Sharma 2005). This pathway culminated in a review of the Israeli studies on ICTs and innovation in schools (Mioduser *et al.* 2003; Nachmias *et al.* 2004 and Tubin *et al.* 2003).

The innovation pathway provided a link to Clarke *et al.* (2000) and to Sherry and Gibson's work (2002), with Gibson having worked with both Clarke and Sherry. Clarke *et al.* opened the door to complexity theory and the complexity of organisational behaviour (Webb & Lettice c.2005, p.2); the complex processes of learning (Davis & Sumara 2005, p.458; Doolittle 2001, p.5); complexity and schools (e.g. Phelps & Hase 2002; Mehan *et al.* 2005) and complexity and ICTs (Scrimshaw 2003; Staples *et al.* (2005). The work of Sherry and Gibson (2002) provided the key to the conceptual framework

development in the form of the three critical processes, namely convergence, mutuality and extensiveness which underlie the sustainability of innovations.

The theoretical terminology that Sherry and Gibson provided differed from that of other authors. Whilst these authors derived, defined and described factors that affect innovation and ICT integration, Sherry and Gibson's concepts concerned the *interaction* between the factors (2002, p.9). The conceptual framework for the study was then built on this terminology to enable the study of contextual interactions that affect teachers' ability to innovate. The study of the particular case at Wilding College as a study of context was also indicated by the fact that almost all research on ICTs in schools had focused on primary schools, on specific subjects or on exemplary projects in secondary schools. Such studies had acknowledged that little work had been undertaken in the majority of schools, i.e. those considered as not exemplary in their use of ICTs. This research opportunity provided the angle from which to view the context of Wilding College.

8.2.3 Chapter 3

The research methodology that emerged from the background to the study and the conceptual framework was described in Chapter 3. The understanding of context from a teacher's point of view involves the interaction of policy, practice, individual beliefs and relationships, the organisation and the systems that comprise the school as a complex entity. To describe this context required a methodology aligned to the complexities of human experiences that considered the teachers' world holistically (Rossman & Rallis 2003, p.9) and in which the participant's voices would come to the fore (Cohen *et al.* 2000, p.22) without discounting the researcher's voice. This duality was accounted for by the choice of a qualitative case study that reflects the epistemological and ontological assumptions of the researcher (Burrell & Morgan 1979, p.22). The chosen approach was therefore subjective-interpretivist based on a phenomenological philosophy. Such an approach accepts that differing realities exist and that assumptions of

meaning cannot be made. The intention of the study was therefore to describe or investigate the lived experience of the participants and to interpret their experiences and thereby make sense of the investigation (van Manen 1990, p.2). The construction of the study was based on the socio-constructivist learning theory in which three levels of learning operated: the organisational learning provided by the contextual study itself; the professional learning that emerges for all participants and the personal learning on the part of the researcher.

The research methodology section argued for the choice of a case study and provided details of the educational setting as the unit of analysis. The data collection, transcription and coding methods were described. The in-depth interviews were supported by observations from day-to-day experience and documented supporting evidence. Data transcription and coding methods were described and issues of validity and reliability were addressed. The limitations of the study and specific ethical issues arising from the participant-researcher perspective concluded the chapter.

8.2.4 Chapter 4

Chapter 4 provided an introduction to the findings and dealt specifically with the first research sub-question:

> *How do organisational interactions influence teachers' ability to innovate and to sustain innovation in practice?*

In order to describe the relationship between innovation and context, the chapter first introduced Wilding College and the teachers, making use of pseudonyms in order to preserve anonymity. Following this description, the main themes that emerged from the data analysis were outlined. These themes were: curriculum change; inclusive practice; professional learning; the nature of the learning area; systemic factors; teacher beliefs; student beliefs and attitudes; and societal and parental factors. The sequence of interviews

was followed as the most appropriate solution to the challenge of maintaining integrity of the data in relation to their context as each individual situation was unique. Each teacher's situation could not be separated from its subject-specific background, although within subject areas differences were found.

The purpose of the study was to describe the effect of context, not to provide a model of an ideal context. The findings were therefore not aggregated into specific overall patterns. However, using the terminology of convergence enabled the illustration of the unique patterns in which differing factors interacted in each situation. Preliminary conclusions were drawn for each interview and for the chapter as a whole.

A further theme to emerge which related to the concept of mutuality was collegial and professional relationships. This theme was addressed in Chapter 5.

8.2.5 Chapter 5

Chapter 5 addressed the second sub-question of the study:

> *How do collegial and professional interactions influence teachers' ability to innovate and to sustain innovation in practice?*

The chapter provided an overview of the concepts of professional learning communities and formal networking structures which underlie collegial and professional relationships within schools. Thereafter the findings were described, again following the interview sequence. The findings drew on the narrative of the interviews, observations during the interviews and descriptions provided by the participants of their networking and collaborative involvement. The findings which related to mutual benefits through collaboration or sharing were illustrated using the same frameworks as for organisational interactions. Where extensiveness was found to be present, this was indicated on the

same figures. Preliminary conclusions were drawn for each interview and for the chapter as a whole.

In order to contextualise ICT interactions against the background provided in Chapters 4 and 5, these were addressed in Chapter 6.

8.2.6 Chapter 6

Chapter 6 focused on interactions with ICTs in response to the third sub-question:

> *How do ICTs influence teachers' ability to innovate and to sustain innovation in practice?*

The chapter provided a brief overview of the literature relating to innovation and ICTs and the complex connectedness between the two concepts. The need to focus on pedagogical goals as process innovations rather than ICTs as product innovations was emphasised. The chapter described the ICT infrastructure at Wilding College and then followed the interview sequence to explore the ICT-related interactions in teachers' experiences. The same method was used to illustrate convergent and disconvergent factors relating to ICTs as in the previous two chapters. Preliminary conclusions were drawn for each interview and for the chapter as a whole.

To provide a further perspective, three members of the school leadership team were interviewed and their views on innovation and ICT integration were reported in Chapter 7.

8.2.7 Chapter 7

Chapter 7 provided a differing perspective to that of the teachers yet one that, according to the literature, is critical to successful ICT integration. Alongside alignment with the curriculum and mission, school leadership is the key to integrating ICTs in a school. The school leadership needs to identify and

determine how technology growth and development goals will serve curricular goals, with each intertwined in reciprocal supportive roles (Staples, Pugach & Himes 2005, p.306-307). This leadership perspective was obtained in order to seek convergence with the perspectives of the teachers and to understand the leadership level of involvement in the context of teacher innovation and ICT integration. Chapter 7 therefore addressed the following sub-question:

> *How do leadership interactions influence teachers' ability to innovate and to sustain innovation in practice?*

In contrast to the teacher interviews, the findings of the leadership interviews were described according to the themes that emerged from the analysis. These themes were:

- Leadership perceptions of ICTs
- Curriculum change
- Curriculum innovation
- Working together
- ICTs and innovation
- Constraints to ICT integration
- Encouraging teachers to integrate ICTs
- Perceptions of the future

A summary indicating convergence and disconvergence between teacher and leadership views was provided. Preliminary conclusions were drawn for the chapter as a whole.

The findings of Chapters 4-7 will be discussed in the following two sections from a theoretical perspective and from an empirical perspective respectively.

8.3 Discussion of the findings from a theoretical perspective

The study of complex contexts, by its very nature defies summarisation in that reductionism implies "*channelling the uncertainty"* of complexity (Lissack 1999, p.120-121). Rather, this discussion will first argue from the point of

theory and its applicability to the case, drawing on examples from the findings to show "*understanding of the uncertainty"* of complexity.

8.3.1 The study of complex contexts

The intention of this study was not to draw a direct relationship between ICTs and contextual factors, but rather to look at the effect of contextual factors on teachers' ability to innovate, including innovating using ICTs. In order to understand this effect, the context itself and the teachers' ability to innovate needed to be explored. The context was explored through seeking evidence of three processes: convergence, mutuality and extensiveness (Sherry & Gibson 2002, p.7) which describe the interactions that enable or inhibit teacher innovation. During the data analysis phase it emerged that there was not only convergence of factors that had a positive effect on teachers' ability to innovate but also convergence of factors that had a negative effect, as illustrated in the figures that accompany Chapters 4-6. In order to differentiate between the two, the term 'disconvergence' was coined to refer to the convergence of negative factors.

8.3.1.1 The context of Wilding College

Many studies have identified contextual factors that affect teachers' ability to integrate ICTs but they do not identify the characteristics of such factors, their applied contexts, nor the relationship amongst the factors (Chen 2006, p.157; Zhao *et al.* 2002, p.484). The term 'context' is used loosely in the literature and I have avoided defining the term up until this point. The argument for this is that context is not a fixed entity, but a set of circumstances that occur in a particular place at a particular time and therefore the meaning of 'context' in this case needed to emerge from the study itself. To study the effects of context is to understand the circumstances of a particular place and time relative to a particular perspective. The temporal nature of circumstances is acknowledged: circumstances are not constant but changing and context is therefore not a constant but is temporal.

The study of Wilding College has found that the term 'context' has referred to circumstances that incorporate a range of factors from personal history and experience inside and outside of teaching, through subject-related factors to roles, relationships and competencies and to the ecology of the system within its societal and cultural domain. Each teacher therefore interacts within a unique context from their perspective. During the period in which this study has taken place there have been various changes in circumstances relating to, *inter alia*, curriculum and staff turnover. The further curriculum change involved Life Sciences and in terms of staff, four participating teachers and leaders left the school. If context is temporal is there value in trying to understand context? I return to Hennie's words quoted at the beginning of the findings '*It's forever changing … as we go along*' (HJ5 Ch.4 Section 4.3, p.141). The temporal nature of reality is one that teachers are constantly dealing with and has therefore to be accepted as a regular and common condition in educational contexts.

If, as Hargreaves and Goodson (2006, p.4) contend, secondary schools are particularly complex and teachers face difficulty in sustaining innovation in the face of dynamic complexity, how does this apply to Wilding College?

8.3.1.2 Complexity and the context of Wilding College

Change in complex systems is dynamic (Clarke *et al.* 2000, p.17; Klein 2004, p.4; Morris 1997, p.24). There is ample evidence of complexity and of ongoing change. Common to all schools is the annual change of student population and the imperative for each individual to be afforded equitable opportunities that cannot be repeated in that each student passes once through the school, and Wilding College is no exception. The school is complex in its holistic philosophy of supporting the six pillars of education (Ch.7 Section 7.4.1, p.348). It is also complex in terms of its partnership links and complex in its operation. The impact of multiple simultaneous changes (Fullan & Hargreaves 1992, p.4) challenges every teacher although only two of these changes dominated the interviews. The school is also complex in the multitude of ways in which interactions occur as demonstrated in the figures in

Chapters 4 to 6, differing from one teacher to the next. To draw on an obvious metaphor, each teacher is a juggler having to maintain so many balls in the air at the same time and yet needing to 'remain on the bus'[1] in line with the curricular vision and goals of the school.

Complexity is characterised by emergent order in disorderly systems (McElroy 2000, p.196). The underlying systems or the *"grammar of schooling"* (Ch.2, Section 2.4.6, p.75) on which a school traditionally operates is highly structured and orderly. However, in contrast to this orderliness, the evidence shows that the tensions that exist in the interactions that affect each teacher's ability to innovate in practice are unpredictable (Davis & Sumara 2005, p.455) and emergent (Lissack 1999, p.112; Davis & Sumara 2005, p.455) or self-organising (Davis & Sumara 2005, p.455). Self-organising implies that teachers as agents within the complex system need to find a way to constantly adapt to the challenges of innovation and change on their own (Webb & Lettice 2004, p.2). This is indeed what happens at Wilding. However, in order for the teachers to cope with such complexity, the environment needs to be fully enabling (Webb and Lettice 2004, p.2).

Experience and collegial relationships appear to be enabling factors at Wilding in that the more experienced teachers are able to cope with the challenges i.e. they are enabled by their individual strengths although, as expressed by Bronwyn (Ch.5 Section 5.5, p.215), they would appreciate more affirmation from the leadership. This affirmation is forthcoming in the cases of Maria (MW95 Ch.5 Section 5.9.1, p.253) and Francois (FP57/59 Ch.5 Section 5.10.2, p.258) in response to their particular challenges with new subject areas. Less experienced teachers (e.g. Magriet) require more enabling pedagogical and collegial support which, as the evidence shows, is inadequate. The interactions are unpredictable in the sense that no matter what is tried by the teachers, they are often at the mercy of the system. Two examples are the negative effects of unstreamed classes on teachers'

[1] Terminology used by the principal at the time of the 2001 Muse vision building exercise with teachers to establish the way forward with the new curriculum. He told teachers that they had to be 'on the bus'. Recalled in a leadership interview (LB: MR146).

intentions (TL18: Ch.4. Section 4.4.2, p.146) and the stymieing of pedagogic intent by lack of access to ICTs (IG232, Ch.6 Section 6.4.1.3, p.283). The complex characteristic of emergence appears in that most teachers are continually trying to find new ways around the challenges with which they are presented e.g. Francois' creative thinking in mentally planning a 'tour' to solve the access problem (FP78: Ch.6 Section 6.4.6.2, p.337).

The unbridled stimulation of creative energy can lead to chaos or weakening of its tensile strength (Clarke *et al.* 2000, p.18). Clarke *et al.*'s contention would appear to apply in the case of Wilding in that the impact of the multiple simultaneous changes results in an over-production of creative and physical energy in trying to cope with the challenges of context, but an under-production of effectiveness. This point is evidenced in the fact that the teachers are too busy to comply with mandated training requirements (e.g. the Assessors' course) that underlie the effectiveness of what they are compelled to achieve in terms of the curriculum change or to attend courses such as the 2008 *Intel* course which was offered. This is the *'Catch 22'* referred to in Chapter 7 (Section 7.4.5, p.360) and which LA refers to in terms of *'something's got to give'* to break out of the conundrum (LA8: Ch.7 Section 7.4.2, p.350).

Given the above, Hargreaves and Goodson's (2006, p.4) contention that secondary schools are particularly complex and teachers face difficulty in sustaining innovation in the face of such complexity, would certainly appear to apply to Wilding College. The broader question of exactly what innovation is within the context of Wilding College requires elucidation.

8.3.2 Innovation

In Chapter 2 the following definition of innovation was derived from the literature:

> *Multiple perspectives and interpretations of innovation therefore exist, particularly within the context of change or reform in schools. However, for the purposes of this study innovation is used in the sense of a*

bottom-up incremental process of beneficial changes in teacher practices at a particular time and in a particular context as a response to multiple simultaneous, top-down, mandated, policy-based changes.

This definition was used in that the study sought the effect of context on teachers' ability to innovate and in the light of the findings, this definition applies. While this definition was appropriate to teacher innovation, it was found that at Wilding 'innovation' had other implications that are bound to teachers' ability to innovate.

The focus found in the leadership interviews was clearly on providing ICTs as innovations in themselves as admitted by both LA and LB (Ch.7, Section 7.4.5 LA 108 p.358 and LB41 p.359). None of the three leaders could identify ways in which they had encouraged innovative *use* of ICTs by teachers. This focus on the ICTs as product innovation was, however, not reflected overall in the teacher interviews. The exception was amongst the Physical Science teachers who desired to have a data projector and functioning PC in each classroom. It is the process innovation or new ways of using the tools that needs to be targeted for professional development (Whitehurst 2009, p.5).

Organisational innovation is described by Venezky (2004, p.5) as *"substantive planned change in a school system to solve a problem, without regard for whether the change resulted in the adoption of novel or traditional procedures"*. Clarke *et al.* (2000, p.17) on the other hand describe innovation as resulting from such change. The cycle of innovation and change at Wilding was initiated by planned substantive *change* in the school system. All teachers acknowledged the influence of the new curriculum (national level policy change) and the change to inclusive practice (school level change) as the drivers of their attempts to innovate. In Richard's case, his creative background (Ch.4 Section 4.5.4.1, p.185) influenced him at least as much as did mandated change, but these two major changes still had an effect on his practice (RL4a Ch.4. Section 4.5.4.1, p.186). In Henry's case the presence of ICTs was enabling (HN60: Ch. 5 Section 5.7.1, p.244). In response to the

new curriculum, teachers were trying things that were new to them although to different degrees. In the case of Bronwyn and Ineke, as well as that of Arthur, this meant trying things that were completely new, as evidenced in their comments about being like first year teachers again (BK4 Ch.4 Section 4.4.6, p.151; AS38 Section 4.5.2.3, p.173). In the case of Magriet and Thabo they envisioned where they wanted their practice to be, but still employed traditional methods. However, the continuation of traditional methods also resulted, at least in part, from their lack of access to ICTs rather than a lack of willingness to innovate. The findings therefore agree with Venezky's contention that substantive planned change plays a role, but not that substantive planned change is itself innovation. Rather, Clarke's view of innovation as resulting *from* change [my italics] is more appropriate in this case of Wilding.

Notwithstanding the above, the "*islandness*" phenomenon (Tubin *et al.* 2003, Ch. 2 Section 2.4.5, p.72) also plays a part. Examples of this phenomenon were found, for instance, in that teachers wished to use ICTs, the ICT labs or data projectors but competing demands restricted them instead to traditional methods. In these instances, the desire to innovate was there, the ICTs were present, but the isthmus connecting the two was submerged by systemic factors. Similarly, Venezky and Davis (2002, p.22) refer to examples of staff acquiring good personal ICT skills, but not integrating them into the teaching and learning process because of either a lack of professional development in this area, or lack of appropriate infrastructure or access to it. In the case of Wilding College this situation also applies. None of the teachers indicated that their own personal ICT competencies held them back from using them in their classroom practice. On the contrary, there was clear evidence of high competencies in most cases, similar to the findings Peck *et al.* (2002, p.53), but the teachers were unable to apply them as they wished.

In Chapter 2 I also wrote:

What is not clear from the literature is the cycle of innovation and change, that is, whether change (a condition) supports innovation, or whether innovation (a changed learning process) results in change.

It would appear from the findings that the cycle of innovation and change is iterative. If change is a constant then the stimulus for innovation is always present. Using Venezky and Davis's argument (2002, p.13-14) on catalysts and levers, *"substantive planned change"* can either be planted as a catalyst with expected change or used to lever desired change. The difference is in the implementation. In the case of Wilding College, the new curriculum appears to have been planted as a catalyst achieving some of the desired results, but other undesired results as well e.g. teacher stress levels, overload and incomplete attainment of assessment requirements. To apply the new curriculum as a *lever* for change would mean envisioning where the school wants or needs to be and then creating a strategy and plan for achieving that end that incorporates all teachers. Using a strategic lever in this way might provide a solution to the mindset problem as described by Henry (HN52 Ch.5 Section 5.7.2, p.241) and ensure a more equitable and transparent introduction of methodologies. However, with hindsight and evidence, these points are more obvious than at the outset of such a major change.

If such a strategic lever were to be employed it needs to be asked what the effect might be on creative energy? Webb & Lettice (2004, p.2) argue that *"self-organisation means that the system organizes itself, i.e. that the single agents of the system find a structure bottom-up on their own, without having a master-plan or an observational guider telling them how to organise".* Does self-organisation counter the notion of a strategic lever? I believe that it does not because, as Webb and Lettice further state, *"self-organising behaviour is supported by an enabling environment".* In the case of curriculum change there are two levels of learning: organisational learning and professional learning. Contemporary learning theory requires the use of scaffolds. Just as students require enabling scaffolds, teachers also require scaffolds to support their construction of knowledge *"proceeding from the ground into the*

atmosphere of the previously unknown. The scaffold is the environment the teacher creates, the instructional support, and the processes and language that are lent to the student in the context of approaching a task and developing the abilities to meet it" (Wilhelm, Baker & Dube 2001). It is this strategic lever that I believe, and that the evidence indicates, that Wilding College lacks in the implementation of the new curriculum as well as in the pedagogic support of ICT use. In the case of professional learning, the organisation as represented by the leadership needs to provide the scaffold and the opportunity for teachers to proceed from the known to the unknown. This situation is consistent with what Rowan *et al.* (2005 p.19) describe as that in which teachers are given the aims such as *"authentic, learner-centered, interactive, continuous and inclusive learning"* but not the tools and are expected to rely on their own *"discovery learning".*

8.3.3 Professional learning

If scaffolding professional learning will help create a more enabling environment as surmised by Arthur (AS119 Ch.5 Section 5.6.2, p.228), then it should address the stress and overload that is evident in the findings. Cros (2000, p.67) argues that to sustain or institutionalise innovation it needs to become part of the culture of the organisation in which it occurs. The culture of the school not only enables student learning, but professional and organisational learning. From the cultural perspective professional learning needs to be viewed as the *"enabling resources made available to people to cope"* … and is constantly *"concerned with constraints imposed on the process of education"* such as the organisation of schools and classrooms (Bruner 1996, pp.2-7). The means of creating this enabling environment are indicated in the literature as developing the notion of a community of practice or professional learning community (Senge 1990, p.308; Wenger 2008, p.2). In its ICT infrastructure, Wilding College has the means to support and enable such a community, but its power needs to be leveraged by the leadership.

The leadership vision for learning is evident in LA's words (LA172: Ch. 7 Section 7.4.8, p. 367) as used in Chapter 7:

> *"Quite wild and woolly. But seriously quite wild and woolly. Not as structured as I think we're used to it, you know. Our model has been a very structured educational model and I think the way it should be looking more and more is less structured … um … quite fragmented in a way. On the outside it probably would appear more disorganised because of the fact we're dealing with this multi-level learning environment where we've got learners working semi-individually at different levels, different stages of their journey within the classroom."*

However, LA used these words in the context of student learning. I believe that they apply equally to professional learning and that rather than having teachers confined to the silos of their classrooms in the same way as students have been traditionally confined to their rows of desks, there should be:

> *"The group on the mat … a group at the computers, a group up at the board with the teacher, a group working on their own in tutorials." (LA172)*

It is not only perceiving the future in terms of student learning, but also in terms of professional learning in this way that, as Senge (1990, p.308) states, a school in the complex knowledge society will become a learning organisation with innovative structures and processes that encourage the development of professional learning capacity to cope with unpredictable and changing environments. Professional learning communities are difficult to establish in secondary schools because of hierarchical administration and the strong subject-based structure that counters collaboration (Giles & Hargreaves 2006, p.127). These authors also identify the conflict between informal relationships in a professional community and formally established collaborative networks.

The relationship between context, complexity and innovation at Wilding College has been discussed from the point of view of theory and related to the concept of professional learning. The empirical evidence will now be interpreted in relation to the literature and in terms of the questions posed in this study.

8.4 Discussion of the findings from an empirical point of view

This section takes each sub-question (Ch. 1, Section 1.5, p.16) in turn and it's relevant chapter and discusses the findings. The distilling of the literature resulted in a conceptual framework as illustrated in Figure 2.5 (Chapter 2 Section 2.8.1, p.98) based on the principles convergence, mutuality and extensiveness (Ch.2 Section 2.5.2, p.84) which were applied to personal innovation in practice by teachers.

8.4.1 The effect of organisational interactions

The effect of organisational interactions was described in Chapter 4. The question that the chapter addressed was:

> *How do organisational interactions influence teachers' ability to innovate and to sustain innovation in practice?*

The variety and complexity of interactions that occurred between convergent and disconvergent factors in the context of Wilding College is evident from the descriptions and the illustrations. The teacher responses provided as many different sets of interactions as the number of participants. Whilst common factors occurred in some interviews, it was often their interplay in each case that was different. It is therefore not possible to generalise factors from one individual or a pair of teachers to the next or from one subject department to the next. However, the *effects* of the factors can be generalised in some instances. For instance, a study of teacher beliefs may have found evidence of positive attitudes, but it is only in making explicit the interplay of factors that the powerful effect of the disconvergent factors in countering that belief emerges. The interplay of organisational factors is illustrated in Table 8.1 in which 'Y' represents a positive effect and 'X' a negative effect.

The first finding on organisational factors was that the mandated change to the OBE curriculum had a dominant effect in every case. Its presence was anticipated given that the research was conducted at a time when major curriculum change reached the penultimate year of its first cycle. Overall, the

OBE curriculum had a positive effect in that it stimulated innovative thinking and all teachers had a positive attitude towards the curriculum. However, the OBE curriculum also had a negative effect in terms of the workload that it generated and the complexity that it added, particularly in the two new learning areas of Life Orientation (LO) and Accountancy. The fact that the curriculum itself was unsettled in three of the six subject areas represented by the teachers indicates the possible extent of this problem, although this effect cannot be generalised to all departments. On the other hand, curriculum change is an ongoing process with which teachers need to contend.

Table 8.1: Interplay of organisational factors

Factor	Bronwyn & Ineke	Arthur & Hennie	Magriet & Thabo	Henry	Richard	Maria	Francois
Curriculum change	Y X	Y X	Y X	Y	Y	Y	YX
Focus on student need	Y Y	Y Y	Y Y	Y	Y	Y	Y
Lack of skills			X X				
Lack of support			X X		X	X	
Class size			X X			X	
No streaming			X X				
Overload	X X	X X	X X		X	X	X
Lack of time	X X	X X	X X	(X)	X	X	X
Own nature				X			
Nature of subject					X		
Further change	X						
Conflicting changes			X X				
Experience	Y Y	Y Y	Y Y	Y	Y		
Collegiality	Y Y	Y Y	Y Y	X	Y	Y	Y
Student factors	Y Y			X	X		X
Creativity					(XY)		
Newness of subject						Y	Y

The second finding is that a focus on student needs arising from the inclusive philosophy of the school was prevalent in every case and, in Arthur's case, had a greater effect on his thinking than the new curriculum. The evidence

showed discordance between the tenets of inclusive practice and the reality of classroom experience. While teachers on the whole had internalised this philosophy, the complex innovation that it represents had not yet been fully institutionalised nine years into the change. The focus on student need and student-centred learning provides ongoing challenges to teachers who aspire to be inclusive in their practice, but appear to lack the time, the skills or sufficient support to differentiate in that practice. This may be attributed to a combination of three factors: the dearth of support for teachers as opposed to support for students, class size and a move away from streaming. Cros warns (2000, p.65) that if innovations do not become institutionalised, then burnout and a return to routine occurs. Although the Wilding teachers have tried to adapt, the overload or stress that was evident from the combination of factors is a very real problem that needs to be addressed.

Time, and in particular the need for teachers to manage time, has been identified as an increasingly predominant factor (Tearle 2004, p.338). The lack of time is the third predominant factor that is of common concern to all Wilding teachers except Henry, particularly in their desire to meet the needs of their students. Although the time factor does not appear to affect Henry he mentions that his departmental colleagues do not follow through on fieldwork due to a lack of time (HN60: Ch.5 Section 5.7.2, p.244). The time factor appears to be a direct consequence of both the new curriculum and the focus on inclusivity. There is convergence between the views of the teachers and those of the leadership on the matter of time shortage and its corollary: overload and stress. The lack of time possibly explains why so few teachers have completed their Assessor's course portfolios even though certification by completing the requirements of the course is compulsory and fundamental to implementing the new curriculum. The teachers are caught between desire and compulsion and cannot resolve the situation themselves without the intervention of the leadership, as Arthur states:

> ***AS70:*** *I think generally [the leadership has] been fairly supportive in an indirect fashion. Just provided the background and some of the resources, but not all of the*

resources we need. But the main resource we need actually is time … and that's the one that's got the most stretch on … [chuckles]

A further observation is that personal responses to mandated change are a contributing factor to a teacher's ability to innovate. The following interpretation extracted from the preliminary findings of Chapter 4 illustrates this point:

> *Henry and Richard illustrate the dichotomy of personal responses to mandated changes. Henry attributes his acceptance of change to his own nature, whilst Richard attributes his to the nature of the subject. Bronwyn and Ineke have embraced change to the extent that they feel threatened by what they perceive to be retrogressive further changes in the curriculum. Thabo and Magriet have embraced the philosophy of inclusion and want to change their practice but are caught in a stressful cycle of conflicting changes that they appear unable to escape from. The experience of Hennie and Arthur helps them to rationalise change although they show some scepticism of how well the OBE curriculum is being implemented in their department. Henry is stifled by the lack of a like-minded colleague and intrigued by student factors that conflict with assumptions of a socially networked society. There is a paradoxical tension between Richard's creative nature and his realisation of socially-constructed knowledge in the practical component of his subject and the traditional delivery of the theoretical component which he has no time to explore. Maria and Francois deal with the immensity of the challenge of the new with remarkable fortitude.*

In each of the above cases, the response is unique to the individual.

Taken at surface level, the implementation of mandated changes has been systematic in that it has been incremental over one academic year at a time. However, in practice, the implementation process for the two major changes has manifested as much more ad hoc. Curriculum change in certain subjects has not proceeded in one linear direction, but first in one direction and then veering into another, sometimes reversing and sometimes without clear direction. Teachers have had to establish their own benchmarks; redesign their practice; and manage their own professional learning in real time; with little or no opportunity for planning workshops, peer demonstration,

observation and critique to assist iterative development of their practice. This point is conceded by LA (LA43: Ch.7 Sections 7.4.2, p.352).

Despite these challenges and limitations, positive convergence occurs to the extent that curriculum implementation is moving forward and academic standards are being maintained[2], although some teachers acknowledge that their practice has regressed or that they have not been able to sustain innovation. Disconvergent factors are a reality that needs to be addressed at system, school and departmental levels.

The following was found in answer to the sub-question on organisational interactions and their effect on teachers' ability to innovate:

1. Curriculum change and the change to an inclusive philosophy stimulate innovation in teacher practice. At the same time disconvergent factors generated by the same changes combine with systemic factors resulting in a neutralising or retrogressive effect on teachers' ability to innovate.
2. The response of teachers to organisational level changes is unique to each individual set of circumstances and cannot be generalised.
3. Limited time or its corollary, overload, is a significant inhibitor to teacher innovation.

This section has addressed the question of the effect of organisational interactions on teacher's ability to innovate. The next section will address the second question in seeking evidence of mutuality and extensiveness in collegial and professional relationships.

8.4.2 The effect of collegial and professional interactions

The effect of collegial and professional interactions was described in Chapter 5. This chapter elicited evidence of mutuality or the condition that allows the

[2] As indicated in the final Grade 12 results for the College.

diffusion of innovation in classroom practice. As shown in the literature, diffusion is the process by which an innovation is communicated through certain channels over time by members of a particular social system with the intention of reaching mutual understanding (Rogers 1995, p.5). Similarly, as described by Cros (2000, p.70-74) in the social interactionism model of diffusion the interplay of individual decisions and their effects are key. Communication networks, and particularly personal networks, underlie this social influence.

In seeking mutuality and extensiveness, the question that the chapter addressed was:

> *How do collegial and professional interactions influence teachers' ability to innovate and to sustain innovation in practice?*

Evidence of the communication channels and social interaction between teachers was found to exist in both the collegial and professional interactions of most teachers. Overall, there is supportive camaraderie between teachers and there is trust between the leadership and the teachers which is made explicit by Arthur (AS70a Ch.5 Section 5.6.3, p.229). In the case of Bronwyn and Ineke the collegial relations and their like-mindedness were palpable to the extent that they would complete each others sentences (BK44 & IG46 Ch.5 Section 5.5, p.205) and always used the first person plural 'we'. In Richard's case, collegiality and the professional relationship is evident from his descriptions of his conversations with Alena (RL28b Ch.5 Section 5.8, p.237). However, in other instances, while relationships are good, there is a small indication of mistrust (AS28/30 Ch.5 Section 5.6, p.214) or as in Henry's case, the lack of a like-minded colleague has plagued him over a considerable time period (Ch.5 Section 5.7.1, p.236). In this latter case it is conflicting paradigms that play a negative role and the evidence is in agreement with Cros' findings on this matter of conflict (Cros 2000, p.70-74).

Relationship balance emerges in the findings as an important factor. In the case of Bronwyn and Ineke, the empowering relationship balance in their

department has changed with staff turnover but has not presented a significant problem. Although turnover has had some impact, cordial collegial and professional relations are maintained and a common sense of purpose (Fullan & Hargreaves 1992, p.4) predominates. In Francois' case, he has a good relationship with his colleague, but lack of time upsets the balance and they are unable to derive the mutual benefit that they would both enjoy (FP39 Ch.5 Section 5.10, p.247). Maria has virtually the whole staff as her department and has communication difficulties with them. The problem here is not the relationships, but the unwieldiness of this disparate department. Fundamental professional relationship problems exist in one department[3], but there appears to be no mechanism for resolving this to mutual benefit.

The modular system of developing units of work provided an opportunity for collaboration in most of the larger subject departments. The system achieved its purpose in distributing the workload, but did not always result in collaborative practice. In Physical Science the workload was not lessened and the development of the modules was uneven as indicated by Arthur. Modular development was also not supported by systematic joint evaluation at either the design or implementation stage (AS28/30 Ch.5, Section 5.6, p.214) and therefore the onus for development remained with the individual with varying success. Also, the potential of the ICT infrastructure was not used to enable collaborative development. The single instance of inter-departmental collaboration on a module was discontinued after one year, attributed to staff turnover as well as relationship factors. While the intention of the module system was to lessen the workload, the mutual benefit was neutral as it did not exploit either collaborative opportunities or the ICT infrastructure. The effect was a distributed workload rather than a collaborative effort that epitomises professional learning in a community of practice.

Ideas are spread not only through spontaneous informal communication but also through more directed and managed communication channels (Rogers 1995, p.10) or networks (Steiner 2004, p.1). In the case of Wilding the more

[3] Not linked for ethical reasons.

formalised communication that targets the spread of ideas is limited to generic professional development workshops at the start of term. There is no forum for professional learning in which ideas on pedagogical practice can be shared, debated or critiqued as recommended by Fogelman *et al.* (2006, p.186) and the OECD (2000, p.116). The lateral and vertical diffusion of innovative ideas is therefore limited and may explain why the leadership are unable to identify specific pedagogic innovations (LA21, Ch.7 Section 743, p.341). The lack of a forum is acknowledged by the leadership (LA43 Ch.7. Section 7.4.2, p.338).

The leadership is empathetic to the critical situation that the teachers find themselves in with the new curriculum and acknowledge the teachers' frustration (LA33 Ch.7 Section 7.4.2, p.337). At the same time, as LB admits, they do not know what happens inside the black box of the classroom (LB103 Ch.7 Section 7.4.1, p.335). While the Assessor's course (Ch.7 Section 7.4.2, p.343) addresses a specific gap in curriculum related knowledge it is not the only limitation to practice that needs to be addressed. Other areas in which the need for professional learning is indicated are pedagogic knowledge of ICT use and differentiation to address student need. These are both evident in the extracts from TL167/169 to MD178/180 (Ch. 6 Section 6.4.2, p.284).

The IEB user groups and cluster groups go some way to providing an outlet for sharing and for gleaning resources i.e. networking. However, the interaction here is limited to sharing resources and there was no indication of collaborative practice across these groups. The flow of influence is perceived to be in a singular direction (HJ96 Ch.5 Section 5.6, p.227) and therefore no mutual benefit derives from this group. The validity of this mono-directional perception is subject to question (MD117 Ch.5 Section 5.6 p.228). In the two new subject areas the teachers turned to their cluster groups out of need and derived benefit from them. Although no mutual benefit resulted at the time, Francois certainly indicated the wish to reciprocate once he was in a position to do so (FP55 Section 5.10, p.253).

Similarly, the partnership in which Wilding College is involved did not appear to provide any mutual benefit, except in Maria's case. Collegial relations with the partner school had, in fact, deteriorated as evidenced in HJ94 (Ch.5 Section 5.6, p.226) and no collaborative synergy ensuing from the partnership was evident.

Table 8.2: Interplay of relationship factors

Factor	Bronwyn & Ineke	Arthur & Hennie	Magriet & Thabo	Henry	Richard	Maria	Francois
Collegiality	Y Y	Y Y	Y Y		Y	Y	Y
Trust		Y					
Relationship balance	X X	X X		X	Y	X	X
Intra-department Collaboration	Y Y	X X	X X	X	Y	Y	Y
Inter-departmental collaboration	Y Y	X X	X X	X		Y	
Joint evaluation processes	X X	X X	X X	X			
Support from ICTs in collaboration	Y Y						
Staff turnover	XY XY	X X				Y	Y
Pedagogic workshops or forum							
Vertical communication of innovations							
Lateral communication of innovations							
Cluster groups (sharing)	X X	X X	X X		X	Y	Y
Cluster groups (collaboration)							
Other groups (sharing)	Y Y	Y		Y	Y		Y
Partnership	X X	X X		X		Y	
Evidence of PLC							

While communication is essential to diffusion and clusters or networks are key to the communication of creative ideas in learning organisations (Lewis & Romiszowski 1996), little advantage appears to be taken of these at Wilding

College either internally or externally, limiting mutual benefits to individuals or to departments. Professional learning communities are essential to schools nowadays (Senge 1990, p.308) but are difficult to establish in secondary schools because of hierarchical structures and a subject-based culture. The evidence, as summarised in Table 8.2, indicates that these limitations apply in the case of Wilding College.

That there is a need for professional learning at Wilding College is evidenced in two instances. Firstly, there are pockets of innovative practice that respond to both the demands of the new curriculum and the affordances of ICTs, but they are invisible to teachers in other departments due simply to the lack of opportunity to share. Secondly, there is tension between subject departments due partly to the competition to attract students to optional subjects and the perceived risk in doing something different (Ch.4, Section 4.4.4, p.148). An appropriate professional learning process as described by Fullan and Hargreaves (1992, p.4-6) would allow teachers to act on their sense of purpose, provide them with the opportunity to voice their opinions, assumptions and beliefs and create a collaborative as opposed to only a collegial community together.

In answer to the sub-question on collegial and professional interactions and their effect on teachers' ability to innovate, this study has found the following:

1. Collegial relationships are positive and supportive to different degrees within departments. Sharing ideas and resources occurs within most subject-departments to mutual benefit. However, where the exception occurs the effects are negative and limiting and little mutual benefit is derived.
2. Generic professional development is provided but does not contribute to mutuality, the sustainability or institutionalisation of innovation or the sharing, evaluation and critiquing of practices.
3. There is no structure or mechanism to extend intra-departmental innovation in practice or its mutual benefits across the school.

4. In the majority of cases, there is little perceived benefit derived from the association with formal networking groups although extensiveness occurs in the outward flow of influence.
5. The ICT infrastructure is not used for collaborative purposes other than the use of email or as a repository for resources.

Against the contextual background of the findings of the responses provided to the first two sub-questions, the findings of the effect of ICTs will now be discussed.

8.4.3 The effect of ICTs on teachers' ability to innovate

Chapter 6 described the findings in relation to the third sub-question which was:

> *How do ICTs influence teachers' ability to innovate and to sustain innovation in practice?*

The findings will be discussed in relation to the organisational, pedagogical and relationship perspectives.

8.4.3.1 From the organisational perspective

There is a complex connectedness of interactions between ICTs and innovation. To ensure pedagogic innovation with ICTs requires a focus on curricular goals, compatibility with assessment, teacher collaboration, and ongoing pedagogical and technical support. ICTs should not be confined to inaccessible laboratories (Cuban 2001 p.163; Means *et al.* 1993, Ch.VIa para.2; Peck, Cuban & Kirkpatrick 2002, p.59) and the focus needs to go beyond the provision of ICTs alone (Means *et al*. 1993, Ch.VIa para2; Cuban 2001, p163; Peck, Cuban & Kirkpatrick 2002, p.51). Financial resources need to be balanced between the provision of ICTs and technical support on the one hand and pedagogical support on the other (Anderson & Becker 2001, p.3).

In terms of these criteria from the literature Wilding College has an extensive ICT infrastructure that functions efficiently as confirmed by the leadership (LB41 Ch.7 Section 7.4.5, p.345). However, the focus has been on this efficient functioning of the ICTs and IT Department needs rather than the effective use of ICT and classroom needs. The lab model has been the accepted model of ICT provision which creates accessibility problems, particularly for optional subjects. A bottle-neck is created in the labs by the simultaneous scheduling of Computer Science and other optional subjects, limiting access for the latter. This is being addressed in part by the intended provision of a multi-media PC and digital projector for each classroom, but a single computer does not support student centred or generative learning (Hokanson & Hooper 2000, p.533); rather it favours teacher-centred learning. The roll-out of this plan also creates equity problems with teachers having to teach identical modules concurrently even though some lack the necessary access to tools essential to the delivery of the module. Therefore, whilst on the surface Wilding College is well-equipped; in practice disconvergent factors limit access at the time it is needed, countering an array of convergent factors that would otherwise enable innovative use of ICTs. Generally, teacher thinking is ahead of what they are able to achieve in practice and their frustrations need to be addressed.

Personal competency and comfort with ICTs influences teachers' ability to innovate in practice and even where competency is limited, as in the case of Maria it is not a deterrent to practice (Ch.6 Section 6.4.5, p. 322). Magriet emphasises the improvement in her productive efficiency through the use of the administrative package (MD156/158: Ch.6 Section 6.4.2, p.290). In this case she perceives the product itself to be the innovation. There is no indication therefore that teachers require further support in the form of training courses in the use of current applications.

The prohibitive cost to students was a factor in the decision to end the laptop programme in the late 1990s. While the financial support for ICTs in the school is relatively generous, given the higher relative costs of ICTs in South

Africa, funding remains a constraining factor in maintaining and upgrading the network and ICT infrastructure and in providing specialised technologies such as digital projectors. However, consideration does not appear to have been given to the idea of less costly alternatives[4]. The cost of ever more powerful mobile technology is decreasing and it is becoming more common to find students with this type of technology in their pockets. Suggestions for integrating mobile use were made by both Henry and Arthur (HN17c & AS131 Ch 6 Section 6.4.2 p.274).

8.4.3.2 From a pedagogical perspective

ICTs need to become an element of the curriculum (Huffman & Rickman 2004, p.282) and innovation needs to take place in the pedagogical practice. Innovative pedagogical practices promote active and independent learning; encourage collaborative and project-based learning in real-world contexts; heighten sensitivity to individual needs and diversity; redefine traditional space and time learning configurations; and increase parent and community connections with the school (Mioduser et al 2003, p.26).

ICTs are fundamental to innovation at Wilding College. This is evident in both the descriptions of innovations and in the teachers' direct statements. The use of ICTs by teachers at Wilding College to a great extent focuses on curricular goals as opposed to the teaching of skills, but the effect of contextual factors on this process is both complex and varied. Regarding skills, the expectation is that students will arrive at the school with both technical competency and information literacy, which the evidence shows does not always occur, with ensuing problems. Where student application skills are limited, peer-teaching is used to resolve the problem in some instances. There is disparity between the expectations of the teachers and student information literacy levels and this problem is unresolved. However, the problem has been addressed at policy level by the recent development of an anti-plagiarism policy which has yet to be implemented consistently in

[4] As of August 2009 a class-size complement of small laptops has been introduced experimentally but, at the time this study concludes, this project is only two weeks old.

practice. Unlike application skills which can be easily transferred through peer-teaching, information literacy skills are embedded in thinking and writing processes and need to be scaffolded in the design of a learning unit (Beetham & Sharpe 2007, p.2-3). Access to the Internet enables the alignment of learning with real-world contexts (Mioduser *et al.* 2003 p.26), particularly in the content areas such as in the examples provided by Ineke (IG17-19 Ch.4 Section 4.5.1.1, p.153) and Henry (HN81 Ch.6 Section 6.4.3.1, p.304).

With regard to curricular goals, the effect of ICTs on teachers' ability ot innovate is different in every case. Bronwyn and Ineke have high expectations of the students' ability to apply thinking skills in using ICTs (Dede 2000, p.282). They scaffold the student learning process with ICTs (Beetham & Sharpe 2007, p.2-3) to attain curricular goals and formative assessment is integrated into their learning design (Dede 2000, p.282; Looi 2004, p.92; Means 1993, p.3; Roschelle *et al.* 2000, p.76). The use of ICTs relies less on their own ICT competencies and more on their pedagogic competency while at the same time they build student competency. In contrast, the Physical Science teachers appear to use ICTs in a more traditional manner as a demonstration medium rather than in an innovative way although their description of using Excel implies generative use (AS131 Ch.6 Section 6.4.2, p.280). Their reliance on traditional methods can be attributed in part to access problems as well as to the nature of the subject. Continuation of traditional methods is consistent with the findings of Peck *et al.*'s study (2002, p.134). In Henry's case ICTs are used in innovative ways for real-time learning (Mioduser *et al.* 2003 p.26) appropriate to the nature of the subject. In Richard's case his focus is on achieving creative ends with a highly technical application, yet he meets resistance because of student factors. Maria achieves curricular goals through collaboration while Francois' ability to achieve them is impeded by systemic factors and ICT policy.

Student resistance to the use of ICTs as determined by Richard and Henry is unexpected and not accounted for in the literature encountered for this study. Richard struggles to encourage students to follow the Computer Art option

and to retain the students in the course. Henry tries to make use of social networking tools to encourage student collaboration, but meets with disinterest until countered by extrinsic motivation. In both these instances, the teachers' technology vision is ahead of that of their students, although a rethink of their learning design processes might be indicated.

8.4.3.3 From a relationship perspective

A school as a professional learning community (Wenger 2008, p.2) emphasises collaborative opportunities amongst professional teachers. ICTs are the combination of network infrastructure as well as the means of communication, collaboration and engagement that enable the processing, management and exchange of data, information and knowledge (DoE 2003, p.16). According to this definition the communication of data, information and knowledge are therefore inherent in the technology itself. However, the extent to which the infrastructure at Wilding College is used in this way for curricular purposes is limited. From an administrative perspective, data is shared via the *Pencil Box* system, although its added-value features have not been exploited. From a communication perspective information is shared to the extent of overload using email as well as e.g. the calendar facility of the email package. However, the use of ICTs for sharing or social construction of knowledge is limited to either email or the Intranet as a distribution repository.

The ICT factors affecting teachers' ability to innovate are summarised in Table 8.5.

In answer to the sub-question of the influence of ICTs interactions and their effect on teachers' ability to innovate, this study has found the following:

1. The ICT infrastructure supports curricular use of ICTs but limits teachers' ability to innovate to the extent that they desire.
2. Where innovations in teaching practice occur they are not diffused to the benefit of other teachers through the use of ICTs and therefore extensiveness and sustainability are limited.

3. As the basis for collaborative interaction between teachers the ICT infrastructure is significantly under-exploited.
4. The school relies on traditional structures which are sometimes in conflict with curricular goals. Possible benefits of asynchronous time and space configurations through ICT use have not been considered[5].
5. Financial constraints common to all schools occur, but no consideration has been given to less costly forms of ICT provision.

Table 8.3: Interplay of ICT factors

Factor	Bronwyn & Ineke	Arthur & Hennie	Magriet & Thabo	Henry	Richard	Maria	Francois
Accessibility	X X	X X	X X	Y	X	X	X
Equitable provision		X X	X X				X
Financial limitations		X X	X X				
ICT support			X				
Student – centred use	Y Y	X X	X X	Y	(XY)	Y	(Y)
Teacher Competency	Y Y	Y Y	Y Y	Y	Y	(Y)	Y
Improved Productivity			Y				
Curricular focus	Y Y	Y Y	Y Y	Y	Y	Y	Y
Student-centred use	Y Y	XY XY	X X	Y	Y	Y	Y
Student factors	Y Y		X X	X	X		X
Collaborative use of ICTs	Y Y						
Exploitation of Admin. system							

8.4.4 The effect of leadership interactions

The final sub-question provided an alternative perspective from the leadership point of view:

How do leadership interactions influence teachers' ability to innovate and to sustain innovation in practice?

[5] That is, until the advent of the *Moodle* learning management system which is, at the time of concluding this study, just starting to take off.

For innovations to succeed in schools certain conditions are required to be present (Sharma 2005, p.54-56). These conditions include supportive leadership, networks rather than hierarchies, effective group decision-making processes, clearly outlined organisational goals, mutual concern for quality and positive support.

The positive support in an atmosphere of trust provided by the leadership at Wilding is acknowledged by every teacher. The leadership support includes affirmation, provision of resources including ICT resources, empathetic understanding of the difficulties that teachers face and personal development opportunities. However, as pointed out by Arthur, the resources are still insufficient in terms of the expectation on curriculum delivery and the one resource that the leadership is unable to provide is time. The pressures on teachers resulting from a lack of time to achieve to expectations are critical and as LA states '*something's got to give'.* It is this problem that only the leadership can find a solution to. Suggestions made by the leadership for improving this situation are that teachers complete the Assessor's course to enable their understanding and that a curriculum map is compiled. However, these measures are easier said than done as teachers do not appear to have the time to make the breakthrough in the first place. A strategic rethink of teacher expectations is thus indicated.

Wilding College is characterised by formal hierarchies (Ch. 7 Section 7.3, p.338). Although collegial relationships and communication are very good the sharing of knowledge and innovative ideas is limited by both the lack of a collaborative culture and the failure to exploit the potential of the ICT infrastructure. Decision making processes are encumbered by the hierarchical structure and the complexity of the partnership and are counter-productive in the case of ICTs (e.g. FP68-76; Ch. 6 Section 6.4.6, p. 325). The goals of the organisation are expressed in terms of excellence and achievement of the individual within the six pillars on which the school culture is founded. Teachers are overtly encouraged to strive for "*greatness*" rather than rely on the "*hubris born of success"* (Collins 2009: see Ch.7 footnote 2,

p.345) as advocated in a series of teacher workshops. However, such excellence is still largely perceived by the students and the parent body in terms of marks and results and, as a consequence, there is conflict between teacher and student views (HN11 Ch.4 Section 4.4.8, p.151).

According to the literature, the involvement of school leadership in the integration of ICTs is critical (Breuleux 2002 p.10; Otto & Albion 2002, p.3; Staples *et al.* 2005, p.305; Sharma 2005 p.53). While the Wilding leadership is involved, their focus has been on product innovation and the efficient operation of the network, rather than on process innovation or support for pedagogic effectiveness. The school leadership needs rather to identify and determine how technology growth and development goals will best serve curricular goals, with each intertwined in reciprocal supportive roles (Staples, Pugach & Himes 2005 p.306-307). To achieve this end the technology leadership, supported by school leadership, must have a strong curriculum focus aligned with technical expertise. In cases where both the technology leader and the principal are focused on acquisition, teacher leadership of the curriculum aspect is essential (Staples et al 2005, p.307).

Beliefs that the leadership hold have a significant impact on the culture that supports the creative integration of ICTs for teaching and learning and determine the interpretation of the vision for learning through either action or inaction (Otto & Albion 2002, p.3-4). The Wilding leadership appears to believe in the potential of ICTs, but LB admits to being unsure of any improvement in student learning that could be associated with ICTs (LB55 Ch.7 Section 7.4.2, p.342). One significant effect of beliefs is expressed by LB (LB121/123 Ch.7 Section 7.4.6, p.353) in describing the difference in approach between the IT directorate and the academic staff: while one party wants the machines to work, the other wants the learning to work. It is this fundamental difference in belief that underlies the tensions in the innovative use of ICTs. LA also concedes (LA172/174) that the structure of the school and the needs of the learners and the curriculum are in conflict. He confirms

the obstacles that were raised as *"grammar of schooling"* factors (Ch.2 Section 2.4.6, p.74) and acknowledges the necessity to address these issues.

Table 8.6: Interplay of leadership factors

Factor	LA	LB	LC
Positive support	**Y**	**Y**	**Y**
Provision of resources	**Y**	**Y**	**Y**
PD opportunities	**Y**	**Y**	**Y**
Pedagogic support			
Meet expectations	**X**	**?**	**Y**
Communal decision-making			
Product innovation	**Y**	**Y**	**Y**
Process innovation	**X**	**X**	**X**
Potential of ICTs	**Y**	**Y**	**Y**
Learner needs c.f. school structure	**X**		
Lateral communication			
Vertical communication			

The interplay of factors from a leadership perspective are summarised in Table 8.6.

In answer to the sub-question of the influence of leadership interactions and their effect on teachers' ability to innovate, this study has found the following:

1. The leadership views converge in most instances with those of the teachers, particularly regarding affirmation, trust and support and the leadership is empathetic to the critical pressures of curriculum change.
2. While the leadership express support for ICT integration, their support has been limited to the provision of resources (product innovation) rather than pedagogic support (process innovation).

3. Structures that cut across hierarchies and support collaborative professional learning are largely absent and this is acknowledged by the leadership.
4. Lateral and vertical communication of innovative ideas is limited.

In view of the findings and conclusions with regard to the sub-questions of this study, the literature and findings will now be drawn together.

8.5 The effect of context on teachers' ability to innovate with ICTs

This study has investigated the effect of context on teachers' ability to innovate, using Wilding College as its case. The case has been investigated in terms of three principles: convergence, mutuality and extensiveness and posed the following question:

> *How do teachers innovate in the face of complex, simultaneous and ongoing changes and, in particular, how do they innovate with ICTs amidst such changes?*

The findings in answer to this question are summarised in Table 8.7. While identifying patterns in organisational and human experiences can be helpful, in complex contexts the inclination to identify patterns even where they do not exist should be resisted (Webb & Lettice 204, p.92). In this study, recurring factors have been found, but it is the interplay of the different factors and the effect of that interplay which has been identified as unique for each individual and therefore cannot be generalised. The reduction of this interplay to a series of statements loses the nuance of this interplay and should be taken into account.

Table 8.5: Summary of findings

Organisational interactions	Collegial & professional interactions	ICT interactions	Leadership interactions
Curriculum change and the change to an inclusive philosophy stimulate innovation in teacher practice. At the same time disconvergent factors generated by the same changes combine with systemic factors resulting in a neutralising or retrogressive effect on teachers' ability to innovate.	Collegial relationships are positive and supportive to different degrees within departments. Sharing ideas and resources occurs within most subject-departments to mutual benefit. However, where the exception occurs the effects are negative and limiting and little mutual benefit is derived.	The ICT infrastructure supports curricular use of ICTs but limits teachers' ability to innovate to the extent that they desire.	The leadership views converge in most instances with those of the teachers, particularly regarding affirmation, trust and support and the leadership is empathetic to the critical pressures of curriculum change.
The response of teachers to organisational level changes is unique to each individual set of circumstances and cannot be generalised.	Generic professional development is provided but does not contribute to mutuality, the sustainability or institutionalisation of innovation or the sharing, evaluation and critiquing of practices	Where innovations in teaching practice occur they are not widely diffused to the benefit of other teachers and therefore extensiveness and sustainability are limited.	While the leadership express support for ICT integration, their support has been limited to the provision of resources (product innovation) rather than pedagogic support (process innovation).
Limited time or its corollary, overload, is a significant inhibitor to teacher innovation.	There is no structure or mechanism to extend intra-departmental innovation in practice or its mutual benefits across the school.	As the basis for collaborative interaction between teachers the ICT infrastructure is significantly underexploited.	Structures that cut across hierarchies and support collaborative professional learning are largely absent and this is acknowledged by the leadership.
	In the majority of cases, there is little perceived benefit derived from the association with formal networking groups although extensiveness occurs in the outward flow of influence.	The school relies on traditional structures which are sometimes in conflict with curricular goals. Possible benefits of asynchronous time and space configurations through ICT use have not been considered.	Lateral and vertical communication of innovative ideas is limited.
	The ICT infrastructure is not used for collaborative purposes other than the use of email or as a repository for resources.	Financial constraints common to all schools occur, but no consideration has been given to less costly forms of ICT provision.	

8.6 Conclusions

Taken together with the literature, the conclusions drawn from the findings of the study are therefore:

Conclusion 1: *Secondary schools are characterised by complex interactions and each teacher's ability to innovate is affected in different ways dependent on the interplay of convergent and disconvergent factors in their individual context. Identifying and addressing disconvergent factors will enhance the institutionalisation or sustainability of innovations in teacher practice.*

Conclusion 2: *The effect of context is different for each individual teacher and professional learning should therefore be differentiated and scaffolded in the same way as student learning is scaffolded and differentiated to student need.*

Conclusion 3: *Time and overload are significant factors in inhibiting teacher innovation and in some cases can cause retrogression or the opposite effect to what is intended by mandated change.*

Conclusion 4: *Positive collegial and professional relationships are fundamental in order for mutual benefit to derive to teachers and students alike.*

Conclusion 5: *Institutionalisation or extension of teacher innovation over time and space within secondary schools requires an open and supportive collaborative structure and accompanying strategy of pedagogic support.*

Conclusion 6: *Schools require both social and ICT infrastructures to scaffold professional learning and the lateral and vertical extension of innovative ideas in a professional learning community both within and beyond the school.*

Conclusion 7: *Alignment between the ICT infrastructure and curriculum needs is essential to support process innovation in teacher practice.*

Conclusion 8: *To realise mutuality, extensiveness and thereby institutionalisation of innovations transparent strategies, channels or mechanisms for the lateral and vertical sharing of innovative ideas need to be in place.*

Conclusion 9: *A fundamental rethink of traditional structures, including the ICT infrastructure, is indicated in order to achieve the combined benefits intended by mandated change, teacher innovation and ICTs.*

Conclusion 10: *The active support of school leadership in developing pedagogic practice is essential to teacher innovation irrespective of the use of ICTs.*

Conclusion 11: *ICTs are fundamental to teacher innovation.*

8.7 Reflection

Methodological, scientific, substantive and personal reflections will be addressed in sections 8.7.1 to 8.7.4.

8.7.1 Methodological reflection

In Chapter 1 I provided the background to the school and to the evolution of this study. Essentially, the study evolved out of personal experience at the school and was a story seeking a framework in which to be told. The school provided a research opportunity because of the richness of the interactions resulting from the complexity of its transformation process and the depth of the data that could be drawn on. From a purely practical point of view, familiarity with the school over a long period of time as well as the demands that the school makes, limiting time for contact with less accessible organisations, were also significant factors in the case selection.

However, the intention of the study was not only to provide a description but also to try and understand the impact of contextual factors on teachers' ability

to innovate. As a participant in the context I was fully aware of the stresses and overload that my colleagues commonly expressed and to date remain the subject of discussion in HOD meetings, without resolution. I was similarly aware of the high aspirations of each teacher. A research problem is a *"difficulty which can often be expressed as a contradiction between what is happening and what someone would like to happen"* (Bassey 1999, p.6). It was the contradictions between these aspirations and the stress levels that teachers endured to try and meet their aspirations that underlay the focus of the study. In order to contribute to a solution this study was framed as a study of context.

Methodological issues that arose included ongoing interaction with the literature, ongoing interaction with the environment and the dynamics of the question development process. The ongoing interaction with the case environment was consistent with my role of participant-researcher. The ongoing interaction with the literature resulted from my role at the school, the disparate nature of context and the vastness of the field. The question development process, beyond semantic implications, was part of the challenge of distilling the essence of the complex context. While the sub-questions were relatively fixed at the outset, they shifted in and out of focus and occasionally morphed into differing entities, eventually settling during the latter part of the analysis phase.

In collecting the data, I needed to be aware of the change of balance in the relationship between myself as a supportive colleague and myself as the researcher. I became the research instrument from my own perspective, but the transcripts indicate that my colleagues still saw me in my usual role. This was not only evident in the way that they addressed me, often using my name, but also in the searing honesty with which, I believe, they shared their views. In their responses they provided "*thick description"* (Geertz 1973, p.6) which caught the diversity, variability, creativity, individuality, uniqueness and spontaneity of the interactions in their human experiences (Cohen *et al.* 2000, p.139). It is for the honesty and detail of their responses that I retained as

much of their narrative as I could. I trust that I have been able to do justice to their stories through my interpretations.

8.7.2 Scientific reflection

The path through the literature resulted in the conceptual framework using the terminology of the sustainability of innovations: convergence, mutuality and extensiveness. This terminology provided a framework with which to describe the interplay or effect of the identified factors rather than the themes themselves. The conceptual framework was ratified in use.

The place of this study is in the description of a particular context from a participant researcher point of view. Based on the literature this case is specifically one that does not emphasise exemplary projects. Many of the studies on ICTs had identified schools that were exemplary in their ICT use or specific projects that were exemplary in the way in which they employed ICTs. From these exemplary projects, taxonomic factors were extracted and described as important to the innovative use of ICTs. However, the limitations of these studies were that they were unable to identify *how* such factors interacted. In seeking convergence, mutuality and extensiveness it has been possible to describe the *effect* of such factors, albeit there was little evidence of extensiveness within the context.

The literature differentiated between sustainability and institutionalisation of innovations. Institutionalisation occurs when an innovation is assimilated into the culture of an organisation and becomes a part of it, losing its own identity (Miles 1983 cited in Billig, Sherry & Havelock *et al.* 2005, p.987). A sustainable innovation is one that retains its own identity and endures over time as part of the organisational culture (Billig *et al.* 2005, p.987). Teaching and learning innovations are sustainable when they become part of and are integrated within the individual and institutionalisation and integration of innovation on a personal level cannot be separated. Interactions with colleagues are crucial to continuous learning about different innovations and helping teachers avoid pitfalls in sustaining the innovations (Lane 2001, p.89-

90). Although the terminology originated in Sherry & Gibson's *Systemic Sustainability Model* (2002, p.9) I believe that they apply equally to institutionalisation of innovation, particularly in the light of Lane's contention on institutionalisation and personal innovation (Ch. 2 Section 2.4.4, p.70). Whether an innovation is sustained or institutionalised is immaterial in this case. What is important is that innovation is stimulated and diffused through interaction with colleagues to enable professional and organisational learning.

8.7.3 Substantive reflection

This study set out to describe the effect of context on teachers' ability to innovate, and to innovate in particular with ICTs. At the outset, the relation between innovation and ICTs was not specified; rather it was left to emerge through the findings.

Innovation in the educational context is defined as pedagogical practices that promote active and independent learning; encourage collaborative and project-based learning in real-world contexts; heighten sensitivity to individual needs and diversity; redefine traditional space and time learning configurations; and increase parent and community connections with the school (Mioduser *et al.* 2003, p.26). Factors identified as critical to the innovation process included, *inter alia*, ICT infrastructure and ICT policy. While this relationship is specified in the literature, the findings also show a direct relationship between ICTs and innovation. For some teachers (e.g. Henry, Francois, Bronwyn and Ineke) ICTs and innovation were inextricably bound together with curriculum innovation. For Richard, ICTs formed a separate curricular component, but the use was generative. For the Physical Science teachers the innovation is largely in the improvement of traditional methods of delivering curriculum. ICTs help solve Maria's problem of distributed delivery across a diverse staff. No matter the nature of the innovation, without ICTs none of these innovations could have occurred.

Research on successful innovative educational pedagogies (Nachmias *et al.* 2004, p.296; Tearle 2004, p.345) highlights the inter-relatedness of contextual

factors. In the case of the Israeli study, the authors acknowledged that their research produced shallow results and suggest that further research investigates the relative importance of the factors that affect innovation, their relation to the innovation life-cycle and the correlation between the factors and the nature and properties of innovation (Nachmias *et al.* p.306-307). While this study did not build directly on their recommendations, it has been able to shed some light on the relationships between similar factors which emerged from this specific context.

8.7.4 Personal reflection

Constructivist learning is not limited to students per se, but is equally applicable to teachers' professional learning and to the process of research as a learning activity (Rossman & Rallis 2003, p.5) in which the report becomes the construction of the researcher's reality as an interpretation of the reality of the researched. This study has synthesised multiple perspectives drawn together from the literature and through my interpretation of my colleagues' realities. In researching their context I have been afforded privileged insight into their realities. The unique case that is Wilding College has been amalgamated through a process of social construction of knowledge. The report is mine and the learning on my part has been immense, but the stories are those of my colleagues and this study has served its purpose if benefit accrues to but one of them.

In working with my colleagues on a daily basis, I have a privileged vantage point. Mine is not the hierarchical advantage which implies rank, judgement or evaluation; rather it is the advantage of encountering and understanding day-to-day realities and pedagogic needs of teachers and it is to these ends that this study has been directed.

8.8 Recommendations

Recommendations for policy and practice and for further research are provided in sections 8.8.1 and 8.8.2

8.8.1 Recommendations for policy and practice

The conceptual framework for this study, as illustrated in Figure 2.5 (Ch.2 Section 2.8.1, p.98), shows potential diffusion of innovations across boundaries between individual teachers within and beyond the boundaries of their subject discipline. Collegial relations, collaborative practice and socially constructed professional learning are processes that bridge the divide between individuals, subject disciplines and different levels of the hierarchy in secondary schools. These processes allow the diffusion of innovations and support their institutionalisation. For benefit to diffuse from an individual teacher's practice to the organisation as a whole therefore requires these processes to be present in a school. For benefit to diffuse beyond the organisation requires networks or wider communities of practice.

The policy and practice recommendations of this study are therefore:

- Secondary schools need to understand the interplay of convergent and disconvergent factors and how they affect each teacher's ability to innovate.
- Secondary schools should establish strategies and processes for bridging the individual and discipline-related boundaries that inhibit the diffusion and institutionalisation of innovation in teaching practices.
- The potential of the school ICT infrastructure should be harnessed to scaffold professional learning and the lateral and vertical extension of innovative ideas in a professional learning community.
- Teachers' professional learning processes should be scaffolded in the same way as student learning processes and be customised to individual need.
- The potential of alternative ICT models should be investigated to address the problems of access that inhibit innovation as well as for their cost-effectiveness.
- Transparent processes for the design, support, benchmarking, evaluation and implementation of teacher-generated innovations

should be established in order to ensure consistent and equitable delivery of curriculum.

8.8.2 Recommendations for further research

Further research into context-specific factors was called for by Breuleux (2001, p.7). On the other hand, Zhao *et al.* (2002, p.484) contended that innumerable studies existed on contextual factors, but that they were limited as they did not identify the characteristics of such factors, their applied contexts and the relationship amongst the factors. This study has responded to these calls. However, a single case is not exhaustive and further research along similar lines is indicated in order to establish whether similar ranges of patterns of effects exist.

This study has also provided an unusual perspective in that my role in the school as teacher-librarian is different to that of a school leader or a classroom teacher. The interpretations of similar incumbents in different contexts may shed light on the expectations of the role in 21st Century school libraries.

Wilding College is a monastic independent school. A similar study in a variety of different schools may further illuminate the effects of context.

Follow-up action research within the school itself is also indicated.

8.9 Limitations of the study

Common limitations of case studies are that results may not be generalisable, it is difficult to cross check for data selectivity or bias and that, as it involves the researcher as a participant in the process, the interpretations will always be subjective (Nisbet & Watt 1984, p.76).

This study does not centralise ICTs but focuses on the context in which they are integrated. It is not a longitudinal study, but looks instead at a transverse

period in time, recognising that dynamic change is continuous. This study does not claim generalisation to the full context or from one context to the next, rather it shows how the combination of factors affects each individual in a unique way.

The study may have benefited from action research as opposed to individual research, but given the time limitations on Wilding teachers it is unlikely that progress could have been made as a joint endeavour, at least not during the period in which the new curriculum was implemented.

8.10 Conclusion

This case study has described and documented the interaction between secondary school teachers and their context as they respond to multiple simultaneous changes in the school environment by innovating in their classroom practice, including innovating with information and communication technologies (ICTs). The study has responded to calls for research into context-specific factors and the findings have shown that each teacher is subject to a unique pattern of interaction of factors affecting their ability to innovate. Taken together with the literature the findings have been able to demonstrate the effect of context on teacher's ability to innovate.

List of References

Note: References to unpaged online documents are cited by chapter or paragraph

Adelman, C., Kemmis, S. & D. Jenkins (1980) Rethinking case study: Notes from the Second Cambridge Conference in H. Simons (ed.) *Towards a science of the singular.* Norwich: Centre for Applied Research in Education, University of East Anglia

Akbaba-Altun, S. (2006) Complexity of integrating computer technologies into education in Turkey in *Educational Technology & Society* 9 (1) 176-187

Albion, P.R. (2003) *Graduating Teachers' Dispositions for Integrating Information and Communications Technologies into Their Teaching*. Available online: http://dl.aace.org/12009. Accessed: 30th January 2005

Ainscow, M (2005) Developing inclusive education systems: what are the levers for change? in *Journal of Educational Change* 6(2) 109-124

Alessi, S.M. & S.R. Trollip (2001) *Multimedia for Learning: Methods and Development,* 3rd edition. Boston: Allyn & Bacon

Ali, I. & J. Proctor (2005) Information and communication technology (ICT) education in The City School, Pakistan: A success story in the large-scale introduction of the UK National Curriculum's ICT component in Pakistan in *Aslib Proceedings* 57 (2)123-130

Anderson, R.E. & H. Becker (2001) *School investments in instructional technology: Teaching, learning and computing: 1998 National Survey Report #8.* Irvine CA: Center for Research on Information Technology and Organizations, July 2001. Available online: http://www.crito.uci.edu/tlc/html/findings.html. Accessed 7th May 2006

Anderson, N.R., & N. King (1991) Managing innovation in organizations in *Leadership and Organizational Development Journal*, *12*, 17–21

Assié-Lumumba, N.T. (2004) Sustaining home-grown innovations in higher education in sub-Saharan Africa: A critical reflection in *Journal of International Cooperation in Education,* 7(1) 71-83

Attwell, G. (2007) *Web 2.0 and the changing ways we are using computers for learning: what are the implications for pedagogy and curriculum?* Available online: www.elearningeuropa.info/files/media/media13018.pdf. Accessed 3rd March 2006

Baggott la Velle, L., McFarlane, A. & R. Brawn (2003) Knowledge transformation through ICT in science education: a case study in teacher-driven curriculum development: Case-Study 1 in *British Journal of Educational Technology*, 34 (2) 183–199

Bassey, M. (1999) *Case Study Research in Educational Settings.* Maidenhead: Open University Press

Batchelor, J. (2007) Mobile information and communication technology use in secondary schools: A feasibility study. Unpublished M.Ed. Dissertation: University of Pretoria.

Beastall, L. (2006) Enchanting a disenchanted child: revolutionising the means of education using Information and Communication Technology and e-learning in *British Journal of Sociology of Education* 27(1) February, 97-110

BCED (2002) *Working with colleagues: A guide for ICT mentors.* Available online: http://www.bced.gov.bc.ca/technology/documents/mentors.pdf. Accessed 7th May 2006

Becker, H.J. (2001) *How are Teachers Using Computers in Instruction?* Paper presented at the 2001 Meetings of the American Educational Research Association. Available online: http://www.**aera**.net. Accessed 7th May 2006

Becker, H.J. (2000) *Findings from the Teaching, Learning, and Computing Survey: Is Larry Cuban Right*? Revision of a paper written for the January, 2000 School Technology Leadership Conference of the Council of Chief State School Officers, Washington D.C. Available online: http://epaa.asu.edu/epaa/v8n51/. Accessed: 7th May 2006

Beetham, H. & R. Sharpe (2007) *Rethinking Pedagogy for a Digital Age: Designing and Delivering e-Learning.* London: Routledge

Bernstein, R.J. (1983) *Beyond Objectivism and Relativism.* Philadelphia: University of Pennsylvania Press

Bialobrzeska, M. & S. Cohen (2005) *Managing ICTs in South African Schools: A Guide for School Principals*. Braamfontein: South African Institute for Distance Education.

Bielefeldt, T. (2005) Computers and student learning: interpreting the multivariate analysis of PISA 2000 in *Journal of Research on Technology in Education* 37(4) Summer, 339-347.

Billig, S.H., Sherry, L. & B. Havelock (2005) Challenge 98: sustaining the work of a regional technology integration initiative in *British Journal of Educational Technology* 36 (6) 987–1003

Blasik, K., Williams, R., Johnson, J. & D.R. Boegli (2003/2004) The marriage of rigorous academics and technical instruction with state-of-the-art technology: A success story of the William T. McFatter Technical High School in *High School Journal* 87(2) Dec 2003/Jan 2004, 44-55

Bloom, J. W. (2000) *Patterns that connect: Rethinking our approach to learning and teaching*. Paper presented to the Annual Meeting of the American Educational Research Association, New Orleans. Later published as: Bloom, J. W. (2004) Patterns that connect: Rethinking our approach to learning, teaching, and curriculum in *Curriculum and Teaching*, 19(1), 5-26.

Bloom, J. W. (2001) *Chaotic and complex systems in children's thinking and learning*. Paper presented to the Annual Meeting of the American Educational Research Association, Seattle, Washington. Available online: http://jan.ucc.nau.edu/~jwb2/research/Complexity/chaosinthinkingpaper.html. Accessed 15th September 2006

Blumenfeld-Jones, D. (1995) Fidelity as a criterion for practising and evaluating narrative inquiry in *International Journal of Qualitative Studies in Education* 8(1), 25-33

Bogdan, R. G. & S.K. Biklen (1992) *Qualitative Research for Education* (2nd ed.) Boston MA: Allyn and Bacon

Botha, A. (2006) The use of mobile phones to mediate a design experiment in a secondary school. Unpublished M.Ed. dissertation: University of Pretoria.

Boulding, K.E. (1956) General Systems Theory - The Skeleton of Science in *Management Science*, 2(3) April, 197-208

Brackett, G. (2000) "Technologies don't change schools – caring, capable people do" commentary in *The Digital Classroom: How technology is Changing the Way We Teach and Learn,* edited by D.T. Gordon. Cambridge MA: Harvard Education Letter.

Breuleux, A. (2001) Imagining the present, interpreting the possible, cultivating the future: Technology and the renewal of teaching and learning. *Education Canada*, Fall.

Available online: http://www.education.mcgill.ca/profs/breuleux/on-nepubs/BrueleuxEdCanFall2001.html. Accessed: 20th May 2006

Breuleux, A., Laferrière, T. & M. Lamon (2002) *Capacity building within and across countries into the effective uses of ICTs.* Paper presented to the 2002 Pan-Canadian Education Research Agenda Symposium "Information Technology and Learning" April 2002, Montreal. Available online: http://teleLearning.mcgill.ca/capacitybuilding/. Accessed 30 January 2005

Brown, T. (2005) Towards a model for m-learning in Africa in *International Journal on e-Learning* 4(3), 299

Bruner, J. (1996) *The Culture of Education.* Cambridge MA: Harvard University Press

Bryant, T. (2006) Social software in Academia in *Educause Quarterly* 2, 61-64

Burgess, H. (1985) Case study and curriculum research: Some issues for teacher researchers in R. Burgess (ed.) *Issues in Educational Research: Qualitative Methods*. London: Falmer, pp. 177-196.

Burrell, G. & G. Morgan (1979) *Sociological Paradigms and Organisational Analysis.* London: Heinemann

Carlson, D. (2005) Hope without illusion: telling the story of democratic educational renewal in *International Journal of Qualitative Studies in Education,* 18(1) January–February, 21–45

Carrigg, F. & M. Honey (2003) No miracles here! in *Edutopia*, Spring 2003, pp. 6-7. Available online: www.glef.org

Center for Applied Special Technology (CAST) (1996) *The Role of Online Communications in Schools: A National Study* designed and conducted by CAST. Available online: http://www.cast.org. Accessed online: 19th October 2003

Chen, C. (2006) Investigating the Influences of Teacher Belief and Contextual Factors on the Technology Integration of Taiwanese High School Teachers. Unpublished PhD Thesis: University of Texas at Austin.

Chung, Q. (2006) Where we are regarding the definition of "Collegiality". Document prepared for circulation in the Committee on Faculty, Villanova University. Faculty of Congress. Academic Year 2006-2007. Available online: Accessed 7th January 2010

Clarke, J., Bossange, J., Erb, C., Gibson, D., Nelligan, B., Spencer, C. & M. Sullivan (2000) *Dynamics of change in high school teaching: A study of innovation in five Vermont professional development schools.* Available online: www.lab.brown.edu. Accessed 24 April 2006

Clements, D. H. (1997) (Mis?) Constructing constructivism in *Teaching Children Mathematics*, 4, 198-200

Cohen, L., Manion, L. & K. Morrison (2000) *Research Methods in Education 5th Edition.* London: Routledge

Collins, J. *Good to great: Why Some Companies Make the Leap ... And Others Don't* Random House 2001

Collins, J. (2008) *How the Mighty Fall and Why Some Companies Never Give In*. Boulder CO: Jim Collins

Coulson, J.E. (1968) *Computer-Based Instruction.* Santa Monica CA: System Development Corporation (ERIC Document: ED 039 705)

Counts, E.L. (2004) The technology of digital media: Helping students to examine the unexamined in *Educational Technology* 44(5) September-October, 59-61

Cox, M., Abbott, C., Webb, M. Blakeley, B., Beauchamp, T. & V. Rhodes (2004a) *ICT and attainment: A review of the research literature.* A BECTA report to the DfES. Available online: http://www.becta.org.uk/research Accessed online: 20th May 2006

Cox, M., Webb, M., Abbott, C., Blakeley, B., Beauchamp, T. & V. Rhodes (2004b) *ICT and pedagogy: A review of the research literature.* A BECTA report to the DfES. Available online: http://www.becta.org.uk/research. Accessed online: 20th May 2006

Cox, M., Preston, C. & K. Cox (1999) *What Factors Support or Prevent Teachers from Using ICT in their Classrooms?* Paper presented at the British Educational Research Association Annual Conference, University of Sussex at Brighton, September 2-5 1999.

Crisan, C., Lerman, S. & P. Winbourne (2007) Mathematics and ICT: a framework for conceptualising secondary school mathematics teachers' classroom practices in *Technology, Pedagogy and Education* 16(1), 21 – 39.

Cros, F. (2000) Innovation in Education: Managing the Future? in OECD: Centre for Educational Research and Innovation (1999) *Innovating Schools,* Chapter 4, pp. 59-75. Available online: http://www.oecd.org. Accessed: 28th January 2007

Cuban, L. (2001) *Oversold and Underused: Computers in the Classroom*, Cambridge MA: Harvard UP

Cuban, L. (1997) *Tinkering Towards Utopia: A Century of Public School Reform*. Cambridge MA: Harvard University press

Cuban, L. (1986) *Teachers and Machines: The Classroom Use of Technology Since 1920*. New York: Teachers College

Daft, R. L., & S.W. Becker (1978) *The Innovative Organization*. New York, NY: Elsevier North-Holland, Inc.

Davis, B. & D. Sumara (2005) Complexity science and educational action research: Towards a pragmatics of transformation in *Educational Action Research* 13(3) 453-466

Davis, B. & D. Sumara (1997) Cognition, complexity and teacher education in *Harvard Educational Review* 67(1), 105-125

Deal, T. & K. Peterson, K. (2000) Eight roles of symbolic leaders in *The Jossey-Bass Reader on Educational Leadership,* Ch. 8, pp. 202–214. San Francisco: Wiley.

Dede, C. (2000) Emerging influences of information technology on school curriculum in *Journal of Curriculum Studies* 32 (2) 281-303

Delamont, S. (1992) *Fieldwork in Educational Settings: Methods, Pitfalls and Perspectives*. London: Falmer

Denzin, N.K. (1994) The art and politics of interpretation in N.K. Denzin & Y.S. Lincoln (eds.) *Handbook of Qualitative Research*. Thousand Oaks: Sage

DfEE (1997) *Connecting the Learning Society.* HMSO: London.

di Benedetto, R. (2006) How Do Independent School Leaders Build the Educational Technology Leadership Capacity of the School? A Multi-Site Case Study. Unpublished PhD Thesis, Drexel University

DoE (2003) *Draft White paper on e-Education: Transforming Learning and Teaching through Information and Communication Technologies.* Pretoria: Department of Education. Available online: http://education.pwv.gov.za. Accessed 15TH October 2003

DoE (2002) *Revised National Curriculum Statement.* Available online: www.mml.co.za/revised_national_curriculum_statement.htm. Accessed 21st July 2009

DoE (2001) *Education White Paper 6: Special needs education: Building an inclusive education and training system.* Available online: www.info.gov.za/whitepapers/2001/educ6.pdf. Accessed: 24th January 2007

Doig, C. (2005) Innovation in Education in 'Designated Character' Schools: A case study of the directors of Discovery 1 and Unlimited Paenga Tawhiti. Unpublished D.Ed. dissertation Griffith University

Doolittle, P.E. (2001) *Complex Constructivism: A Theoretical Model of Complexity and Cognition* [Draft] Blacksburg VA: Virginia Polytechnic Institute & State University

Duchastel, P. & M. Molz (2004) Learning and design: The quest for a theory of learning in *Educational Technology* 44(1) 45-48

Dwyer, David (1994) Apple Classrooms of Tomorrow: What We've Learned in *Educational Leadership* April 1994, 4-10

Dwyer, D. C., Ringstaff, C., & J.H. Sandholtz (1991) Changes in teachers' beliefs and practices in technology-rich classrooms in *Educational Leadership* 48(8) 45-52

Eadie, G. M. (2003) New Zealand Initiative: ICT Professional Development for Teachers. Unpublished paper. Available online: www.marsden.school.nz. Accessed 23/02/06

Ehrich, L.C. (2003) Phenomenology in T. O'Donoghue & K. Punch (eds.) *Qualitative Educational Research in Action: Doing and Reflecting*. London: Routledge Falmer, pp. 42-69

Ekholm, M. & U.P. Trier (1987) The concept of institutionalization: some remarks, in Miles, M. Ekholm & R. Vandenberghe (eds.) *Lasting school improvement: exploring the process of institutionalization*, pp. 13-21. Leuven: ISIP-OECD

Elmore, R.F. (2000) *Building a New Structure for School Leadership.* Washington DC: The Albert Shanker Institute

Elmore, R. F. (1996) Structural reform and educational practice in *Educational Researcher* 24(9) 23–26

Elbaz-Luwisch, F. (2005) *Teachers' Voices: Storytelling and Possibility*. Greenwich CN: Information Age Publishing

Erikson, E. (1986) Qualitative methods in research on teaching in M.C. Whittrock (ed.) *Handbook on Research in Teaching* (3rd ed.). New York: Macmillan, pp. 119-161

Ewing, R. & D.L. Smith (2003) Retaining quality beginning teachers in the profession in English Teaching: Practice and Critique, 2(1), pp.15-32

Farmer, J., Hauk, S. & A. Neumann (2005) Negotiating reform: Implementing process standards in culturally responsive professional development in *The High School Journal*, April/May 2005, 59-71

Finger, G., Jamieson-Proctor, R. & G. Watson (2003) *Recommendations for the Development of an ICT Curriculum Integration Performance Measurement Instrument: Focusing on Student Use of ICTs* Available online: http://www98.griffith.edu.au. Accessed: 30th January 2005

Fluck, A. (2004) *Some national and state approaches to integrating IT in education.* Available online: http://www.educ.utas.edu.au/users/afluck. Accessed: 30th January 2005

Fogelman, J., Fishman, B. & J. Krajcik (2006) Sustaining innovations through lead teacher learning: A learning sciences perspective on supporting professional development in *Teaching Education* 17(2) June, 181–194

Fouts, J.T. (2000) *Research on Computers and Education: Past, Present and Future:* [Report] prepared for the Bill and Melinda Gates Foundation, February 2000. Seattle: The Foundation

Fullan, M. (1991) *The New Meaning of Educational Change*. London: Cassell

Fullan, M.G. (1993) *Successful School Improvement: The implementation Perspective and Beyond*. London: Open University Press

Fullan, M. (2001) *The New Meaning of Educational Change*, (3rd ed.). New York: Teachers' College Press

Fullan, M. (2001a) *Leading in a Culture of Change*. San Francisco: Jossey-Bass

Fullan, M. & A. Hargreaves (1992) *Teacher Development and Educational Change*. London: Falmer.

Fuller, T. (1990) Introduction in *The Voice of Liberal Learning: Michael Oakeshott on Education* edited by T. Fuller. New Haven CT: Yale University Press, pp. 1-16.

Geertz, C. (1973) *The Interpretation of Cultures: Selected Essays*. New York: Basic Books

George, P.S. (2005) A Rationale for Differentiating Instruction in the Regular Classroom in *Theory Into Practice* 44(3) Summer, 185-193

Giles, C. (2006) Leading educational change and school improvement in *.Edu (Alumni Newsletter*, University of Buffalo) p.3 & 13

Giles, C. & A. Hargreaves (2006) The sustainability of innovative schools as learning organizations and professional learning communities during standardized reform in *Educational Administration Quarterly* 42 (1), February, 124-156

Gilligan, C. (1982) *In a Different Voice: Psychological Theory and Women's Development*. Cambridge, MA: Harvard University Press

Glatter, Castle, Cooper, Edwards and Woods (2005) What's new? Identifying innovation arising from school collaboration initiatives in *Educational Management Administration & Leadership* 33(4), 381-399

Golafshani, N. (2003) Understanding Reliability and Validity in Qualitative Research in *The Qualitative Report* 8(4), 597-607

Godwin, S. & R. Sutherland (2004) Whole-class technology for learning mathematics: the case of functions and graphs in *Education, Communication and Information* 4(1) March, 131-152

Goodison, T. (2003) Integrating ICT in the classroom: A case study of two contrasting lessons in *British Journal of Educational Technology* 34(5), 549–566

Gregory, E. (2005) Introduction: Tracing the steps in Conteh, J., Gregory, E., Kearney, C. & A. Mor-Sommerfeld (eds.) *On Writing Educational Ethnographies: The Art of Collusion.* Stoke-on-Trent: Trentham Books, pp. ix-xxiv

Griffiths, G. (1985) Doubts, dilemmas and diary-keeping: some reflections on teacher-based research in R. Burgess (ed.) *Issues in Educational Research: Qualitative Methods*, pp. 197-215. London: Falmer

Gubrium, J. F., & J. A. Holstein (eds.) (2002) *Handbook of Interview Research: Context and Method*. Thousand Oaks CA: Sage

Hammersley, M. & P. Atkinson (1983) *Ethnography: Principles in Practice*. London: Routledge

Harada, V.H. (2001) From instruction to construction: Learning in the Information Age, in Fitzgerald, M., Orey, M. & R.M. Branch (eds.), *Educational Media and Technology Yearbook 2003.* Westport, CT: Libraries Unlimited, pp. 40-48

Hargreaves, A. (2002) Sustainability of educational change: The role of social geographies in *Journal of Educational Change*, *3*(3-4), 189-214

Hargreaves, A. (2003) *Teaching in the Knowledge Society: Education in the Age of Uncertainty.* Maidenhead: Open UP

Hargreaves, A., & Fink, D. (2000) The three dimensions of educational reform in *Educational Leadership* 57(7), 30-34

Hargreaves, A. & I. Goodson (2006) Educational change over time? The sustainability and non-sustainability of three decades of secondary school change and continuity in *Educational Administration Quarterly* 42 (1) February, 3-41

Hargreaves, D.H. (1967) *Social Relations in a Secondary School.* London: Routledge & Kegan Paul

Hargreaves, D.H. (2000) Schools and the future: The key role of innovation in OECD: Centre for Educational Research and Innovation (1999) *Innovating Schools,* Chapter 3, pp.45-57, Paris: OECD/CERI. Available online: http://www.oecd.org. Accessed: 28th January 2007

Hargreaves, D.H. (2004) *Working Laterally: How Innovation Networks Make an Education Epidemic*. London: Department for Education and Skills Innovation Unit, Demos and the National College for School Leadership

Heller, J. (1961) *Catch-22.* New York: Simon & Schuster

Hennessy, S., Ruthven, K. & S. Brindley (2005) Teacher perspectives on integrating ICT into subject teaching: Commitment, constraints, caution and change in *Journal of Curriculum Studies* 37(2) 155-192

Hernandez-Ramos, P. (2005) If not here, where? Understanding teachers' use of technology in Silicon Valley schools in *Journal of Research on Technology in Education* 38(1) Fall, 39-64

Hillis, P. & P.L.M. Munro (2005) ICT in History education: Scotland and Europe in *Social Science Computer Review*, 23(2) 190-205

Hills, P. (2008) Authentic learning and multimedia in history education in *Learning, Media and Technology* 33(2) June, 87-99

Hitchcock, G. & D. Hughes (1995) *Research and the Teacher* (2nd ed.). London: Routledge

Hokanson, B. & S. Hooper (2000) Levels of teaching: A taxonomy for instructional design in *Educational Technology* 44(6) 14-22

Hoover, W.A. (2003) The practice implications of constructivism in *SEDL Letter* Vol. IX (3): Constructivism. Available online: http://www.sedl.org/pubs/sedletter/v0903/welcome.html. Accessed 7th July 2003

Howie, S., Muller, A. & A. Patterson (2005) *Information and Communication Technologies in South African Secondary Schools*. Pretoria SITES/HSRC

Huffman, S. & W. Rickman (2004) Technology planning: the SIMPLE model in *Educational Technology* 44(4) 36-40

Husserl, E. (1931) Ideas: *General Introduction to Pure Phenomenology*. London: George Allen & Unwin

Ilomäki, L. Lakkala, M. & E. Lehtinen (2004) A case study of ICT adoption within a teacher community at a Finnish lower secondary school in *Education, Communication & Information* 4(1) March, 53-69

ISTE (2002) *Educational Computing and Technology Standards*. Eugene OR: ISTE. Available online: www.doe.in.gov/dps/.../NCATEEducationalComputingInitial.pdf Accessed: 7th May 2006

Jordan, A. (2001) Special education in Ontario, Canada: A case study of market-based reforms in *Cambridge Journal of Education* 31(3), 349-371

Kangro, A. & I. Kangro (2004) Integration of ICT in teacher education and different school subjects in Latvia in *Educational Media International* 41(1) March, 31-37

Kearns, P. & J. Grant (2002) *The Enabling Pillars: Learning, Technology, Community, Partnership.* A Report on Australian Policies for Information and Communication

Technologies in Education and Training. Available online: http://www.dest.gov.au/ Accessed: 7th May 2006

Kerlinger, N. (1970) *Foundations of Behavioural Research.* New York: Holt Rinehart & Winston.

Kerlinger, N. (1973) *Foundations of Behavioural Research* (2nd ed.). New York: Holt Rinehart & Winston.

Kirk, D. & D. Macdonald (2001) Teacher voice and ownership of curriculum change in *Journal of Curriculum Studies* 33(5), 551-567

Klein, J.T. (2004) Interdisciplinarity and complexity: An evolving relationship in *E:CO* 6 (1-2) 2-10 [A shorter, edited English-language excerpt of a Spanish-language chapter based on an address delivered at an international congress on "Interdisciplinary Studies and Complexity" at the UNAM in Mexico City; with permission of the editors of Estudios Interdisciplinarios y Complejidad. Ed. Siglo XXI-CEIICH, UNAM, México. 2004]

Kramer, B.S., Walker, A.E. & J.M. Brill (2007) The underutilization of information and communication technology-assisted collaborative project-based learning among international educators: a Delphi study in *Educational Technology Research and Development* 55(5) October 2007, 411-545

Kuiper, E., Volman, M. & J. Terwel (2005) The web as an information resource in K-12 Education: Strategies for supporting students in searching and processing information in *Review of Educational Research* 75(3) Fall, 285-328

Kukulska-Hulme, A. & J. Traxler (2005) Mobile teaching and learning in Kukulska-Hulme, A. & J. Traxler (eds.) *Mobile Learning – A Handbook for Educators and Trainers*. Oxford: Routledge

Kulik, C. & J.A. Kulik (1991) Effectiveness of computer-based instruction: an updated analysis in *Computers in human behaviour,* v.7, 75-94

Kulik, J.A. (1994) Meta-Analytic studies of findings on computer-based Instruction in Baker, E.L. & H.F. O'Neil Jr. (eds.) *Technology Assessment in Education and Training.* Hillsdale NJ: Lawrence Erlbaum

Kvale, S. (1992) A post-modern psychology – a contradiction in terms? in S. Kvale (ed.) *Psychology and Postmodernism*, pp. 31-57. London: Sage

Kvale, S. (2002) The social construction of validity in Denzin, N.K. & Y.S. Lincoln (eds.) *The Qualitative Inquiry Reader.* Thousand Oaks: Sage, pp.299-325.

Labaree, D.F. (2006) Innovation, nostalgia, and the politics of educational change in *Educational Administration Quarterly* 42(1) February, 157-164

La Grange, J.-B., Artigue, M., Laborde, C. & L. Trouche (2001) A meta-study on IC technologies in education: towards a multi-dimensional framework to tackle their integration in M. Van Den Heuvel-Panhuizen (ed.) *Proceedings of the 25th Conference of the International group for Psychology of Mathematics Education 1*, 111-125. ERIC ED 466 950

Lan, J., He, S., Ouyang, J.R., Zhonghai, Q. & Q. Bao (2000) Technology infusion in a Chinese middle school: A comparative perspective in *Proceedings of the SITES 2000 Conference*, San Diego CA.

Lane, J.L. (2001) Teaching and learning innovations in higher education: Faculty perceptions of sustainability: A thesis in instructional systems. Unpublished PhD Thesis: Pennsylvania State University.

Lazarowitz, R. & J. Huppert (1993) Science process skills of 10th grade biology students in a computer-assisted learning setting in *Journal of Research on Computers in Education* 25 (2) 366-382

LeCompte, M. & J. Preissle (1993) *Ethnography and Qualitative Design in Educational Research* (2nd ed.) London: Academic Press

Lemke, C. & E.C. Coughlin (1998) *Technology in American schools: Seven dimensions for gauging progress: A Policymaker's Guide.* Milken Exchange on Educational Technology. Available online: http://www.mff.org/publications/publications.taf?page=158. Accessed 7th May 2006

Lenard, M. (2005) Dealing with online selves: Ethos issues in computer-assisted teaching and learning in *Pedagogy: Critical Approaches to Teaching Literature, Language, Composition, and Culture* 5(1), 77-95

Lewis, J. (1999) Leading the learning community – a new role for teachers. Handout from the author, September 2001.

Lewis, J. & A. Romiszowski (1996) Networking and the learning organization: Networking issues and scenarios for the 21st Century in *Journal of Instructional Science and Technology*

1(4) November. Available online: http://www.usq.edu.au/electpub/e-jist/docs/old/vol1no4/abstract.htm. Accessed: 15th April 2007

Lincoln, Y.S. & E.G. Guba (1985) *Naturalistic Inquiry*. Beverley Hills: Sage

Lissack, M. (1999) *Complexity: The science, its vocabulary and its relation to organizations.* Available: http://emergence.org/Complexity1.htm Accessed: 2nd October 2006

Looi, C-K., Hung, D., Bopry, J. & T-S. Koh (2004) Singapore's Learning Sciences Lab: Seeking transformations in ICT-Enabled Pedagogy in *Educational Technology Research & Development* 52(4) 91–115

Loughran, J. (2003) Exploring the nature of teacher research in A. Clarke & G. Erickson (eds.) *Teacher Inquiry: Living the Research in Everyday Practice*. London: Routledge & Falmer

Louis, K.S. (2006) Change over time? An introduction? A reflection? in *Educational Administration Quarterly* 42(1), p.165-173

Lorenzo, G., Oblinger, D. & C. Dziuban (2006) How choice, co-creation, and culture are changing what it means to be net savvy in *Education Quarterly* 30(1) 2007. Available online: http://www.educause.edu/Apps/forum/as05.asp. Accessed: 14th August 2008

Lundvall, B.-Å., & B. Johnson (1994), 'The learning economy', *Journal of Industry Studies*, 1 (2) 23-42

MacDonald, B. & R. Walker (1975) Case study and the social philosophy of educational research in *Cambridge Journal of Education* 5(1), 2-11

Matheos, K., Daniel, K., & G.I. McCalla (2005) Dimensions for blended learning technology: learners' perspectives in *Journal of Learning Design*, 1(1), 56-76. Available online: www.jld.qut.edu.au/Vol 1 No 1. Accessed 08 May 2006

Maxwell, J. A. (1992) Understanding and validity in qualitative research in *Harvard Educational Review*, 62 (3), 279-300

Maykut, P.M. & R. Morehouse (1994) *Beginning Qualitative Research: A Philosophic and Practical Guide.* London: Falmer.

McElroy, M. W. (2000) Integrating complexity theory, knowledge management and organizational learning in *Journal of Knowledge Management* 4(3) September, 195-203

Means, B., Blando, J., Olson, K. et al (1993) *Using Technology to Support Education Reform.* A report sponsored by the US Department of Education. Available at: http://www.ed.gov/pubs/EdReformStudies/TechReforms/index.html Accessed 2nd February 2004

Mehan, H., Hubbard, L. & M.K. Stein (2005) When reforms travel: the sequel in *Journal of Educational Change* 6, 329-362

Merleau-Ponty, M. (1962) *The Phenomenology of Perception*. London: Routledge & Kegan Paul

Merriam, S.B. (1998) *Qualitative Research and Case Study Applications in Education* (rev. ed.). San Francisco: Jossey Bass

Merriam, S.B. & E.L. Simpson (1984) *A Guide to Research for Educators and Trainers of Adults*. Malabar FL: Robert E. Kriegler Publisher

Miles, M. B. (1983) Unraveling the mystery of institutionalization in *Educational Leadership* 24(4), 14–19

Miles, M.B. & A.M. Huberman (1994) *Qualitative Data Analysis: An Expanded Sourcebook* (2nd ed.). Thousand Oaks: Sage

Milton, P. (2005) *Sustaining innovation: Paradox or Pandora's Box?* Presentation to ArtsSmarts Partners' Conference, Moncton, New Brunswick, November 3rd 2005. Available online: www.artssmarts.ca/media/en/pennyMiltonPresentation.pdf. Accessed: 28th January 2007

Mioduser, D., Nachmias, R., Tubin, D. & A. Forkosh-Baruch (2003) Analysis schema for the study of domains and levels of pedagogical innovation in schools using ICT in *Education and Information Technologies* 8(1), 23–36

Mioduser, D., Nachmias, R., Forkosh-Baruch, A. & D. Tubin (2004) Sustainability, scalability and transferability of ICT-based pedagogical innovations in Israeli schools in *Education, Communication & Information* 4(1) March, 71-82

Mishler, E.G. (1990) Validation in inquiry-guided research: the role of exemplars in narrative studies in *Harvard Educational Review* 60(4), 415-442

Monke, L. (1997) The web & the plow in *Education Week 9(2).* Available online: http://www.teachermagazine.org/vol-09/02monke.h09. Accessed 4th December 2003

Morgan, S.K. (2001) Computer integration in South African schools with Reference to St Stithians College. Unpublished M.Ed. (CIE) dissertation: University of Pretoria

Morgan, J.I. & C. Tidmarsh (2004) Reconceptualising ICT in Geography teaching in *Education, Communication & Information* 4(1) March, 177-192

Morris, D. (1997) Adrift in a sea of innovations: A response to Alexander, Murphy and Woods in *Educational Researcher, 26(4),* 22-26

Mouly, G.J. (1978) *Educational Research: The Art and Science of Investigation*. Boston: Allyn & Bacon

Mumtaz, S. (2000) Factors affecting teachers' use of information and communication technology: a review of the literature in *Journal for Information Technology for Teacher Education* 9(3), 319-341

Murray, L. & B. Lawrence (2000) *Practitioner-Based Enquiry: Principles for Postgraduate Research*. London: Falmer

Morris, D. (1997) Adrift in a sea of innovations: A response to Alexander, Murphy and Woods in *Educational Researcher* 26(4), 22-26

Nachmias, R. Mioduser, D., Cohen, A., Tubin, D. & A. Forkosh-Baruch (2004) Factors involved in the implementation of pedagogical innovations using technology in *Education and Information Technologies* 9(3), 291–308

Nisbet, J. & J. Watt (1984) Case study in Bell, J., Bush, T., Fox, A., Goodey, J. & S. Goulding (eds.) *Conducting Small-Scale Investigations in Educational Management.* London: Harper & Row, pp.79-92.

Noddings, N. (1984) *Caring: A Feminine Approach to Ethics and Moral Education.* Berkeley: University of California Press

OECD/CERI (2000) *Innovating Schools.* Paris: OECD/CERI. Available online: http://www.oecd.org/. Accessed 28th January 2007

OECD (2005) *Definition and selection of key competencies: Executive summary*. Available online: http://www.oecd.org/edu/statistics/deseco Accessed: 17th August 2009

OFSTED (Office for Standards in Education) (2003) *Excellence in Cities and Education Action Zones: Management and Impact*, HMI 1399. London: OFSTED

OFSTED (2002) *ICT in Schools: The impact of government initiatives: Effects of government initiatives: Progress Report, April 2002:* A report from the Office of Her Majesty's Chief Inspector of Schools. London: OFSTED. Available online: www.ofsted.gov.uk. Accessed: 24th April 2006

Oppenheimer, T. (1997) The computer delusion in *Atlantic Monthly* 280(1) p.45-62 http://www.theatlantic.com/issues/97jul/computer.htm Accessed: 19th October 2003

Otto, T.L., & Albion, P.R. (2002). *Understanding the role of school leaders in realizing the potential of ICTs in education.* International Conference of the Association for the Advancement of Computing in Education (March, Nashville). Available online: http://www.aace.org Accessed 30th January 2005

Owston, R. (2006) Contextual factors that sustain innovative pedagogical practice using technology: an international study in *Journal of Educational Change* 8(1) March, 61-77

Oxford Study Dictionary (1991) Oxford: OUP

Pang, M-S. J., Kim, H. & H-J. Kim (c.2000) *Developing indicators that represents the level of ICT use at elementary and secondary schools. Available online:* http://www.kookmim.ac.kr Accessed: 19th October 2003

Patton, M.Q. (2002) *Qualitative Evaluation and Research Methods* (3rd edition) Thousand Oaks: Sage

Peck, C., Cuban, L. & H. Kirkpatrick (2002) Techno-promoter dreams, student realities in *Phi Delta Kappan* 83(6) February, 472-480

Pelgrum, W.J. & Anderson, R.A. (eds.) (1999) *ICT and the Emerging Paradigm for Life Long Learning: A Worldwide Educational Assessment of Infrastructure, Goals and Practices*. Amsterdam: IEA.

Peltzer, K. (2005) Educator Supply and Demand in the South African Public Education System: Integrated Report from the Education Labour Relations Council (South Africa), Human Sciences Research Council, South African Medical Research Council, University of KwaZulu-Natal, University of KwaZulu-Natal: Mobile Task Team on the Impact of the HIV/AIDS on Education. Pretoria: HSRC

Pettigrew, A., Woodman, R.W. & K.S. Cameron (2001) Studying organisational change and development: Challenges for future research in *Academy of Management Journal* 44(4): 697–714.

Peurach, D., Glazer, J. & K. Gates (2004) Supporting instructional improvement: Teacher learning in comprehensive school reform. Unpublished report, University of Michigan, Ann Arbor, MI: Study of Instructional Improvement. Available online: http://www.sii.soe.umich.edu/documents/_vti_cnf/PeurachGates2004.pdf.

Phelps, R. & S. Hase (2002) Complexity and action research: exploring the theoretical and methodological connections in *Educational Action Research* 10 (3)

Phelps, R., Hase, S. & A. Ellis (2005) Competency, capability, complexity and computers: exploring a new model for conceptualising end-user computer education in *British Journal of Educational Technology* 36(1): 67-84

Platt, J. (1981) On interviewing one's peers in *British Journal of Sociology* 32(1) pp. 75-91

Plomp, T. (2006) *Preparing for teaching in an information society: various perspectives.* Paper presented to the Annual Conference of the Society for IT in Teacher Education (ISTE) Orlando, (FL) March 2006

Prensky, M. (2009) H. Sapiens Digital: From Digital Immigrants and Digital Natives to Digital Wisdom. Originally published in *Innovate* 5(3) (http://www.innovateonline.info/). Accessed 4th February 2009

Prensky, M. (2001) Digital natives, digital immigrants in *On the Horizon* 9(5), October, 1-6

Prescott, M. B. (1995) Diffusion of innovation theory: borrowings, extensions, and modifications from IT researchers in *ACM SIGMIS Database Archive* 26 (2-3) May/August

Quellmalz, E.S. & R. Kozma (2003) Designing assessment of learning with ICTs in *Principles, Policy & Practice* 10(3) November, 389-408

Ravitz, J.L., Becker, H. & Y.T. Wong (2000) *Constructivist-compatible beliefs and practices among U.S. teachers: Teaching, learning, and computing: 1998 National Survey Report #4*. Irvine CA: Center for Research on Information Technology and Organizations

Reynolds, M.E. (2005) The Contribution of Knowledge Management to Learning: An Exploration of its Practice and Potential in Australian and New Zealand Schools. Unpublished dissertation M.Ed. (CIE), University of Pretoria

Richardson, J. (2000) *Teaching, learning, and computing: 1998 National Survey Report #4.* Irvine CA: Center for Research on Information Technology and Organizations

Richardson, L. (1994) Writing: a method of inquiry in Denzin, N.K. & Y.S. Lincoln (eds.) *Handbook of Qualitative Research*. Thousand Oaks: Sage

Riel, M. & H. Becker (2000) *The beliefs, practices, and computer use of teacher leaders:* Paper presented at the American Educational Research Association, New Orleans, April 26, 2000. Available online: http: www.aera.org. Accessed 7th May 2006

Rodrigo, M.T. (2003) Tradition or transformation? An evaluation of ICTs in Metro Manila schools in *Information Technology for Development* 10, 95–122

Rogers, E.M. (1995) *Diffusion of Innovations* (4th ed.) New York: Free Press

Rorty, R. (1979) *Philosophy and the Mirror of Nature.* Princeton NJ: Princeton University Press

Roschelle, J.M., Pea, R.D., Hoadley, C.M., Gordin, D.N. & B.M. Means, (2000) Changing How and What Children Learn in School with Computer-Based Technologies in *Children and Computer Technology* 10(2) Fall/Winter 2000 http://www.futureofchildren.org. Accessed 19th October 2003

Rossman, G.B. & S.F. Rallis (2003) *Learning in the Field: An Introduction to Qualitative Research.* Thousand Oaks: Sage

Rousseau, C.K. & A. Powell (2005) Understanding the significance of context: A framework to examine equity and reform in secondary mathematics in *The High School Journal*, April/May, 19-31

Rowan, B. Camburn, E. & C. Barnes (c.2005) *Benefiting from Comprehensive School Reform: A Review of Research on CSR Implementation*. Ann Arbor MI: The University of Michigan Consortium for Policy Research in Education

Rosenzweig, P. (2007) *The halo effect.* New York: Free Press

Rubin, H. J., & I.S. Rubin (1995) *Qualitative Interviewing: The Art of Hearing Data*. Thousand Oaks CA: Sage.

Schmidt, M. & R.E. White (2004) Educational change: Putting reform into perspective in *Journal of Educational Change 5(3), 207-211*

Schuman, L. & D. Ritchie (1996) *Perspectives on instruction: Behaviorism, cognitivism, and constructivism.* Available online: http://edweb.sdsu.edu/courses/edtech540/Perspectives/Perspectives.html. Accessed: 7th July 2003

Schutz, A. (1972) *The Phenomenology of the Social World.* London: Heinemann

Scrimshaw, P. (2003) ICT in European schools: emerging issues from the ValNet project in *The Curriculum Journal* 14(1) Spring, 85-104

Selwyn, N. (1999) Why the computer is not dominating schools: A failure of policy or a failure of practice? in *Cambridge Journal of Education* 29(1), 77-91

Senate Employment, Education and Training References Committee (1998), *A Class Act: Inquiry Into the Status of the Teaching Profession.* Canberra: The Committee. Available online: www.aph.gov.au/library/Pubs/BD/1998-99/99bd020.htm. Accessed 14th August 2008

Senge, P. (2006) *The Fifth Discipline: The Art and Practice of the Learning Organization.* London: Random House Business Books

Senge, P. (1990) Building Learning Organizations in *Sloan Management Review Reprint Series*, 32(1) Fall, 7-23

Sharma, R. (2005) Identifying a framework for initiating, sustaining and managing innovations in schools in *Psychology and Developing Societies* 17, 1 (2005)

Sherry, L. (2002) Sustainability of innovations in *Journal of Interactive Learning Research* 13(3), 209-236

Sherry, L. (1997) *An integrated technology adoption and diffusion model.* Paper presented to the meeting of the Association for Educational Communications and Technology (AECT), St. Louis, MO, 18-21 February 1998. Available online: http://www.cudenver.edu/public/education/sherry/pubs/aect98.html. Accessed 14th September 2006.

Sherry, L. & D. Gibson (2005) Responsive dissemination: A data-driven approach to change in *Journal of Technology and Teacher Education* 13(1), 85-104

Sherry, L., & D. Gibson (2002) The path to teacher leadership in educational technology. *Contemporary Issues in Technology and Teacher Education* [Online serial] *2*(2).

Available: http://www.citejournal.org/vol2/iss2/general/article2.cfm. Accessed 19th April 2006

Sherry, L., Lawyer-Brook, D., & L. Black (1997) Evaluation of the Boulder Valley Internet Project: A theory-based approach to evaluation design in *Journal of Interactive Learning Research* 8(2), 199-234

Sikes, P. (1999) Series editor's preface in Bassey, M. (1999) *Case study research in educational settings.* Maidenhead: Open University Press

Skilbeck, M. (1983) Lawrence Stenhouse: research methodology in *British Educational Research Journal* 9(1), pp. 11-20

Smagorinsky, P. (1995) Constructing meaning in the disciplines: Reconceptualizing writing across the curriculum as composing across the curriculum in *American Journal of Education* 10(2), February, 160-184

Smith, H.W. (1975) *Strategies of Social Research: The Methodological Imagination.* Englewood Cliffs NJ: Prentice Hall

Smith, L. (1974) *An aesthetic education workshop for administrators: Some implications for a theory of case studies.* Paper presented at AERA, Chicago, 1974

Software Information Industry Association (SIIA) (2000) 2000 Research Report on the Effectiveness of Technology in Schools: Executive Summary. Available online: http://www.siia.com. Accessed 19/10/03

Soule, H. (2003) What do you mean by ICT integration? *Reform Forum: Journal for Educational Reform in Namibia*, #16 April

South African Information Technology Industry Strategy Project (SAITIS) (2002) *ICT Diffusion and ICT Applications in Usage Sectors: An International Scan Prepared for The South African IT Industry Strategy Project* (SAITIS) by Miller, Esselaar & Associates March 2002. Available online: www.saitis.co.za. Accessed: 18th August 2009

Spector, J.M. (2001) An overview of progress and problems of educational technology in *Interactive Educational Multimedia* 3, 27-37

Stake, R.E. (2000) Case studies in Denzin, N.K. & Y.S. Lincoln (eds.) *Handbook of Qualitative Research*. Thousand Oaks: Sage

Stake, R.E. (1995) *The Art of Case Study Research.* London: Sage

Staples, A., M.C. Pugach & D.J. Himes (2005) Rethinking the technology integration challenge: Cases from three urban elementary schools in *Journal of Research on Technology in Education* 37(3) Spring, 285-311

Stein, M.K., Hubbard, L. & B. Mehan (2004) Reform ideas that travel far afield: The two cultures of reform in New York City's district #2 and San Diego in *Journal of Educational Change*, 5(2), 161-197

Steiner, M. (2004) *The role of clusters in knowledge creation and diffusion – an institutional perspective.* [Paper presented to the] 44th European Congress of the European Regional Science Association, Porto, August 25th – 29th, 2004. Available online: http://ideas.repec.org/p/wiw/wiwrsa/ersa04p612.html. Accessed 28th January 2007

Stenhouse, L. (1985) Case study methods in Husen, T. & T. N. Postlethwaite (eds.) *International Encyclopaedia of Education.* Oxford: Pergamon, pp.640 -646.

Sturman, A. (1994) Case study methods in J. P. Keeves (ed.) *Educational Research, Methodology and Measurement: An International Handbook*. Oxford: Elsevier, pp.61-66

Sturman, A. (1999) Case study methods in J. P. Keeves & G. Lakomski (eds.) *Issues in Educational Research*. Oxford: Elsevier, pp.103-112

Tearle, P. (2003) ICT implementation: what makes the difference? in *British Journal of Educational Technology* 34(5)567–583

Tearle, P. (2004) A theoretical and instrumental framework for implementing change in ICT in education in *Cambridge Journal of Education* 34(3) November, 331-351

Thomas, H.E. (2006) Investigating the Influences of Teacher Belief and Contextual Factors. Unpublished PhD thesis: University of Pretoria.

Tinio, V. (2003) ICT integration in education in the Philippines. Available online: http://www.scribd.com

Tubin, D., Mioduser, D., Nachmias, R. & A. Forkosh-Baruch (2003) Domains and levels of pedagogical innovation in schools using ICT: Ten innovative schools in Israel in *Education and Information Technologies* 8(2) June, pp.127-145

Tuckman, B.W. (1972) *Conducting Educational Research.* New York: Harcourt Brace Jovanovich

Turner, C. (2006) Height, foot length and threat to Woodland: Positive learning from pupil relevant data in *Teaching Statistics* 28(1) Spring, 22-25

Tyack, D., & W. Tobin (1994) The "grammar" of schooling: Why has it been so hard to change? in *American Educational Research Journal* 31(3), 453-479

UNESCO (2001) *The Open File on Inclusive Education.* Paris: UNESCO

UNESCO (2004) Integrating ICTs into education: lessons learned. Available online: www.unescobkk.org. Accessed 11th August 2009

Van Braak, J. (2001) Individual characteristics influencing teachers' class use of computers in *Journal of Educational Computing Research* 25(2) 141-157

van Manen, M. (1990) *Researching Lived Experience: Human Science for an Action Sensitive Pedagogy.* Albany NY: SUNY Press

Venezky, R. (2004) Technology in the classroom: steps toward a new vision in *Education, Communication & Information* 4(1) March, 4-21

Venezky, R.L. & L. Davis (2002) *Quo Vademus? The Transformation of Schooling in a Networked World* (Version 8c March 6, 2002). Paris: OECD/CERI 2002

Vidovich, L. (2003) Methodological framings for a policy trajectory study in O' Donoghue, T. & K. Punch (eds.) *Qualitative Educational Research in Action: Doing and Reflecting*, Chapter 5. London: Routledge Falmer, pp. 70-96

Vygotsky, L.S. (1978) *Mind and Society: The Development of Higher Mental Processes.* Cambridge, MA: Harvard University Press

Webb, M.E. (2005) Affordances of ICT in science learning: implications for an integrated pedagogy in *International Journal of Science Education* 27(6) May 705–735

Webb, M. E. & M. Cox (2004) A review of pedagogy related to information and communications technology in *Technology, Pedagogy and Education* 13 (3) January, 235-

Webb, C. & F. Lettice (c.2005) *Performance measurement, intangibles, and six complexity science principles.* Available online: www.e-rodeo.org. Accessed: 4th June 2006

Wenger, E. (1998) Communities of Practice: Learning as a Social System in *Systems Thinker,* June 1998. [Also published in *Organization* 7(2) 225-246] Available online: http://www.co-i-l.com/coil/knowledge-garden/cop/lss.shtml Accessed: 25th August 2009 (html version)

Weiss, C. (1980) Knowledge creep and decision accretion in *Knowledge: Creation, Diffusion and Utilization*, 1(3), 381-404

Wheatley, M. J. (1994) *Leadership and the New Science: Learning About Organization from an Orderly Universe.* San Francisco: Berrett-Koehler

Whitehurst, G. (2009) Innovation, motherhood, and apple pie *in Brown Center Letters on Education.* Available online: http://www.brookings.edu/brown.aspx. Accessed online: 3rd August 2009

Wickström & Bendix (2000) The Hawthorne effect: what did the original Hawthorne studies actually show? in *Scandinavian Journal of Work, Environment & Health* 26(4) 363-367

Wildy, H. (2003) Meaning and method: using metaphors in qualitative research in O'Donoghue, T. & K. Punch (eds.) *Qualitative educational research in action: doing and reflecting*, Chapter 7, London: Routledge Falmer, pp. 111-125

Wilhelm, J., Baker, T. & J. Dube (2001) Strategic reading: guiding students to lifelong literacy, New Hampshire: Heinemann [Adapted extract retrieved from http://www.myread.org/scaffolding.htm]

Willis, J. & W. Danley (1981) *Nailing jelly to a tree*. Beaverton OR: Dilithium Press.

Wilson, B. (2005) Theory and method as tools: reflections on research on the pedagogical uses of ICT in education in *Computers in Human Behavior* 21(3) 541-546

Windschitl, M. (2000) Using the WWW for teaching and learning in K-12 classrooms: What are the interesting research questions? in *Cyber Psychology & Behavior*, 3 (1), 89-96

Windschitl, M. (1998) The WWW and classroom research: what path should we take? in *Education Researcher* Jan-Feb 1998, 28-33

Wishart, J., McFarlane, A. & A. Ramsden (2005) Using personal digital assistants (PDAs) with Internet access to support initial teacher training in the UK. Available online: http://www.mlearn.org.za/CD/papers/Wishart.pdf. Accessed 14th August 2008

Yin, R.K. (1994) *Case Study Research: Design and Methods* (2nd edition). Thousand Oaks: Sage

Yuen, A.H.K., Law, N. & C. Wong (2003) ICT implementation and school leadership: case studies of ICT integration in teaching and learning in *Journal of Educational Administration* 41(2) 158-170

Zaltman, G., Duncan, R., & J. Holbek (1973) *Innovations and Organizations*. New York: Wiley.

Zhao, Y. & G. Cziko (2001) Teacher adoption of technology: A perceptual control theory perspective in *Technology and Teacher Education*, 9(1) 5-30

Zhao, Y., Pugh, K., Sheldon, S. & J.L. Byers (2002) Conditions for classroom technology innovations in *Teachers College Record*, 104(3), 482-515

Appendix 1.1

Teacher-librarian's role

This extract is from Reynolds (2005, p.39-43):

The traditional role of the teacher-librarian was to provide access to resources (ASLA 2001, p.40), variously described as collectors, conservators and custodians of the documentary record of civilisation (Bundy 2001c, p.3) or hoarding bowerbirds (Cornock & Jones 2002, p.1). These labels describe the *librarian* aspects of the role. New roles identified in the literature are as '*filters and not funnels'* of information (Leppard 2003, p.5), dispensers (McLoughlin 2002, p.33) providing systems for effective information use in and beyond the school (ASLA 2001, p.34). They facilitate inquiry for understanding (Leppard 2003, p.3) and thinking process, problem-solving and critical reading skills (Carr 1990). As providers of information resources, teacher-librarians need to form part of a collaborative team to develop the potential for integrating ICTs in the learning process (ASLA 2001, p.21). They plan and co-teach collaboratively (Loertscher, 1988) and communicate with parents (Shaw 2003, p.6). Teacher-librarians need excellent IT skills (Cornock & Jones 2002, p.3) whilst recognising that information literacy and not information technology is the critical issue (Bundy 2003, p.3; Cornock & Jones 2002, p.3). *"We must re-image ourselves as proactive, knowledgeable leaders who are the educational interfaces between ICT and learning"* (Langford 2001, p.1).

They are involved in curriculum design as well as curriculum resourcing (Leppard 2003, p.6). Teacher-librarians help prepare students for information literacy (Harvey 2001, p.2): the competencies of collecting, analysing and organising information (Mayer 1996, p.3) thereby developing students into critical consumers of information (Nimon 2003, p.1) and independent, courageous explorers (McLoughlin 2002, p.33). Teacher-librarians uphold values, advocating and enabling the free flow of information and ideas through co-operation and sharing and a commitment to social inclusion (Bundy 2001b, p.9). Teacher-librarians thus perform a hybrid role as educators, managers and service providers (Mallan, Lunden & Elliot Burns 2001 , p.30; Harvey 2001, p.2) handling multimedia and telecommunications, information literacy and inquiry, learner needs analysis, collaboration and curriculum interaction (Tilley & Callison 2001). The teacher-librarian networks professionally and internally as a service-orientated, engaged leader and motivator (Cornock & Jones 2002, p.5),

an empowering collaborator (Sit 2003, p.2), partner in organisational learning (Okiy 2004, p.5) and knowledge navigator (Bonanno 2002, p.8). The teacher-librarian provides an atmosphere conducive to learning and understanding (Okiy 2004, p.5) and ensures dynamic and constructive interactions (Sit 2003, p.11) for the accommodation of curriculum change. The profession, not the place, defines the service. *"The value that teacher-librarians have is the opportunity to contribute skills and knowledge to key elements of a school's transformation plans"* (Leppard 2003, p.3).

It could be argued that learning and understanding are the prerogatives of the teacher rather than of the teacher-librarian. However, the label of teacher-librarian is a clear indication of the intention of the role. A teacher-librarian has a unique view of a school, functioning at grassroots level, interacting with learning areas, individual teachers, classes and individual students. This may be termed the *hamster's* view. At the same time, the teacher-librarian has a *helicopter* view (Garratt 2001, p.20): an objective overview of the learning processes in the school. It is bifocal vision: the ability to see on two planes at once. Simply put, the teacher-librarian sees the big picture from a unique perspective. The teacher-librarian's role is also a non-threatening one. History and Geography teachers may be threatened by each other's presence in the Human and Social Sciences learning area. In contrast, the teacher-librarian has no territory to defend (Reynolds 2002, p. 9). Todd suggests that the difference between teacher-librarians and teachers is that the teacher-librarian's agenda is open ended learning, whilst the teacher's is the limit of the assignment, syllabus, subject or exam (Todd 2000[1]). The teacher's place is in the classroom. A knowledge manager's role is a co-ordinating one working with the different dynamics between teachers, curriculum, students and management within the school as well as networking beyond it. The teacher-librarian's classic role of being proactive in terms of information needs is critical in times of change. It is here that the teacher-librarian's bifocal view has value and moves the profession from one of information provision to a leadership role. It is the combination of understanding user needs, understanding the educational environment, understanding the need and purpose for change and proficiency with both creating and using the tools of change that give the teacher-librarian's role strategic value in the knowledge environment.

[1] Todd gave this response in answer to a question following his presentation.

Knowledge management is, according to Todd (2000, p.40) a significant concept for schools as engaged, interactive, networked learning communities. Todd challenges teacher-librarians to take on the role of knowledge-managers, rather than being just information managers, despite resistance from teachers who do not want to share their knowledge and expertise. Todd advocates imagination, engagement, alignment as requirements to overcome the barriers to teachers sharing knowledge. Similarly, Cram and Sayers (2001, p.3) argue that it is essential for librarians to understand knowledge management and participate in it; otherwise, they remain just information managers. Effective knowledge management requires interaction with the community of practice within which the Library is embedded.

Combes (2001, p.4) describes how the shift to inquiry-based outcomes affects the role of the teacher-librarian. She describes the *Sevenoaks* experience that has an infrastructure designed to facilitate and support an outcomes-focused, flexible learning environment that allows for the integration of ICTs across learning area programmes and encourages the development of online curriculum as a method of programme delivery.

The primary objective of the knowledge initiative is not to change the culture of the school or create a knowledge sharing culture, no matter how problematic the culture is perceived to be; nor is it the teacher-librarian's problem to change the culture of the school. Instead, the teacher-librarian's change role "*is to create a knowledge-information infrastructure that changes student outcomes … the construction of understanding and the construction of meaning"* (Todd 2001, p.18). Todd believes that if the construction of understanding and meaning is what learning is all about then a constructivist learning philosophy and practice centring on knowledge construction and knowledge use must define the role and practice of the school library. Todd argues that an appropriately defined vision for knowledge management, centred on constructivist learning, successfully implemented, may well change the culture of the school (Todd 2001, p.18).

There is consensus amongst the ASLA XVII Conference presenters (Bell, Cram & Sayers, and Langford & Wall) that it is the teacher-librarian's role to facilitate knowledge management in the school. They point out that the teacher-librarian can provide the innovation and co-ordinate the structures to support knowledge

management. An email on the *Infolink*[2] electronic mailing list expressed the view that teacher-librarians should *"get back to basics and forget about technology"*. Teacher-librarians are not technologists. The teacher-librarian role has focused on reading for pleasure and information as well as information literacy. Teacher-librarians are traditionally information managers. Their role should not be replaced but rather displaced with a broader, more holistic co-ordinating role relevant to the knowledge age. Getting back to basics is getting back to the learning and how it can best be supported. Learning is the bottom line.

Todd refers to his earlier research conducted together with Southon on teacher-librarians' views of knowledge management (Todd 2001, p.8). For some it was a "*must do"* because it was new. Others dismissed knowledge management, as they were *"too busy doing information management"*. For others it was information management in a new guise or *"a way of shoring up some kind of professional ego: the search for status, recognition, acceptance and value".* Todd advocates a focus on what we want our organisations to be rather than what we want to do:

> *[This] is future and goals directed, and constructed on people centred characteristics of working together with a common set of beliefs and values to achieve these goals … [T}he fundamental motive for knowledge management has to be contributing to the development of the smart school, one where knowledge construction and knowledge use are not simply espoused in mission statements and policies, but are the essence of learning and the day-by-day practices in school.* (Todd 2001, p. 8).

Teacher-librarians have moved from resource managers to information literacy, but the outcome is no longer the information literate student or school (Todd 2001, p.14). Todd suggests instead that the next wave is that of knowledge management and knowledge management is part of learning. The teacher-librarian's focus becomes one of integrating information, people and the knowledge process into dynamic, constructivist learning environments (2001, p.14).

> *"Your change role is to create a knowledge-information infrastructure that changes students' outcomes … the construction of understanding and the construction of meaning"* (Todd 2001, p.18).

[2] *Infolink* serves the South African teacher-librarian community through *Schoolnet SA.*

The issue for schools is twofold. Firstly, teacher-librarians must themselves accept the challenge of knowledge management and secondly schools need to recognise the potential contribution that a teacher-librarian can make to knowledge management. However, it is recognised that the multiple roles played by teacher-librarians may well fall within the ambit of knowledge management.

List of references to Appendix 1.1

ASLA (2001*) Learning for the future: developing information services in schools*, 2nd edition. Australia: Curriculum Corporation.

Bonanno, K. (2002) The mind – your greatest, creative asset in *ACCESS* 16(1), pp. 8-12.

Bundy, A. (2001b) Attitude is everything - towards an information enabled knowledge nation. Paper presented to a meeting of ALIA NT members. Darwin NT, November 2001. Available online: http://www.library.unisa.edu.au/about/papers/attitude.htm. Accessed 13.03.05

Bundy, A. (2001c) *Enabling the knowledge nation: What Australia needs in the 21st Century.* Address to the 11th National Library Technicians Conference. Available online: http://conferences.alai.org.au/libtec2001/papers/bundy.html Accessed 11.02.05.

Bundy, A. (2003) *Only connect: towards the information enabling of young Australians.* Address to the School Library Association of Victoria (SLAV) Conference, March 2003. Available online: http://www.library.unisa.edu.au/about/papers/connect1.htm Accessed 13.03.05

Carr, K.S. (1990) How can we teach critical thinking? *ERIC Digest.* Urbana, IL: ERIC Clearinghouse on Elementary and Early Childhood Education. (ED326304)

Carroll, J.M., Rosson, M.B., Dunlap, D.L., & P.L. *Isenhour (2003) Frameworks for sharing knowledge: Towards a professional language for teaching practices* in Proceedings of the 36th Hawaii International Conference on System Sciences, 2003. Available online: http://www.hicss.hawaii.edu/HICSS36/HICSSpapers/DDOML22.pdf. Accessed 07.02.05

Combes, B. (2001) *The Sevenoaks experience: the role of the teacher librarian in setting up a system to manage documentation, support materials and online curriculum.* Paper presented at the ASLA XVII Conference, Mudjimba Beach, Queensland, October 2001.

Cornock, L. & R. Jones (2002) The patchwork TL in *Commentary* 16(4) 2002. Available online: http://www.asla.org.au/access/a_commentary_160402.htm. Accessed 13.03.05

Cram, J. & R. Sayers (2001) *Creating and managing context: the use of knowledge management principles to deliver virtual information services to schools*. Paper presented at the ASLA XVII Conference, Mudjimba Beach, Queensland, October 2001.

Garratt, B. (2001) *The learning organization: developing democracy at work*. London: HarperCollinsBusiness

Harvey, R. (2001) Teacher librarians ... who are you? in *Commentary* 15(4) 2001. Available online: http://www.asla.org.au/access/a_commentary_150401.htm. Accessed 13.03.05

Langford, L. (2001) "Editorial" in *ACCESS*, 15(1), p 1.

Leppard, L. (2003) The role of the teacher librarian in essential learning in *Commentary* 17(3) 2003. Available online: http://www.asla.org.au/access/a_commentary_170303.htm. Accessed 13.03.05

Loertscher, D.V. (1988) *Taxonomies of the school library media program*. Englewood CO: Libraries Unlimited

Mayer, E (1996) Information literacy and the autonomous learner in *Learning for life: Proceedings of the Second National Information Literacy Conference 30 November-1 December 1995.* Adelaide, University of South Australia

Mallan K., Lundin, R. & Elliot Burns, R. (2001) Exploring the impact of new technologies on the role of teacher librarians in *ACCESS* 15(1), pp. 29-32.

McLoughlin M. (2002) Profile – Jan Sismey in *ACCESS*, 16(3), pp. 33.

Nimon, M. (2003) School libraries in Australia in *The Australian Library Journal* 53(1). Available online: http://www/alia.org.au/publishing/alj/53.1/full.text/nimon.html. Accessed online: 13.03.05

Okiy, R.B. (2004) The Universal Basic Education (UBE) Programme and the development of school libraries in Nigeria: A catalyst for greater female participation in national development in *Information Development* 20(1) 2004, pp. 43-50.

Reynolds, M.E. (2002) *Sailing into the wind: the role of the teacher-librarian in the knowledge environment.* Paper presented at the ISASA School Librarians Conference, Grahamstown, April 2002.

Reynolds, M.E. (2005) The Contribution of Knowledge Management to Learning: An Exploration of its Practice and Potential in Australian and New Zealand Schools. Unpublished dissertation M.Ed. (CIE), University of Pretoria

Shaw, J. (2003) Navigating a raging river: A Canadian teacher-librarian's experience implementing information technology. Available online: http://libres.curtin.edu.au/libres13n2/ess&op_shaw.htm Accessed 13.03.05

Sit, A. (2003) *Capitalizing on knowledge: mentorship among teacher-librarians in Hong Kong.* Available online: http://www.ied.edu.hk/fesym/1A03-010%20Full%20paper.pdf Accessed 13.03.05

Tilley C. & D. Callison (2001) Preparing school library media specialists for the new century. *Journal of Education for Library and Information Science* 42(3): 220-227.

Todd, R. (2000) Building a knowledge-sharing culture in schools: Knowledge management in action in Hay, L., Hanson, K. and J. Henri (eds.) *New millennium, new horizons: Information services in schools*. 2000 Online Conference Proceedings. Wagga Wagga: Charles Sturt University: Centre for Studies in Teacher Librarianship.

Todd, R. (2001) *The Smart School: Knowledge management working for your future*. SCIS Oration delivered to the ASLA XVII Conference, Mudjimba Beach, Queensland, October 2001

Appendix 1.2

Ethical clearance certificate

UNIVERSITY OF PRETORIA

FACULTY OF EDUCATION

RESEARCH ETHICS COMMITTEE

CLEARANCE CERTIFICATE	**CLEARANCE NUMBER :** CS07/02/04
DEGREE AND PROJECT	PhD Curriculum Studies Crossing boundaries: convergence, mutuality and extensiveness in the integration of information and communication technologies in secondary schools: a case study
INVESTIGATOR(S)	Mary Reynolds - 23287137
DEPARTMENT	Curriculum Studies
DATE CONSIDERED	16 March 2007
DECISION OF THE COMMITTEE	APPROVED

This ethical clearance is valid for a period of 3 years and may be renewed upon application

CHAIRPERSON OF ETHICS COMMITTEE	Dr S Human-Vogel
DATE	19 March 2007
CC	Prof J C Cronje Jeannie Beukes

This ethical clearance certificate is issued subject to the following conditions:

1. A signed personal declaration of responsibility
2. If the research question changes significantly so as to alter the nature of the study, a new application for ethical clearance must be submitted
3. It remains the applicant's responsibility to ensure that all the necessary forms for permission and informed consent are kept for future queries.

Please quote the clearance number in all enquiries.

Appendix 2.1

Keyword relationships

Keyword relationships								
Underlying theories			Specific theories	Concepts	Aspect			
Complexity theory	Systems theory	Innovation theory	ICT integration	Beliefs	Student	Teacher	Organisation	
				Competencies				
				Access				
			Transformation	Policy	Alignment	Structure	Time	
				Leadership				
				Professional development				
			Inclusion	Cognition	Learning preferences	Learning styles	Differentiated learning	
				Diversity				
			Learning theory	Productive/ Generative learning	Student learning	Professional learning	Organisational learning	
				Active/experiential learning				
				Constructivism				
				Life-long learning				
			Community of Practice (CoP)	Collaborative learning	Student	Teacher	Organisation	
				Knowledge sharing				
				Organisational learning				
			Critical literacies	Information literacy	Thinking skills	Scaffolding	Resources	
				Verbal literacy				
				Visual literacy				
				Mathematical literacy				

Appendix 3.1

General Teacher Interview Questions June 2007

1. It is generally accepted (and has been shown by research) that high schools in particular are highly complex environments. As a high school [Wilding] is particularly complex. Changes in the school structure (the co-ordinate model), in the pastoral care system (the House/Tutor system) and in our approach to the classroom (the Inclusion policy) have all placed demands on teachers. On top of that we have the nationally mandated changes to an outcomes-based curriculum and new forms of assessment. How has all this impacted your classroom practices?
2. How have these innovations developed?
3. How have you worked together as a department to foster innovation?
4. In what ways have you been encouraged or supported by school leadership in fostering innovation?
5. Have there been external influences on your innovation processes and, if so, what are they?
6. Have you been involved in any partnerships or networks in developing innovations?
7. Why have some innovations been discontinued?
8. A further factor in that complexity has been the influence of the technological world and the 'knowledge age' that requires us to teach 21st Century skills and use ICTs in that process. In your department, what innovations involving ICTs have been significant to you and why?
9. How have these ICT related innovations come about? What factors sparked them?
10. In what ways have you been encouraged or supported by each other within your department in your development of ICT use in the curriculum?
11. Each learning area requires a different range of classroom strategies. Has your specialist area as a [subject] teacher influenced your approach to ICTs significantly and if so, in which ways?
12. Amongst the many changes that are happening at [Wilding], how would you rate the use or significance of ICTs?
13. In what ways have you been encouraged or supported by others beyond your department in your development of ICT use in the curriculum?
14. What constraints, if any, could you identify that might have hindered your ability to use or integrate ICTs in the classroom?

Appendix 3.2

General Leadership Interview Questions June 2007

15. It is generally accepted (and has been shown by research) that high schools in particular are highly complex environments. As a high school [Wilding College] is particularly complex. Changes in the school structure (the co-ordinate model), in the pastoral care system (the House/Tutor system) and in our approach to the classroom (the Inclusion policy) have all placed demands on teachers. On top of that we have the nationally mandated changes to an outcomes-based curriculum and new forms of assessment. How do you think all this impacts classroom practices?
16. What innovations are you aware of that have emerged from these classroom practices?
17. How have you seen departments working together to foster innovation?
18. In what ways are you able to encourage or support teachers in fostering innovation?
19. Have there been external influences on the innovation processes and, if so, what are they?
20. Are you aware of or have you been involved in any partnerships or networks in developing innovations?
21. Why have some innovations been discontinued?
22. ICTs are the information and communication technologies that we use such as PCs, network access, data projection facilities etc. You have been involved with the school for [X] years, of which this is your [XX] as [in a leadership role] with, inter alia, responsibility for ICTs [at Wilding]. During this period, what developments in the use of ICTs in the school have been significant to you and why?
23. Are there any particular innovations in ICT use [at the school] that you are aware of or would like to comment on?
24. In what ways have you encouraged teachers to develop their use of ICT in the curriculum and can you give examples?
25. Has your specialist area as a [subject] teacher influenced your approach to ICTs significantly and if so, in which ways?
26. What constraints, if any, could you identify that might have hindered the integration of ICTs in [the school]?

Appendix 4.1
Table of changes – external and internal

Type	Change	Cause	Effects	Date
Political & societal changes	Globalisation	Economic changes; technology development	All sectors especially education; ICT development	c.1995
	Change of government & new constitution	National change from apartheid to democracy	Affects every aspect of life	1994
	Provincial & municipal boundaries	Need for equitable distribution of resources	State & local government departments; restructuring of provincial education departments	post 1994
	Human rights	Entrenchment of rights of individual	Implications for rights culture and disciplinary matters in schools	1994
	Diversity, including employment equity	Equalisation of employment opportunities across race, gender and (dis)ability	Diversification of teacher and student populations; language factors	2000
	Skills shortage	Providing opportunities for all	Most sectors, especially teachers never exposed to good education systems	Ongoing
	HIV/AIDs factor	Ongoing social disintegration	Organisations and individuals; teachers, families and students	1984 -
	Proliferation of independent schools	Dissatisfaction with state education system	Leads to competition and need for marketing	1991 -
	Personal safety & security	Increasing crime rates and diminished effectiveness of police; first world/third world contrasts	Stress levels of individual teachers and students; theft and increase in security spending for schools	Ongoing
	Transport & time issues	Lack of public transport	Everyone; punctuality & travelling time	2004 -
	Services infrastructure	Lack of planning	Electricity supply	2007 -
Education policy changes	Curriculum 2005	Change from Christian National Education to democracy based curriculum	All grades, choice of subjects, language options, curriculum content	2003
	Outcomes based assessment	Assessment basis changes from marks orientation	Requires comprehensive change in teaching paradigm and practice	2002
		Memorisation	Applied knowledge, skills and values	
		Focus on teaching	Scaffold learning process	
		Assessment of learning	Assessment for learning	
	Inclusive philosophy	Recognition of rights and individual learning differences, including gifted learners, learning disabled and physically disabled learners	Learner-centred focus, learning styles, multiple intelligences; change in admission policy; classroom support; move away from streaming; support of individual needs.	2001
	Primary & 2nd language changes	Recognition of 11 official languages	Shortage of resources; change in subject structures from compulsory to optional	2003

Type	Change	Cause	Effects	Date
Education policy changes (continued)	New subjects & options (LO, EMS, Maths Lit)	Curriculum development at GETC & FET phases	Retraining; staffing numbers; provision of resources	2001
	Amalgamated subjects (HSS, NS)	Interdependence of knowledge	Staffing structures; subject choices; curriculum balance	2004
	Discontinued/private subjects (Latin, French)	Limited curriculum options	Re-deployment or retrenchment of teachers; private options	2004
	Alignment of content	Move away from western-based content	Move towards relevant South African and Afro-centric content	2003
	Examination board	Joint Matriculation Board to Independent Examinations Board	Closer compliance to national policy; new content; focus on assessment	c.2000
	School evaluation (Umalusi)	Replacement of critical inspection	Supportive evaluation; school as organisation as well as teaching practice	2007
School driven changes	Partnership	Co-ordinate a series of schools	Hierarchical structure; staffing structures; collegial relationships; gender-aligned content	1995 -
	Middle School	Alignment with curriculum phases; specialised phase for adolescent needs	Physical school structure; hierarchical structure; teachers to become middle school specialists; ethos of senior school	Discussed, agreed, not implemented
	Timetable changes & experiments	Accommodate complex changes	Teachers and students; time allocation to subjects and extra-murals	ongoing
	Community service	Social responsibility; leadership development; wider curriculum	Teachers on voluntary basis; all students; curriculum	c.2000
	Good to great	Assumption of 'good school'	Conscious move to 'great school'	2008
	Intern programme	Skills shortage; SETA support	Mentoring teachers; staffing structures	c.2002
	Retirement age	Lowered from 63 to 60	Shortage of experienced teachers	c.2000
	Class size	Increase costs	Teachers and students	c.2004
	Pastoral care (House & Tutor system)	Expansion of care system	Teacher workload & relationships with students	2000
	Leadership programme	Belief in concept of 'servant leadership'	Teacher workload & relationships with students	c.2002
	New subjects (Accounting, Design & Technology, Drama, Information Technology, Computer Applications Technology, Business Economics)	Stakeholder demand; new curriculum	Teaching ratios; demand on resources; broader subject option choices	2007
Technology driven changes	Proliferation of ICTs	Network, upgrades and updates (e.g. MS Office 2007); new applications	Retraining teachers & learners; updating systems & documents; maintenance & support	ongoing

Type	Change	Cause	Effects	Date
Technology driven changes (continued)	Plagiarism	Internet access; lack of access to databases; lack of information literacy skills; resource-based curriculum	Teachers and students; ethical practice	2000
	Administrative system	Data volume & integrity	Teacher training and access	c.1995
	Internet, Intranet & email access	Access to resources; communication	Information overload (especially email) for teachers and students	c.1995
	Integrated resource provision	Demand	Costs; maintenance; teachers and students	c.1993
	Web 2.0 & social networking; mobile technology; Multi-media	Student use & demand	Security; bandwidth; student focus on task	2004/5
Practice driven changes	Co-operative learning	All these changes have either a theoretical basis or they are driven by need i.e. student need or teacher need.	Affect teachers and students	1995
	Active learning			
	Peer tutoring c.f. teacher-centred teaching			
	Scaffolding learning			
	Non-streaming			2006
	Team teaching			
	Resource-based learning			2000
	Subject focus days (ex Middle School explorations)			c.2000 - 2005
	ICT integration			c.1994
	Moodle Learning management system			2007 -
	CASE (Maths & Science)			c.1998
	Video production			2005 -
	Intel course			c.2000, 2008

Appendix 6.1
Anti-plagiarism policy

Introduction

1. The College values academic integrity highly and therefore all teachers and learners must be made aware of the issues that undermine academic integrity and constitute plagiarism.

2. The College is committed to ensuring that all teachers and learners are responsible and ethical users of information. All teachers and learners will be guided in the appropriate use of information and ideas and the correct methods of acknowledging sources of information. Teachers and students will be held accountable for delivering honest work.

3. Emphasis should be placed on educating to avoid plagiarism rather than on punishing plagiarism.

Definition

4. Plagiarism is defined as the act of passing off someone else's words, ideas or creations as one's own whether deliberate or accidental.

Plagiarism Infringements

5. Plagiarism is committed when someone:
   - 5.1. Paraphrases from a source without proper acknowledgement
   - 5.2. Presents or uses the ideas, research findings, opinions, designs or creations of others as original work without acknowledging the creator(s) of the source
   - 5.3. Pieces together different pieces of information or ideas to form a whole from electronic (cutting and pasting) or from printed sources (copying) without proper acknowledgement
   - 5.4. Copies someone's words, ideas, illustrations or electronic files in any format from a source or sources such that very little of the resulting work is original, whether or not credit is given
   - 5.5. Copies someone's exact words without quotation marks and proper acknowledgement
   - 5.6. Changes words but not the sentence structure of the original without acknowledging the source
   - 5.7. Does not provide a list of references, commonly known as a bibliography
   - 5.8. Fabricates data or references
   - 5.9. Works on or completes an assignment for someone else, or collaborates with someone else on work that should have been done independently
   - 5.10. Obtains an assignment from another person, from a paper mill or from the Internet and submits it as one's own work

Prevention of Plagiarism

6. Teachers' Responsibilities:
   - 6.1. Avoiding plagiarism is ultimately the student's responsibility. However, teachers should design assignments to challenge student thinking and reasoning, to encourage creativity and to avoid plagiarism infringements

6.2. Teachers should place emphasis on developing good writing and research skills rather than punitive action
6.3. Teachers should make all learners aware of practices that constitute plagiarism and methods of avoiding it at the start of each research assignment
6.4. Teachers should make all learners aware of the ethical reasons for honest academic work and the consequences of committing plagiarism
6.5. Teachers should provide an assignment sheet with detailed instructions and a rubric outlining formative assessment as well as assessment of the final product
6.6. Teachers should provide clear guidelines on correct referencing and avoiding plagiarism
6.7. Teachers should provide clear guidelines regarding acceptable amounts of help from peers or adults

7. Learner Responsibilities:

7.1. Learners must uphold the College Charter by being ethical and honest in their work
7.2. Learners must demonstrate understanding by using their own words, sentence structures and ideas to synthesise the sources to which they refer
7.3. Learners must acknowledge the sources consulted and used in their work by creating a list of references
7.4. Learners in Grades 10 – 12 must demonstrate the depth and breadth of their research by using in-text references
7.5. Learners must sign every assignment and state on it that it is their own unaided work and that to the best of their knowledge, their referencing is correct

Consequences of Committing Plagiarism for Learners

The consequences for committing plagiarism are in accordance with the College's disciplinary policies.

List of References

This policy was developed with reference to the following sources:

Akers, S. & K. Peters (2002) Deterring and Detecting Academic Dishonesty [online] Available from: http://www.purdue.edu/ODOS/osrr/academicdishonesty.htm [accessed 15 Oct 2007]

Chapo, R. [n.d.] Legal Definitions and Terms [online] Available from: http://www.sandiegobusinesslawfirm.com/ [accessed June 2008]

Curtin University of Technology (2007) Academic Integrity at Curtin: Student guidelines for avoiding plagiarism [online] Available from: http://academicintegrity.curtin.edu.au/studentbook.html [accessed 26 October 2007]

The Learning Centre [online] Available from: http://www.plagiarism.org [accessed 24 October 2007]

Lockhart, J. & A. Coetzee (2001) Legal use of Information: Information Literacy [online] Available from: http://www.lib;uct.ac.sa/infolit/use.htm [accessed 24 October 2007]

St Michael's School, Bow Island [online] Available from: http://www.mhcbe.ab.ca [accessed 20 October 2007]

Stony Brook University Libraries (2004) SBU Library Research Guide [online] Available from: http://www.sunysb.edu/tutorial/mod6/07copyright.shtml [accessed 6 June 20008]

Terryville High School Plagiarism Policy [online] Available from: http://plymouth.k12.ct.us/ths/media/Plagiarism.htm [accessed 30 October 2007]