



Durham E-Theses

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and Computing

BAKER, DIANA,CLARE

How to cite:

BAKER, DIANA,CLARE (2017) *Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and Computing*, Durham theses, Durham University. Available at Durham E-Theses Online: <http://etheses.dur.ac.uk/12434/>

Use policy

The full-text may be used and/or reproduced, and given to third parties in any format or medium, without prior permission or charge, for personal research or study, educational, or not-for-profit purposes provided that:

- a full bibliographic reference is made to the original source
- a [link](#) is made to the metadata record in Durham E-Theses
- the full-text is not changed in any way

The full-text must not be sold in any format or medium without the formal permission of the copyright holders.

Please consult the [full Durham E-Theses policy](#) for further details.

Academic Support Office, Durham University, University Office, Old Elvet, Durham DH1 3HP
e-mail: e-theses.admin@dur.ac.uk Tel: +44 0191 334 6107
<http://etheses.dur.ac.uk>

Teachers' encounters with major disciplinary and curriculum change

Diana Baker

Abstract

The impact of teachers' beliefs on effective curriculum change implementation is widely recognised. This study identifies the factors affecting the change process; developing and presenting a theoretical model of the process of curriculum change precipitated by disciplinary shift as perceived by the teachers experiencing the transformation. It was carried out in the context of, arguably the most significant disciplinary shift in the last two decades of the English National Curriculum: the movement from ICT to Computing. The research was founded on the views, beliefs and experiences of existing ICT teachers as they 'lived through' the planning and implementation of the new curriculum. The research followed an inductive interpretive approach to expose a theoretical model grounded in this data. This grounded research methodology is original in both its emphasis and context.

The model that emerges identifies that teachers' beliefs act to form their enacted support of the new curriculum that manifested itself in a number of ways. The teachers' beliefs that drive their enacted support form a complex interrelationship that involves their beliefs, regarding the nature of IT education and student ability; their perceptions of how the curriculum change would personally affect them and their stated support of the new curriculum. Each of these aspects has a number of intervening influences meaning that for each individual teacher there were both positive and negative forces acting on each. As the emergent model identifies how teachers respond to curriculum change the conclusions of this research have consequences for both teachers, and school leaders and policy makers. Additionally, in presenting existing ICT teachers' beliefs regarding IT education, and how these were formed through their biographies and how they have influenced said teachers' responses to the new curriculum this study establishes new knowledge and understanding of subject specialist teachers and their beliefs, in both ICT and other disciplinary areas.

Thesis title: Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and Computing

Author: Baker, Diana Clare

Submitted for: Professional Doctorate

Department: Education

Institution: Durham University

Year of submission: 2017

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

Table of Contents

List of Tables.....	7
List of Figures	7
1 Introduction.....	10
1.1 Background of the study - Why now? Why ICT teachers?	10
1.2 The nature of this thesis	19
1.3 Guiding aim, objectives and questions	20
1.4.....	25
1.4.1 Selection of participants.....	25
1.4.2 Data analysis	27
1.5 Substantial and original contribution to knowledge	29
1.6 Definition of terms	31
1.7 Organisation of this thesis	32
2 Literature Review.....	33
2.1 Literature overview	33
2.2 Teachers' beliefs and change – The role of teachers' beliefs and teachers' identities in changing teachers' behaviour	35
2.2.1 Teacher beliefs and teacher identity – Principles and features.....	35
2.2.2 Beliefs as a driver – The restraining impact of teachers' beliefs on changing teachers' behaviour	44
2.2.3 Beliefs and curriculum change – The impact of teachers' beliefs and teacher identity on the implementation of educational interventions.....	46
2.2.4 Beliefs and IT education – How teachers' beliefs curtailed the integration of ICT into the classroom.....	48
2.2.5 Summary	51
2.3 The importance of biography – The role of past and present experiences and landscapes on teacher beliefs and identity	52
2.3.1 Studying teacher beliefs – How research on teacher beliefs developed to recognise biographical approaches.....	52

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2.3.2 The significance of biographies - How teachers' views of their previous experiences form their teacher beliefs and identities.....	54
2.3.3 What biographical research has shown – How research using biographies has increased our understanding of teacher beliefs and teacher identity	56
2.3.4 Summary	60
2.4 What makes ICT teachers a unique breed? – Factors of ICT teachers' biographies that make their beliefs and identities different.....	61
2.4.1 A different 'apprenticeship' – How ICT teachers' experience sets them apart	61
2.4.2 A different landscape – How IT education's role sets ICT teachers apart	62
2.4.3 A breed worthy of study – The sparsity of research on ICT teachers..	65
2.4.4 Summary	67
2.5 The systems development life cycle of the Computing curriculum so far – The Computing curriculum change, its history and development.....	68
2.5.1 Identification – Why there was a perceived need for the change.....	69
2.5.2 Analysis – What was wrong with the existing curriculum.....	70
2.5.3 Design – How the new Computing curriculum developed.....	72
2.5.4 Implementation – The new Computing curriculum.....	74
2.5.5 Summary	75
2.6 Chapter overview	75
3 Methodology and Research Design	77
3.1 Introduction – Why grounded theory.....	77
3.2 Rationale – Why grounded theory in this particular context?	78
3.3 The role of the researcher	84
3.4 Participants and sampling strategy	87
3.5 Research ethics.....	90
3.6 Research design and data collection methods	92

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3.7 Rigour and trustworthiness of the research	95
3.7.1 Trustworthiness	96
3.7.2 Triangulation	97
3.7.3 Dependability	98
3.7.4 Transferability	98
3.7.5 Confirmability	98
3.8 Data analysis.....	99
3.8.1 Data analysis – Open coding and constant comparison.....	101
3.8.2 Data analysis – Axial and selective coding.....	105
3.8.3 Generating new theory.....	107
3.9 Potential benefits of the research	108
4 Findings.....	115
4.1 Introduction	115
4.2 Introducing Adrian	119
4.3 Introducing Barry	120
4.4 Introducing Curtis	122
4.5 Introducing Denise	124
4.6 Introducing Ewan.....	125
4.7 Introducing Fitz.....	126
4.8 Introducing Greg	127
4.9 Introducing Heather.....	130
4.10 The nature of existing ICT teachers' beliefs regarding the previous ICT curriculum and the recent curriculum change	131
4.10.1 What are the current ICT teachers' beliefs regarding the purpose of IT education?.....	132
4.10.2 What are the current ICT teachers' beliefs regarding how effectively the existing ICT curriculum achieved these purposes?	140
4.10.3 What are the current ICT teachers' beliefs regarding how effectively the new Computing curriculum will achieve these purposes?	145

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4.11 How teachers' biographies helped establish their beliefs regarding the IT curriculum and the change	172
4.11.1 What particular biographic events were significant in shaping these beliefs?	172
4.12 How these beliefs influenced how the teachers prepared for, and are coping with the change?.....	186
4.12.1 How are current ICT teachers negotiating the curriculum change?	186
5 Discussion	199
5.1 Introduction	199
5.2 How the grounded theory was developed from the data	200
5.3 Enacted support of the new curriculum.....	207
5.4 Stated support of the new curriculum	210
5.5 Perceived personal impact of the new curriculum.....	214
5.6 Conceptual narrative and emergent theory.....	218
6 Concluding Thoughts	225
6.1 Reflections on the process	225
6.1.1 Strengths and limitations.....	225
6.1.2 Improvements	229
6.2 Contribution to the field.....	230
6.3 Future work	232
7 Appendix A – Institution informed consent agreement	234
8 Appendix B – Respondent informed consent agreement	239
9 Appendix C – Consent agreement information sheet	240
10 Appendix D – Pre-interview data collection sheet.....	242
11 Appendix E – Research tool.....	243
12 Appendix F – Questions asked of the data to help identify what it is trying to say.....	248
13 Appendix G – Constant comparisons to be made in order to establish and refine the conceptual categories	249

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

14 Appendix H – Glaser’s ‘coding families’ with examples.	250
15 Bibliography.....	251

List of Tables

Table 1 - Research participants and dimensions of interest related to their education and career histories.....	88
Table 2 – Research process timeline	111
Table 3 – Sources of data	114
Table 4 – The coding process.....	203
Table 5 - The main concepts induced and their internal relationships.....	206

List of Figures

Figure 1 - Representation of how the research questions address the study’s purposes.....	23
Figure 2 - Representation of the whole study, showing the relationship between research purposes, research objectives, the research questions, the conceptual content and data collection.....	24
Figure 3 – The Relationship between teachers’ beliefs, orientations and knowledge.....	38
Figure 4 – The systems development lifecycle for the Computing curriculum change.....	68
Figure 5 - The grounded theory process for this research.....	100
Figure 6 - Constant comparison.....	104
Figure 7 - The relationship between the research purposes, objectives and questions.....	118

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

Figure 8 - Diagrammatic metaphor of the relationship between the three main emerged categories.....200

Statement of copyright

The copyright of this thesis rests with the author. No quotation from it should be published without the author's prior written consent and information derived from it should be acknowledged.

Acknowledgements

I would like to thank my supervisor without whom this thesis would not have been conceived let alone made it to completion. Their detailed, honest, constructive and, above all, caring feedback and support has been invaluable. Thank you.

I would like to thank my colleagues, past and present, who took part in this study and who were very happy to contribute their thoughts, feelings and views with me, and shared their experiences of the curriculum change with me with honesty and with openness. Adrian, Barry, Curtis, Denise, Ewan, Fitz, Greg and Heather I couldn't have done it without you.

Finally, I want to give the biggest thanks to Tom who has supported me with grace and fortitude through this, and many other equally immense, projects.

Dedication

I would like to dedicate this thesis to Tom who has done more to help me identify and articulate my beliefs, teacher and otherwise, than he will ever know and Edward who has changed my identity in more ways than one.

1 Introduction

1.1 Background of the study - Why now? Why ICT teachers?

Over recent years there has been considerable disquiet among ICT teachers, Computing and IT academics and Computing and IT professionals regarding the ICT curriculum at school and its effectiveness in engaging students, developing understanding of IT and preparing students to work in the IT profession (Chakrabarti, 2012; Brittain, 2011; The Royal Society, 2012; Bayley, 2012; Office for Standards in Education, 2011). Many have blamed the quality of the curriculum and teaching on ICT's lack of popularity amongst students and the declining number opting to study the subject at Key Stage Four and beyond (Charlesworth 2011, Shah 2011, Office for Standards in Education 2011). Still others proposed that the way ICT was taught was damaging students (Bayley 2012, Burns 2012) and the IT industry as a whole (Sahota, 2011; British Computer Society, 2012b). This led to an apparent consensus among these parties that the curriculum had to change (BBC News, 2012a; BBC News, 2012c; British Computer Society, 2012a; Naughton, 2012). The Department for Education proposed a new approach to the study of IT that was placed under consultation (Department for Education 2012) and was enthusiastically promoted by the then Education Secretary (Brittain, 2012; Burns, 2012; BBC News, 2012b). This new syllabus covered both primary and secondary IT contexts and required students to develop effective ICT skills while moving the emphasis away from these to how computers operate and the underpinnings of programming (Computing at School Working Group 2012). As such the curriculum change had substantial implications for those teaching ICT in both primary and secondary sectors.

The impact of teachers' beliefs on effective (and ineffective) curriculum change and implementation is recognised (Fullan 1993, Cox, Preston & Cox 1999, Hennessey, Ruthven & Brindley 2005, Brinkerhoff 2006) as is the significant lack of shared beliefs regarding the nature of the ICT curriculum and pedagogies among ICT teachers (Hadjerrouit 2009, Hennessey, Ruthven & Brindley 2005, Mumtaz 2000). ICT teachers' beliefs regarding IT are multi-faceted and include

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

beliefs about the nature of technology, what should be taught and the origin and nature of technological expertise (Hadjerrouit 2009, Hammond 2011, Hennessey, Ruthven & Brindley 2005, Mumtaz 2000). Their beliefs are further augmented by more universal teachers' beliefs including self-efficacy beliefs and beliefs about student learning (Sammons, Day, Kington, Gu, Stobart & Smees 2007, Dix 2012, Poletini 2000, Song 2011). Beliefs about the nature of education and learning and particularly whether knowledge is transmitted or constructed play a significant role in teachers' educational belief systems (Hadjerrouit 2009, Dix 2012, Poletini 2000). Conflict regarding such beliefs may have led to some of the disquiet regarding ICT education within secondary schools. Many of those criticising ICT education cite the fact the curriculum has developed in a way that it had become dominated by knowledge transmission models (British Computer Society 2012, Burns 2012, Sahota 2011, The Royal Society 2012).

Research has presented evidence that a teacher's beliefs on what makes effective education is based on their experiences in classrooms as pupils and that their beliefs of what makes a good teacher is based on their recollections of teachers they had when at school (Morgan & Hansen 2008, Lortie 2002, Jegede 2009). In fact, this appears to be a significant driver in why many selected teaching as a career (Santoli 2009, Khoh, Ling, Ch'ng & Chuan 2013, Rinke, Mawhinney & Park 2014, Rinke 2008, Kirchhoff & Lawrenz 2011). Interestingly even 'ineffective' lessons experienced during an 'apprenticeship' will be drawn on to teach (Morgan & Hansen 2008). Additionally, previous careers experience may also be significant in developing teachers' beliefs (Robson 2002, Zhang, Wang, Losinski & Katsiyannis 2014, Kirchhoff & Lawrenz 2011). From research it is apparent that teachers' life experiences, and particularly their classroom experiences while pupils themselves, play a major role in influencing their beliefs regarding education, pedagogies and curricula content. Most teachers have experienced classroom life in their subject from both sides of the desk, with many having experienced lessons in their subject as pupils at a variety of levels, sometimes all the way through from primary school to degree level (Department for Education 2014). Even those teaching in out-of-field subjects will have experience as pupils at pre-degree level, and, in England, the introduction of the National Curriculum will have made such experiences more alike.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

The fact that teachers' life experiences, particularly their classroom experience while pupils themselves, play a major role in influencing their pedagogical beliefs may be particularly significant and troublesome for ICT teachers. In contrast to teachers of most other subjects many of them are teaching out-of-field having qualified as a teacher and at degree level in another subject (Burns 2012, Department for Education 2014, BBC 2012b). As such they have not experienced classroom life in their subject from both sides of the desk, and many have not experienced the subject at all as pupils due to the fact that ICT was only introduced as a discrete subject in 1995 (Hammond 2004, House of Commons 2016, Mitchell 2016). Hence many current ICT teachers have not experienced an 'apprenticeship of observation' in the subject (Hammond 2011) which appears so significant in establishing teachers' pedagogical beliefs, shared or otherwise. This lack of opportunity to establish shared pedagogical beliefs is further compounded by the wide variety of career routes most IT professionals (Valenduc et al. 2004) and teachers (Hammond 2004) have taken. Individuals' experience of how they were trained whilst working shapes their beliefs on education (Robson 2002) as does the route through which they qualified (Zhang, Wang, Losinski & Katsiyannis 2014). So the diversity of pre-teaching careers and qualification routes exhibited by ICT teachers is likely to further frustrate the identification of their beliefs.

The nature of IT and technology add further levels of intricacy to ICT teachers' beliefs. The potential role of IT within education is vast and how best to take advantage of its many aspects is widely debated (Hadjerrout 2009, Hammond 2011). Do students need to be taught about how it works or how to use it 'appropriately' for conventional business type activities; should they be using it to support and supplement traditional learning in other subjects (Charlesworth 2011), should they be using it to support and develop their creativity or take advantage of its collaborative nature to help improve their cognition (Hadjerrout 2009, Hammond 2011)? Every educator, or individual who holds an opinion on education will see IT's role within the class differently. ICT teachers' identities will have a significant impact on their view of the role of IT. Whether they see themselves predominantly as a facilitator; enabling students to develop skills for their future career, a mathematician; teaching how to use logic and abstraction to solve problems, an innovator; using ICT to develop new approaches in the

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

classroom, a creative; using ICT to unleash their students, and their own, creative abilities, or any of the many other potential teacher identities it will influence what they see as the educational role of IT.

Additionally, due to its transformational role in business there is much interest from commercial quarters in how IT is taught and this has become accompanied by a pressure to adapt what goes on in the classroom to suit the needs of future employers (British Computer Society 2012). Even if the conflicts between educators regarding the role of IT within education and between those who believe there is more to education than developing work skills in young people and those who believe industry should influence what is taught could be resolved that would not remove the complexity. The rate of change with technology means that any agreement reached would be obsolete before a copy of it could be circulated to all interested parties! Similar issues with finding agreement between groups holding diverse and often philosophically different, views in a constantly shifting environment are experienced in other fields including international relations, economics and medicine.

There has always been much debate about what IT should be at schools and how it should be taught. When ICT was first introduced into the National Curriculum in 1990 the initial discussion centred on how it should be delivered. Three models were proposed: teaching ICT across the curriculum, teaching ICT as a separate subject and combining both approaches so ICT was taught both as a separate subject and within other subjects (Hammond 2011). The introduction, in 1995, of ICT as a discrete subject within the curriculum addressed these issues to some extent by proposing that the best approach was that of combining discrete lessons with additional input in other subjects (Hammond 2004). However, the debate had already moved on to the nature of ICT and the purpose of teaching it at school. Some felt that the focus of ICT was to equip students with the relevant skills in the most commonly used applications whereas others wanted to focus on ICT's potential in problem solving and cognitive development (Hammond 2004, Lloyd & Albion 2009). This dichotomy was evident in ICT teachers' behaviour, with the majority striving to develop activities that could allow both (Hammond 2011).

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

As the way ICT education was delivered at secondary schools settled down to a 'mixed diet' of discrete and cross curricular input there continued to be "... issues in defining the nature and scope of ICT as a subject ..." (Hammond 2004, p. 30). These issues included: whether ICT lessons should be teacher-led with class activities or undirected individual progress towards learning outcomes achieved through trial and error (Lloyd & Albion 2009) (objective versus constructive view of knowledge acquisition); the balance between theory and practical skills based lessons; whether students should be given simplified yet unrealistic tasks to help them learn the skills or experience real life or simulated activities to see how ICT is actually employed; and the distorting effect of the examination curricular leading to the school ICT focus being on outdated material rather than the latest applications in day to day life (Hammond 2004). Some suggested there were three main strands to ICT within education: using ICT to support teaching (for example using word processors to write in English lessons or spreadsheets to produce graphs for comparison in mathematics); learning through ICT (use of virtual learning environments or web based environments to provide materials for students); and ICT as a subject (learning the skills, knowledge and concepts of ICT) (Hadjerrouit 2009). Yet this clear statement hides the complexity that not only concerns whether IT is a tool or a subject but also what is included within the subject of ICT (Hadjerrouit 2009).

The recent move has been to introduce Computing and highlight the significance and importance of computational thinking, both within and beyond the subject (Computing at School Working Group 2012, Wing 2006). The new curriculum also draws on computer science's foundational principles, ideas and concepts; recognising the key concepts and processes that students should master and identifying that they should be able to demonstrate their mastery through programming (Department for Education 2013). Despite this it is not universally agreed that this is appropriate; the argument that it is necessary for the understanding of how computers work is countered by the fact that it is a difficult subject to master; computational thinking and programming call on higher order thinking skills from the outset and hence, some fear, may prove too challenging to some students (Hadjerrouit 2009). Individual ICT teachers will feel differently about each of these issues, as well as others, and their actions when implementing any curriculum change will be significantly influenced by these

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

beliefs. By considering ICT teachers' beliefs on the nature of IT education we can start to unpick this complex relationship as "... the investigation of teacher beliefs helps to bridge the connection between teachers' thoughts about teaching and their classroom behaviour" (Hobbs 2011, 156).

Pajares (1992) identified beliefs as being the best indicator of the decisions individuals make throughout their lives and stated that they determine the energy and commitment individuals will expend on any task. Beliefs influence what we think, what we know and what we do (Pajares 1992). Teachers have beliefs relating to the nature of education (Day, Stobart, Sammons & Kington 2006), what should be taught (Hennessey, Ruthven & Brindley 2005), how to teach (Santoli 2009, Lortie 2002) and how students learn (Hammond 2011). They have power over where teachers teach (Day & Gu 2007), what they consider they should teach, and hence, what they do teach and how they teach it (Song 2011, Poletini 2000, Lortie 2002), how they establish how well they have taught (Brinkerhoff 2006), or their students have learnt (Morgan & Hansen 2008, Song 2011, Lortie 2002). Beliefs have far-reaching consequences on teachers' interactions with the organisations they teach in (Poletini 2000, Lortie 2002), their pedagogical choices (Dix 2012) and their day to day classroom activities (Sammons, Day, Kington, Gu, Stobart & Smees 2007, Lortie 2002, Kordaki 2013). Considered in this way it is no wonder that individual teachers' beliefs are identified as a significant influence on school change (Fullan 1993, Scott 1999, Lortie 2002). From a teacher's perspective perhaps one of the most consistent and significant areas of change is that of the curriculum and it has been established that teachers' beliefs have a significant impact in the way curricula are developed and implemented (Day & Gu 2007, Day, Kington, Stobart & Sammons 2006, Gu & Day 2007, Lortie 2002, Dix 2012).

In an attempt to articulate a coherent construct Pajares (1992) identified sixteen fundamental assumptions about beliefs. The first of these assumptions are that beliefs are based on earlier life experiences, are acquired through a process of cultural transmission and do not tend to change over time (Pajares 1992). From this it can be seen how fundamental individual teachers' life stories are in considering belief formation. A further assumption is that the earlier a belief is formed the harder it is to change (Pajares 1992). The fact that beliefs which are acquired early in life are harder to change is particularly significant for teachers.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

Lortie's (2002) work on the 'apprenticeship of observation' highlights the fact that teachers acquire their beliefs on what teaching is when they are pupils themselves and as these beliefs are formed in childhood they will be particularly constant.

Lortie (2002) states that through their many years as pupils in classrooms individuals have undergone an 'apprenticeship of observation' and, during this acquired very strong beliefs as to what teaching is. Students enter teacher preparation courses with such beliefs and during the course they gain awareness of the fact that they are based on incomplete knowledge and non-expert observations. Yet, their view of what made good or bad teaching does not alter in the light of expert input from tutors on their teacher preparation course. They still judge their past educational experiences as good or bad as viewed through their 'pupil', rather than their 'teacher', eyes (Lortie 2002) - such beliefs, formed in childhood, prove particularly constant (Pajares 1992). This 'apprenticeship of observation' establishes beliefs as to what should be taught and how teachers should teach, once more based on the observations made as pupils (Lortie 2002). Previous research has presented evidence that a teacher's beliefs regarding what makes effective education are based on their own experiences in classrooms and that their beliefs of what makes a good teacher are based on their recollections of teachers they had (Morgan & Hansen 2008, Lortie 2002, Jegede 2009). In fact this appears to be a significant driver in why many selected teaching as a career (Santoli 2009, Khoh, Ling, Ch'ng & Chuan 2013). However, previous careers experience may also be significant in developing teachers' beliefs (Robson 2002) as they can be influenced both by IT training engaged in whilst working and by observations of the current and required skills levels within the workforce at their place of work.

Although research on ICT teachers' beliefs is sparse, evidence of the reality that teachers' beliefs act as a significant barrier or facilitator to change is widely appreciated and the relevance of this to teachers' adoption of ICT in their teaching has been highlighted in a number of studies (Mumtaz 2000, Hennessey, Ruthven & Brindley 2005, Cox, Preston & Cox 1999, Brinkerhoff 2006). Cox, Preston & Cox (1999) highlight how the issues identified in Davis, Bagozzi and Warshaw's (1989) Technology Acceptance Model are clearly identified by teachers engaged in integrating ICT into their teaching. The model recognises

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

that individuals' beliefs might be considered more significant than any external drivers in the take-up of ICT. An interesting issue identified by studies regards teachers' perceived skill levels for teaching with ICT. Research has highlighted that lack of skills in using ICT is not the primary concern, but a lack of pedagogical content knowledge skills (Moseley et al., 1999). This issue has been highlighted in a variety of subjects (Morgan & Hansen 2008, Dix 2012, Mumtaz 2000) and could be particularly significant for ICT teachers due to the lack of agreement on what IT is and hence how it is best taught (Hadjerrouit 2009).

It has been recognised that teachers' perceptions of their professional identity also affect their ability and willingness to cope with educational change and to implement innovations in their own teaching practice (Computing at School Working Group 2012, Day 2002, Ni & Guzdial 2012). In order to form their teacher identity, teachers draw on a variety of knowledge, including knowledge of affect, teaching, human relations, subject matter and their own beliefs. Recognition of this highlights teachers' beliefs, and the biographies that determine them, as major constituents of teachers' professional identity formation (Beijaard, Meijer & Verloop 2004, Flores & Day 2006, Lasky 2005). Researchers have found that such beliefs begin with the student teachers' personalities and are further shaped by their biographies (Beijaard, Meijer & Verloop 2004, Day, Kington, Stobart & Sammons 2006).

The concept of teachers' professional identity was relatively unrecognised twenty years ago and even in 2004 it was still identified largely as an emergent field (Beijaard, Meijer & Verloop 2004). The concept of teacher identity is problematic in itself due to different (or omitted) meanings in the literature; however, the various meanings that are apparent share the idea that identity is not a fixed attribute of a person but an ongoing process (Day, Kington, Stobart & Sammons 2006, Flores & Day 2006, Hong 2010, Lasky 2005, Thomas & Beauchamp 2011). This process requires the individual to engage in reflective processes that involve interpreting oneself within a specific context (Beijaard, Meijer & Verloop 2004). As such a teacher's personal and professional identity not only changes and develops throughout their life but also from school to school and classroom to classroom. Hence the importance of the context (often referred to as the landscape) on shaping professional identity cannot be overlooked (Day, Kington, Stobart & Sammons 2006).

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

Initial work on teacher identity proposed that teachers derived their professional identity from the ways they see themselves as subject matter experts, pedagogical experts, and didactical experts. These are related to the professional, rather than personal, aspect of teacher identity and illustrate how teacher identity relates to the teaching profession (Beijaard, Verloop & Vermunt 2000). However, as the field became more established the importance of the teachers' personal conceptions of themselves, their roles and their reflections on these came to be recognised as equally significant (Beijaard, Meijer & Verloop 2004). Researchers also became increasingly aware of the considerable impact of emotion on teacher identity (Veen & Lasky 2005, Lasky 2005, Timostsuk & Ugaste 2010, Shapiro 2010, Reio 2005). They also began to become aware of the important role other people, the teacher's landscape and society in general played in teacher identity formation (Beijaard, Meijer & Verloop 2004, Day, Stobart, Sammons & Kington 2006, Timostsuk & Ugaste 2010, Day, Elliott & Kington 2005). Some researchers went on to argue that the personal and social reflective nature of teacher identity formation meant individual teachers use their interpretations of events and social interactions as a way of forming and confirming their teacher identity and, hence, an individual teacher's identity is discursive (Beijaard, Meijer & Verloop 2004). This post-structuralist view claims that teachers' identities are essentially unstable and can be affected at any time by a change in their personal circumstances or their working environments (Day, Kington, Stobart & Sammons 2006). As such trying to identify, let alone classify, any similarities in teachers' identities by age, amount of time teaching, educational stage taught, subject or any generalised sociological context is meaningless (Day, Kington, Stobart & Sammons 2006). These post-structuralist views added weight to the argument supporting using qualitative methods to elicit teachers' individual stories in order to uncover their teacher beliefs (Hobbs 2011). However, they have not proved definitive enough to cease researchers enquiring into how individual teachers' experiences can lead to common and shared beliefs, behaviours (Santoli 2009) and responses to curriculum change (Dix 2012, Morgan & Hansen 2008, Song 2011).

More recent research suggests that teacher identity has two distinct aspects: the professional and the personal. The professional aspect reflects what teachers believe to be important to the profession and their subject whereas the personal

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

aspect reflects what they desire and consider to be important. It has been suggested that the professional self has five interwoven parts: self-image, self-esteem, job-motivation, task perception and future perspectives; and if teachers see changes as opposed to their view in one or more of these parts they will find it difficult to adopt and adapt to them (Day 2002). It is also proposed that teachers experience discomfort when the two aspects of teacher identity come into conflict (Beijaard, Meijer & Verloop 2004). It has further been proposed that teachers experience tension between the rational models and constructions of knowledge they use to help form their professional identity and their personal knowledge of children, including their own childhood experiences (Day, Kington, Stobart & Sammons 2006). Some have suggested that teacher identity is even more multifaceted (Day, Kington, Stobart & Sammons 2006), specifying that it consists of many sub-identities that may conflict or align with each other (Beijaard, Meijer & Verloop 2004). Other researchers have noted that teachers can take on different identities, depending upon the social setting. This variety of selves is not problematic for teachers but the relationship between them can be; if all a teacher's selves cannot be accommodated harmoniously they will experience significant emotional and/or psychological discomfort (Beijaard, Meijer & Verloop 2004).

Despite the difficulties noted earlier much scholarship on teacher identity has tried to identify the characteristics of teacher identity (Beijaard, Meijer & Verloop 2004). This research has been successful in identifying some common characteristics (Day, Stobart, Sammons & Kington 2006, Day 2002, Lasky 2005, Day, Kington, Stobart & Sammons 2006) though others have argued that teacher identity is not something teachers have, but something they use in order to make sense of themselves as teachers and the context in which they teach (Beijaard, Meijer & Verloop 2004, Flores & Day 2006).

1.2 The nature of this thesis

This cross-sectional research is intended to provide an understanding of the role of respondents' beliefs as barriers to, or facilitators of, ongoing curriculum change within a specific disciplinary and institutional context. Its objective is to elicit the individual's subjective experience and views regarding ICT teaching and the

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

curriculum and identify how previous educational and career experiences contributed to their development and how they affect how the individual teacher negotiates curriculum change. It is widely recognised that the fact beliefs are complex and difficult to define mean individual teachers find it hard to articulate, or even identify, their beliefs (Mumtaz 2000, Pajares 1992, Morgan & Hansen 2008). Employing qualitative methods are best suited for understanding such complex phenomena due to their purposes, approach and different researcher roles (Brown, Stevens, Troiano & Schneider 2002). Grounded theory is particularly appropriate to this research as it “is useful in providing rigorous insight into areas that are relatively unknown” (Jones & Alony 2011, 96) and, as has been noted previously, teachers’ beliefs in general and ICT teachers’ beliefs in particular are just such areas. This method will provide a “detailed, rigorous and systematic method of analysis [whilst] reserving the need for the researcher to conceive preliminary hypothesis” (Jones & Alony 2011, 96).

1.3 Guiding aim, objectives and questions

This research aims to investigate the experience of existing ICT teachers and in particular to inquire into how teachers’ beliefs are formed and how they influence said teachers’ reaction and responses to significant curriculum change. Its purposes are to:

1. gain an understanding of existing ICT teachers’ beliefs regarding the ICT curriculum prior to and during a time of significant change;
2. understand how such beliefs regarding the curriculum are formed through teachers’ past experiences;
3. consider how these beliefs are impacting on how the teachers are negotiating the curriculum change.

There are three associated objectives.

1. To examine the nature of existing ICT teachers’ beliefs regarding the previous ICT curriculum and the recent change.
2. To study how these teachers’ biographies helped establish their beliefs regarding the ICT curriculum and the change.

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

3. To observe how these beliefs have impacted on teachers' reaction and responses to the change.

Four major research questions inform these purposes and objectives.

1. What are the current ICT teachers' beliefs regarding the purpose of IT education?
2. What are the current ICT teachers' beliefs regarding how effectively the changed, and preceding, curricular achieve these purposes?
3. What particular biographic events were significant in shaping these beliefs?
4. How are these beliefs influencing how the teachers prepared for and are coping with the change?

Four central conceptual areas stand behind this research.

1. Teachers' beliefs
2. Formation of teachers' beliefs, including the Apprenticeship of Observation
3. The prescribed versus the described curriculum
4. Beliefs as barriers to, or facilitators of, curriculum change

As grounded theory methodology is intended to explore, analyse and generate concepts about individuals' actions and social processes (Thornberg 2012) it makes it an appropriate choice. Grounded theory supports the development of middle-range theory (Thornberg 2012) that is grounded in data that has been systematically gathered and analysed (Strauss & Corbin 1994). Such theory "evolves during actual research, and it does this through continuous interplay between analysis and data collection" (Strauss & Corbin 1994, 373). In line with other methods of qualitative research a variety of sources of data are legitimate: interviews, field observations, documents of all kinds; as are both qualitative and quantitative data and analysis techniques (Strauss & Corbin 1994). The method is particularly appropriate to the present study due to its effectiveness in generating substantive theories (Strauss & Corbin 1994) and a theory rather than the theory (Neal 2009) both of which are desirable in such an, as yet, neglected area of study.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

This grounded theory study drew on a number of sources including interviews; departmental documentation: schemes of work, lesson plans and other teaching and assessment resources; lesson observations; previous and current curriculum advice from the English Department for Education and other relevant bodies and organisations.

Figure 1 is a diagrammatic representation of how the research questions addressed the study's objectives and purposes. Figure 2 is a diagrammatic representation of the whole study, showing the relationship between Research Purposes, Research Objectives, the Research Questions, the Conceptual Content and Data Collection.

1 Introduction

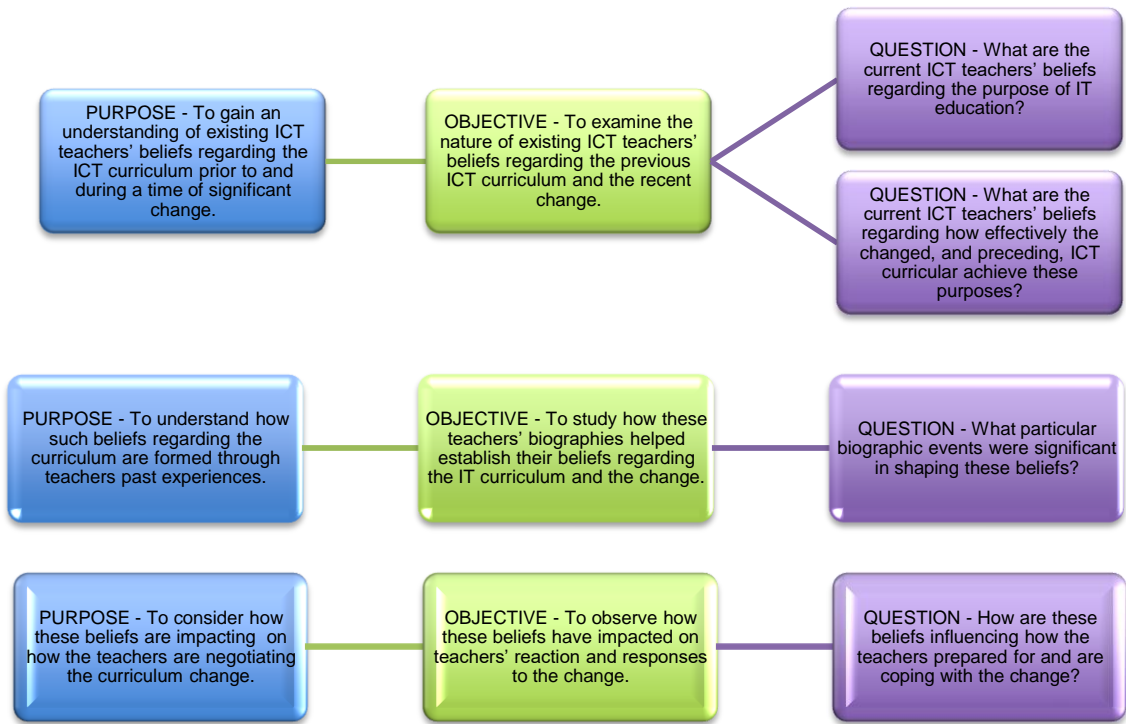


Figure 1 - Representation of how the research questions address the study's purposes

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

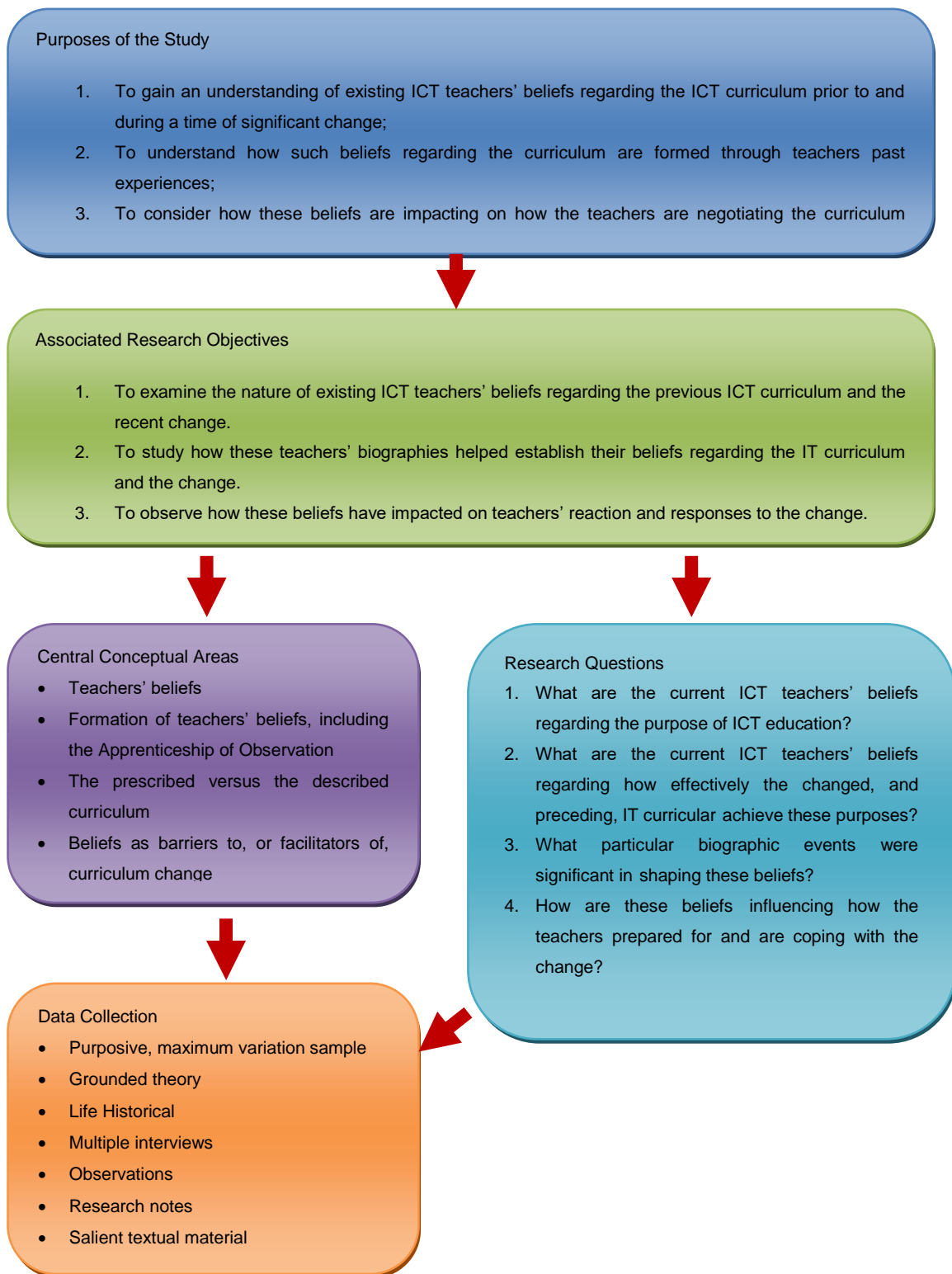


Figure 2 - Representation of the whole study, showing the relationship between research purposes, research objectives, the research questions, the conceptual content and data collection

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1.4 Research outline

1.4.1 Selection of participants

The ICT department in which the researcher teaches provided the setting for this study. It was a suitable site for the study as it was staffed by experienced teachers with a variety of backgrounds, both educationally and career wise. As such it reflects the makeup of many secondary school ICT departments who are staffed by a mixture of both specialist and non-specialist ICT teachers. The researcher had access to participants and was in a position to observe how the curriculum change was implemented. However, issues of 'insider research' were clearly significant and formed a major element of methodological considerations, as did issues of ethics and disclosure. As a result of the context of the research, permission to approach the participants was granted from the management at the school, in addition to Ethical Approval from the researcher's doctoral department at Durham University.

The participants made up the body of a teaching department who were solely responsible for the delivery of discrete ICT lessons within an 11 to 18 school. The sample could be considered a convenience sample - selected because it was the department the researcher taught in and hence readily available with few, if any, access issues. In this case, against the norm, a convenience sample was not the most undesirable sampling method (Mertens 2010) since the department contained staff members illustrating a wide range of the dimensions of interest it was a purposive sample (Coe 2012). The school was a state maintained 11 - 18 comprehensive school in the North of England. ICT was taught at all key stages as a discrete subject with all courses coming under the jurisdiction of the Business Department. The department consisted of nine staff members each of whom was responsible for delivery of ICT, though they were not all involved on all ICT courses. All nine staff members were involved in the research.

Various factors meant these participants were suitable subjects of such a study. The fact that the department contained staff members illustrating a wide range of the dimensions of interest: past study of ICT and Computing; different teaching qualifications; and various pre-teaching careers; means it reflected maximum variation sampling and hence was suitable for a grounded theory approach

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

(Brown, Stevens, Troiano & Schneider 2002). The department was in the process of implementing schemes of work to reflect the curriculum change and as such could be considered a representative case (Bryman 2008). Additionally, as this study was investigative and not looking to make claims that could be generalised there was less of a need to ensure it reflected the make-up of the general ICT teacher population.

The fact that beliefs are complex and difficult to define leads to the reality that it is not always possible for individuals to be able to articulate, or even identify, their beliefs (Mumtaz 2000, Pajares 1992, Morgan & Hansen 2008). This means a semi-structured in-depth interview, offering opportunities for clarification, prompts and probes, was most appropriate (Mertens 2010, Mears 2012). Interviews are recognised as being a relevant tool when trying to understand someone's impressions, understanding and experiences (Mertens 2010, Mears 2012), and many existing papers on teachers' beliefs have used this method to collect information (Hammond 2011, Song 2011, Dix 2012, Robinson & McMillan 2006). Interviews have been particularly prevalent in research that considers teachers' past experiences, biographies and beliefs such as the research proposed (Morgan & Hansen 2008, Poletini 2000, Dix 2012, Hammond 2004). The desire to follow up on significant issues, return to conversations to check understanding, review respondents' responses to the change and adopt a constant comparison thematic analysis of interview data meant it proved necessary to carry out follow up interviews with respondents to clarify points (Thornberg 2012, Mears, In-Depth Interviews 2012). As teachers' beliefs are influenced by the curriculum they deliver and resources they use (Lortie, 2002; Poletini, 2000) it also proved necessary to refer to schemes of work, lesson plans and other teaching and assessment resources (Ashley 2012). Teachers' behaviour can present evidence of their beliefs (Hobbs 2011) so field notes of observations in department meetings and other departmental situations and teachers' reflections on how the curriculum change is progressing were also a source of data. These resources helped to provide a fuller picture of what was happening (Bryman 2008) and act as triangulation (Coe 2012) ensuring the trustworthiness and reliability of the data (Brown, Stevens, Troiano & Schneider 2002). This was further assured by the use of member checks and debriefs which took place throughout the data collection and analysis processes.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

The fact the researcher is a long-standing member of the department with some management responsibilities that reach across areas of the department may impact on the plausibility of any interpretation. This could lead to respondents feeling a power disparity that could make them reluctant to respond openly (Mears 2012). Additionally, all the department members are aware of the researcher's enthusiasm for the change which may also influence their responses making them either voice concerns more strongly as they feel the views need counter balancing or be reluctant to share concerns for fear of conflict introducing issues with inference validity (Coe 2012). Hence the researcher took every opportunity to assure respondents of their neutrality and desire to collect a true picture of their views at every stage of the process at each contact with the respondents.

1.4.2 Data analysis

As is customary in grounded theory data was collected and analysed in tandem (Bryman 2008) using the iterative approach of constant comparison. As data was collected it was initially coded to identify concepts and categories pertinent to ICT teachers' curriculum beliefs, the formation of these beliefs and their impact on the teachers' responses to the curriculum change. In this study this initial coding took place on the original interviews of existing ICT teachers. Transcripts were typed up from digital recordings of the interview and then analysed line by line. This stage is sometimes referred to as open coding (Thornberg 2012). This analytic process was also used to identify further data requirements; in terms of the focus for the data required, the questions asked, sources to be used - theoretical sampling (Thornberg 2012) and further reading. As the coding progressed new questions were introduced to interview schedules and alternate sources of information such as documents and follow up interviews were introduced.

Memo writing was used throughout the initial (open) coding, and subsequent stages, to aid in the generation of concepts, and categories as coding progressed. Such memos served as reminders for common terms being used and also, perhaps more significantly, as a support for reflection on both the process, and the emergent categories, relationships and hypotheses. These memos will included both text and diagrams and they altered in nature as the

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

study evolved. At the outset they may have been short; less conceptualised and full of analytical questions and hunches, however, as research progressed they became longer, more conceptualised and more akin to written findings (Thornberg 2012), diagrams were also more prevalent in these later stages. In this way memos will be used to crystallize ideas and keep track of thinking (Bryman 2008).

The initial (open) coding was used to ask analytical questions of the data and helped to “search for and identify what is happening in the data” (Thornberg 2012, 87). During this phase the data was analysed critically and analytically. The codes that emerged in this phase were drawn from the data by the researcher and as such reflected both the experiences of the participants and the researcher (Bryman 2008). The researcher’s role as an existing ICT teacher within the department under study meant they had to deal with, and address, issues impacting on participant research (Silverman 2010). At this, and every phase of the study, account was taken of their own past experiences and pre-existing ideas on the areas under study and also how the study, and their involvement in it, might influence the participants, both in terms of their formal interview responses and their actions in responding to the curriculum change.

The initial coding proceeded, comparing “data with data, data with code, and code with code to find similarities and differences ... in turn [leading] to the sorting and clustering of initial codes into new more elaborated codes” (Thornberg 2012, 87). The data collection and coding became more focused and, by this method of constant comparison, allowed the identification of a set of focused codes, that highlighted the most significant and related concepts. Categories were developed and then saturated in order to explore the relationships between ICT teachers’ beliefs, their formation and their impact on curriculum change. Finally the theoretical coding phase continued the iterative process in order to develop and test a hypothesis about the connections and hence develop a substantive theory (Bryman 2008) on how ICT teachers’ beliefs were formed and how these influence their reaction and responses to significant curriculum change. During all the coding phases data was closely examined to identify, include and integrate deviant cases in order to increase the validity of the research (Silverman 2010). In reality the demarcation between the three phases was apparent within this study due to its limited nature, both in scope, expertise and time.

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1.5 Substantial and original contribution to knowledge

At a time of curriculum shift it is important to consider factors that may impede or encourage adoption of new ideas; teachers' beliefs and identities are widely recognised as such factors (Fullan 1993, Cox, Preston & Cox 1999, Hennessey, Ruthven & Brindley 2005, Brinkerhoff 2006, Day 2002, Beijaard, Verloop & Vermunt 2000, Beijaard, Meijer & Verloop 2004, Ni & Guzdial 2012). Teachers' perceptions regarding their education, their subject and their identity strongly influence their judgments (Beijaard, Verloop & Vermunt 2000) and, therefore, research on how teachers perceive themselves, i.e. their professional identity, is important when discussing responses to significant curricula change. Drawing on knowledge of teachers' professional identity may be useful in helping teachers cope with educational changes hence smoothing the introduction of educational interventions and other changes (Beijaard, Meijer & Verloop 2004). In order to establish how strongly held, and influential, such beliefs may be it is important to establish how and when they were formed and how interconnected to individual's belief systems they are (Nespor 1987, Pajares 1992). It will also be useful to consider how teachers' beliefs regarding the risk involved in, and benefits available from pedagogical changes lead them to carry out conscious and unconscious risk assessments leading them to adopt or reject such proposed changes (Howard 2013). Within secondary ICT education curriculum shift is upon us and hence it is an appropriate time to examine ICT teachers' beliefs and how they were formed so that their impact on the implementation of the new curriculum can be considered and incorporated.

Work on teachers' beliefs in general is far from comprehensive and exhaustive, this is despite Pajares (1992) clear identification that teachers' beliefs were an area in need of further study; and research specifically on ICT teachers' beliefs is even more neglected. It is recognised that research on ICT as a school subject is an area that lacks research (Hadjerrouit 2009), despite there being plenty of literature available on ICT use within education. A key words search for "ICT teachers' beliefs" in the topic or title fields of any academic citation index returns only material relating to teachers' beliefs regarding using ICT in their teaching of other subjects. This demonstrates just how sparse (or possibly non-existent) work specifically on ICT teachers' beliefs is. It is hoped that this study will contribute some understanding to these neglected fields

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

This research aimed to investigate the experience of existing ICT teachers; in particular, to inquire into how such teachers' beliefs are formed and how they influence said teachers' reaction and responses to significant curriculum change. The literature used in support of this study addressed a number of areas including the construct of teachers' beliefs and the formation and impact on teacher behaviour of teachers' beliefs. Previous research on teachers' beliefs was considered to examine how they impact on attempts to change teachers' practice. Research was also interrogated to establish if there are features that make ICT teachers unique, and the potential impact of this on their beliefs. The research utilised grounded theory practice based on the data collected in individual reflective interviews, from teachers' CVs and field notes from observation. Themes that emerge from analysis of this data were compared to literature, including existing research and curricula and programmes of study in order to generate concepts and categories that were further analysed and interrogated to generate a substantive grounded theory.

The research aimed to address conceptual gaps by taking a novel approach that was original in both its emphasis and context. It asked existing ICT teachers to explain their beliefs regarding IT education and reflect on how their route to ICT teaching, including their own schooling, higher education and previous employment, influenced the formation of these beliefs. They were asked to articulate their beliefs regarding the role and purposes of IT education and the significance and impact of the curriculum change that was in process. The research then examined how they responded, prepared for and began to teach the new Computing curriculum and attempted to understand how the existing beliefs of these teachers influenced their actions. The grounded theory that emerged from this study attempts to articulate the relationships between teachers' beliefs regarding the role of IT education and their implementation of the new curriculum

Teachers' beliefs have an impact on curriculum change and its effectiveness and a significant curriculum change in ICT at schools is taking place at present. However, there is:

1. a limited amount of research on how teachers' beliefs are formed;

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

2. scarce research on how teachers' beliefs act as barriers to, or facilitators of, curriculum change;
3. very little research on ICT teachers' beliefs in general;
4. no research on ICT teachers' biographies.

This study makes several substantial and original contributions to knowledge.

1. It adds substantive theory in an area where limited theory presently exists.
2. The study provides a unique insight into how existing ICT teachers' beliefs were formed.
3. The theory leads to an understanding and explanation of the way that teachers' beliefs can influence the effectiveness of curriculum change.
4. The theory is relevant to the introduction of change at a time of radical curriculum transformation within ICT.

1.6 Definition of terms

For the purposes of this study the definition of 'ICT teacher' is any person involved in delivering examined, or non-examined, ICT courses prior to and during the introduction of the new curriculum. The terms 'information communication technology' and 'ICT' will be used to refer to "the purposeful application of computer systems to solve real-world problems, including issues such as the identification of business needs, the specification and installation of hardware and software, and the evaluation of usability... the productive, creative and explorative use of technology" (Computing at School Working Group 2012, 5). The term 'computer science' refers to the "discipline that seeks to understand and explore the world around us, both natural and artificial, in computational terms. Computer science is particularly, but by no means exclusively, concerned with the study, design, and implementation of computer systems, and understanding the principles underlying these designs" (Computing at School Working Group 2012, 5). The term 'Computing' will be used to refer to the new school subject that is made up of computer science, ICT and digital literacy. The term 'information technology' or 'IT' is used in its common industry use to

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

1 Introduction

describe the broader discipline that encompasses the creative and productive application of digital technology including computer science. However, these terms may be used differently in the literature and by the research participants so need to be interpreted with care.

1.7 Organisation of this thesis

This thesis is organized into six chapters. Chapter One presents an introduction and background of the problem as well as an overview of the purposes, research questions, methodological details and the contribution this study makes. Chapter Two contains a review of the literature concerning the major conceptual and theoretical frameworks. Four threads of research are examined: teachers' beliefs; the formation of teachers' beliefs, including the apprenticeship of observation; the prescribed versus the described curriculum; and beliefs as barriers to, or facilitators of, curriculum change. Chapter Three contains a description of the qualitative research undertaken, justifying the grounded theory methodology and biographical approaches employed. In addition, the chapter discusses the procedures and methods of collecting and analysing the data. Chapter Four includes the findings in the shape of an examination of the participants' beliefs regarding the purpose of IT education and the existing and new curricula, how such beliefs were influenced by participants' biographies and impact their responses to the curriculum change as well as accompanying textual and other salient findings. Chapter Five contains a discussion of the findings aligned with the three core concepts that emerged from the research process: the participants' enacted support of the new curriculum; the participants' stated support of the new curriculum; and the participants' perceptions regarding the personal impact of the change, and how these are located within the original conceptual threads of the field of literature. Chapter Six acts as a conclusion and includes reflections on the research process including recommendations for improvement, a discussion of the work's original contribution to professional knowledge as well as suggestions for further work in the field.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

2.1 Literature overview

For three decades English education has been increasingly prescribed by central government with the National Curriculum specifying the curriculum content delivered in schools. Within the National Curriculum, and in addition to it, many policies, expectations and interventions have been introduced. Yet the way these have been enacted in individual schools and classrooms varies vastly from one to the next and often from the original guidance given. The reasons for this are numerous and complex but within the classroom one of the most significant is how the policy intersects with teachers' beliefs and identities. The recent change from ICT to Computing is one of the biggest changes to the National Curriculum in two decades and as such will impact across the board. The severity and longevity of this impact will depend on how the change is put into practice by individual teachers at individual schools and this, in turn, will depend on said individual teacher's beliefs and identities.

Teachers' beliefs have an impact on curriculum change and its effectiveness and a momentous curriculum change in IT at schools is taking place at present. This thesis will follow a grounded theory methodology to study how existing ICT teachers' curriculum beliefs are established and the impact of these beliefs on the implementation of the new curriculum. This approach is necessary as there is:

1. a limited amount of research on how IT teachers' beliefs are formed;
2. scarce research on how teachers' beliefs act as barriers to, or facilitators of, curriculum change in the disciplines of IT and Computing;
3. very little research on ICT teachers' beliefs in general;
4. no research on ICT teachers' biographies.

Furthermore, there is no existing research, let alone theory, on how ICT teachers' beliefs and identities have been affected by their unique teacher biographies and

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

life histories. It is essential that these omissions are addressed and with some urgency as the new Computing curriculum calls upon a seismic shift in the way ICT teachers conceive and think about their subject.

Though not tied to a specific framework, a number of frameworks and concepts will be drawn upon during the completion of this thesis. The most significant of these being the effect of teachers' beliefs and teachers' identities on adoption of new teaching practices and the role of teachers' biographies in forming their teacher beliefs and teacher identity. It will also consider the ways in which ICT teachers' biographies differ from those of teachers of other subjects and the effect this has on their teachers' beliefs and identities and examine the history, development and contents of the new Computing curriculum.

This review of literature is based on a selection of articles, books, reports and other publications. Initial literature sources were identified through performing searches on ICT teacher beliefs on academic databases; relevant papers that were identified in this way then highlighted further sources through their references. This search strategy generated literature on the following general criteria: (1) research that examined teachers' beliefs and identities and the impact of these on attempts to change teachers' behaviour, including the introduction of prescriptive educational interventions; (2) research that examined the role teachers' biographies play in the formation of teachers' beliefs and identities; (3) research that suggests ICT teachers' biographies are different from other teachers; (4) reports that identify and outline the context of and background to the Computing curriculum change.

The focus of this thesis is to investigate the experience of existing ICT teachers and in particular to inquire into how such teachers' beliefs are formed and how they influence said teachers' reaction and responses to significant curriculum change. It will achieve this by answering questions regarding current ICT teachers' beliefs concerning the purpose of IT education and the IT curriculum, significant biographic events involved in shaping these beliefs and the influence of these beliefs on the teacher's preparation for and responses to the change. To be able to answer such questions, it is important to fully understand the role teachers' beliefs play in their responses to required changes in their teaching behaviour that is the purpose of the first section of this chapter.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2.2 Teachers' beliefs and change – The role of teachers' beliefs and teachers' identities in changing teachers' behaviour

2.2.1 Teacher beliefs and teacher identity – Principles and features

The concept of beliefs originated in psychology and has always been beset by difficulties regarding both a clear definition and the fact that many terms are used, almost interchangeably when discussing beliefs (Pajares 1992). It is generally appreciated that beliefs and knowledge are different (Nespor 1987, Pajares 1992) though the distinction is hard to make. This is further complicated by the fact that beliefs influence knowledge (Nespor 1987) and, in theory, that knowledge can influence beliefs (Pajares 1992); though research would suggest that this is not usually the case in practice (Morgan & Hansen 2008, Hennessey, Ruthven & Brindley 2005, Cox, Preston & Cox 1999, Nespor 1987, Pajares 1992).

Nespor (1987) identified six features of beliefs that helped distinguish them from knowledge: existential presumption, alternativity, affective and evaluative loading and episodic structure; and identify how they were organised as a system: non-consensuality and unboundedness. Pajares (1992) extended this work by identifying sixteen fundamental assumptions about beliefs. These assumptions were proffered to try and establish the “inferences and generalizations [that] can be made with reasonable confidence” (Pajares 1992, 324). They attempt to present beliefs as a coherent construct and hence aid further work in the field. In these assumptions Pajares (1992) identified that the beliefs held by an individual combine to create their belief system and that individuals use this to help them make sense of the world and their interactions with it - acting as a filter through which individuals interpret new things. In this way beliefs help determine how individuals define and select tasks and play a crucial role in an individual's behaviour and knowledge acquisition. Yet despite their substantial influence, beliefs are inferred, and very rarely explicitly examined (Pajares 1992).

Pajares (1992) identifies beliefs as being the best indicator of the decisions individuals make throughout their lives and states that they determine the energy and commitment individuals will expend on any task. Beliefs influence what we think, what we know and what we do (Pajares 1992). Nespor (1987) states that

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

beliefs are particularly significant in making sense of teachers' worlds as the contexts and environments within which teachers work, and many of the problems they encounter, are ill-defined and deeply entangled and when people encounter such domains or problems many standard cognitive processing strategies are no longer viable (Nespor 1987).

Teachers have beliefs relating to the nature of education (Day, Kington, Stobart & Sammons 2006), what should be taught (Hennessey, Ruthven & Brindley 2005), how to teach (Santoli 2009, Lortie 2002) and how students learn (Hammond 2011). They have power over where teachers teach (Day & Gu 2007), what they consider they should teach, and hence, what they do teach and how they teach it (Song 2011, Poletini 2000, Lortie 2002), how they establish how well they have taught (Brinkerhoff 2006), or their students have learnt (Morgan & Hansen 2008, Song 2011, Lortie 2002). Beliefs have overreaching consequences on teachers' interactions with the organisations they teach in (Poletini 2000, Lortie 2002), their pedagogical choices (Dix 2012) and their day-to-day classroom activities (Sammons, Day, Kington, Gu, Stobart & Smees 2007, Lortie 2002, Kordaki 2013). Considered in this way it is no wonder that individual teachers' beliefs are identified as a significant influence on school change (Fullan 1993, Scott 1999, Lortie 2002). From a teacher's perspective perhaps one of the most consistent and significant areas of school change is that of the curriculum and it has been established that teachers' beliefs have a significant impact in the way curricula are developed and implemented (Day & Gu 2007, Day, Kington, Stobart & Sammons 2006, Gu & Day 2007, Lortie 2002, Dix 2012).

A further aspect of teachers' beliefs that has been identified as significant in terms of curriculum reform is their teachers' orientation toward teaching and learning. It has been shown that teaching reforms are more likely to be adopted by teachers when their teachers' orientations aligned with the goals of reform (Nargund-Joshi, Rogers & Akerson 2011). Teachers' existing orientations towards teaching their subject have also been shown to influence how they implement new teaching methods (Rogers, Cross, Gresalfi, Trauth-Nare & Buck 2011). Research in this field "...suggest[s] that teachers develop and hold strong preconceptions and beliefs about teaching and learning, the subject-matter that they teach, and their roles and responsibilities in the classroom" (Talanquer, Novodvorsky & Tomanek 2010, 1390). Teachers' orientations shape what they

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

implicitly conceive as the purposes and goals for teaching their subject at a particular grade level, and serve as a conceptual map that guides their teaching behaviour, both in and outside of the classroom (Talanquer, Novodvorsky & Tomanek 2010). Such general views about the purposes of teaching and learning a specific subject are considered a central component of a teacher's pedagogical content knowledge (PCK). A teacher's orientation toward teaching a subject goes beyond general pedagogical strategies to consideration of the best approaches for teaching specific content and requires teachers to draw from both their personal views about the goals for learning the subject and their knowledge for teaching in their discipline. Hence, orientations, like all beliefs, act as screens colouring how teachers view each of these issues and so develop their overall knowledge for teaching their subject (Nargund-Joshi, Rogers & Akerson 2011, Rogers, Cross, Gresalfi, Trauth-Nare & Buck 2011). The relationship between teachers' beliefs, orientations and knowledge can be seen in Figure 3. Teachers' actions are the result of both their knowledge and beliefs. Research has shown that beliefs have more significance due to the fact that they colour teachers' interpretation of both the events they are responding to and the knowledge they are using to make sense of the situation.

The foundations of teachers' orientations were laid down by the work of Lee Shuman in his work on pedagogical content knowledge (PCK). In his writings he proposed that teacher expertise didn't only need content (subject) knowledge and pedagogical (instructional methods) knowledge but a third linking component of pedagogical content knowledge (Friedrichsen, Van Driel & Abell 2011). Pedagogical content knowledge allows teachers to identify the best way to teach a specific subject topic to a specific group of their students (Ramnarain & Schuster 2014). It is a type of knowledge that is unique to teachers (Cochran 1997) and integrates teachers' subject knowledge (the knowledge of the specific topic they need to teach) and their pedagogical knowledge (the methods they have in their teaching repertoire).

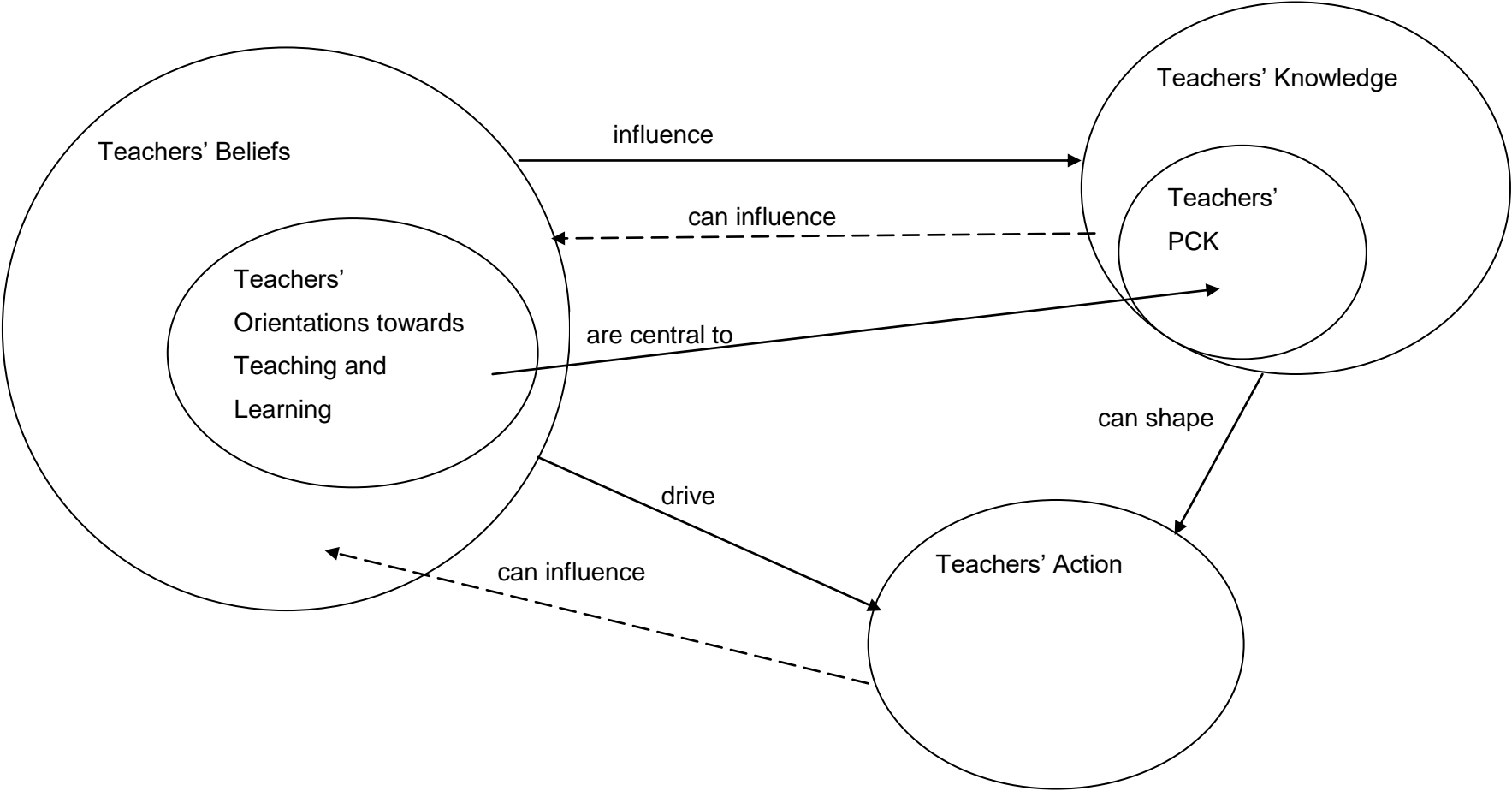


Figure 3 – The Relationship between Teachers' Beliefs, Orientations and Knowledge

2 Literature Review

Teacher orientations grew from the work of Pamela Grossman, a student of Shulman's who had worked with him as he developed the concept of PCK. Grossman identified conceptions of purposes for teaching English and English subject matter in her 1990 book *The Making of a Teacher: Teacher Knowledge and Teacher Education* (Talanquer, Novodvorsky & Tomanek 2010). She defined these conceptions as including knowledge and beliefs about the purposes for teaching English at different grade levels and specified that they were reflected in teachers' goals (normally multiple) (Friedrichsen, Van Driel & Abell 2011) for teaching particular English subject matter (Ramnarain & Schuster 2014). In her book Grossman also identified conceptions of what it means to teach English which included teachers' beliefs regarding the principal purpose of studying English, goals for students and the nature of English at the particular educational stage they taught at (Friedrichsen, Van Driel & Abell 2011).

During the same period Anderson and Smith introduced the term teachers' orientation in their 1984 research on fifth grade science teachers (Friedrichsen, Van Driel & Abell 2011). Anderson and Smith defined teachers' orientations as the general patterns of thought and behaviour related to teaching and learning a specific subject. This definition reflected Grossman's conceptions of the purposes for teaching a specific subject and also recognised the importance of combining teachers' understanding and behaviour (Friedrichsen, Van Driel & Abell 2011). The definition of teachers' orientations was further refined by Magnusson et al. in 1999 to integrate both sets of conceptions identified by Grossman. Their definition of orientations considered the teacher's knowledge and beliefs regarding the purpose and goals for teaching a specific subject at a specific grade level identifying them as a general way of seeing or conceptualising teaching of the subject (Friedrichsen, Van Driel & Abell 2011, Talanquer, Novodvorsky & Tomanek 2010, Ramnarain & Schuster 2014). Others have defined teachers' orientations as "...general patterns of thought and behavior related to ... teaching and learning." (Nargund-Joshi, Rogers & Akerson 2011, 626); "...as a general way of viewing teaching ... [that] connects views with teachers' actions." (Nargund-Joshi, Rogers & Akerson 2011, 626); "...practice and experiences about learning..." (Opfer, Pedder & Lavicza 2011, 443); "...knowledge and beliefs about the purposes for teaching" (Rogers, Cross, Gresalfi, Trauth-Nare & Buck 2011, 894); "...general patterns of thought and

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

behaviour related to ... teaching and learning...” (Ramnarain & Schuster 2014, 630); “sets of ideas, understandings, and interpretations of experiences concerning the teaching, the nature of content of ... and the students and learning which the teacher uses in making decisions about teaching, both planning and execution.” (Ramnarain & Schuster 2014, 630).

Teachers’ orientations regarding their subject are shaped by multiple beliefs, and a belief system that contains many dimensions including beliefs about the goals or purposes of teaching the subject, the nature of the subject and teaching and learning of the subject. Profiles of teachers of a specific subject can be constructed by seeking relationships between, and patterns in these beliefs (Friedrichsen, Van Driel & Abell 2011). In this way empirical studies can be carried out to establish which distinctive different teaching orientations exist in practice within a subject area (Friedrichsen, Van Driel & Abell 2011). Hence, teachers’ orientations can provide a nuanced portrayal of teachers of a specific subject.

Despite the fact they are considered a pivotal component of teachers’ pedagogical and content knowledge, few studies have been carried out to understand practicing teachers’ orientations towards their subject (Talanquer, Novodvorsky & Tomanek 2010). Furthermore, consideration of teachers’ orientations is complicated by both the duality of the concept, i.e. they are considered both purposes and general views (Friedrichsen, Van Driel & Abell 2011, Ramnarain & Schuster 2014), both thoughts and behaviours (Nargund-Joshi, Rogers & Akerson 2011); and the lack of consistency as to a definition (Friedrichsen, Van Driel & Abell 2011). This is further compounded by the fact that the construct recognises that teachers’ knowledge and practices are shaped by multiple beliefs; including beliefs regarding the goals or purposes of teaching the specific subject, the nature of the subject, and teaching and learning of the subject (Friedrichsen, Van Driel & Abell 2011). These factors mean the construct is by its nature “messy” and difficult to unpick and examine: “A teacher’s orientation is not necessarily a rigid, static, and well-defined construct with neat boundaries, but instead a complex and fluid entity with central and peripheral components (goals, beliefs) influenced by a variety of issues, such as school context, curriculum, and student characteristics.” (Talanquer, Novodvorsky & Tomanek 2010, 1401).

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

The fact that orientations are heavily context dependent (Ramnarain & Schuster 2014) means that while aspects of teachers' orientations may remain constant over time, the influence of their context – including previous teaching experiences, career stage, teaching institution, and the pupils being taught at any given time - will determine the orientation to some extent (Opfer, Pedder & Lavicza 2011). Research has shown that, in common with other beliefs, teachers' orientations do not always align with their classroom practice (Nargund-Joshi, Rogers & Akerson 2011). A further issue is that some have suggested that instead of the detailed and sophisticated analysis of beliefs outlined above teachers' orientations are rather being used simply to label or pigeonhole teachers of specific subjects using a predetermined list of categories. (Friedrichsen, Van Driel & Abell 2011)

Teachers' beliefs are powerful concepts that significantly affect teachers' behaviour within the classroom; however, we should not overlook concerns as to how useful they can be. One such concern is Pajares statement that beliefs "... travel in disguise and often under alias..." (Pajares 1992, 309) which introduces a complexity that means this multiplicity of terms must be treated with caution (Hobbs 2011). Little evidence has been presented for the inter-changeability of these terms (Funkhouser & Mouza 2013) nor is there any discussion of whether they all hold the same weight for an individual, or between individuals. Additionally, it is recognised that belief systems include multiple psychological attributes such as attitudes, judgments, assumptions, and conceptions (Koc 2013) that further increase their complexity. The fact that teachers' beliefs are formed by their life histories (Hobbs 2011, Lortie 2002) means that no two individuals will hold the same set of beliefs – this could lead us to question the usefulness of beliefs in the study of teacher behaviour.

Teachers' beliefs are closely interwoven with their identity; teacher (professional) identity is broadly defined as being recognized as a certain kind of teacher by one's self or others (Ni & Guzdial 2012). Teachers draw on a variety of knowledge, including knowledge of affect, teaching, human relations, subject matter and their own beliefs, to form their teacher identity. As beliefs are often unarticulated they lead to different forms of teacher identity than those based on the teacher's knowledge of educational theories. A teacher's sense of identity is a key factor in their motivation, job fulfilment, commitment and efficacy (Day,

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

Stobart, Sammons & Kington 2006, Day 2002, Hong 2010). Teacher identity encapsulates a set of values, beliefs and goals that shape how teachers make sense of their teaching experiences. It thus controls the way teachers teach, the way they develop as teachers, and their attitudes toward educational changes (Ni & Guzdial 2012). It has been recognised that teachers' perceptions of their professional identity affect their ability and willingness to cope with educational change and to implement innovations in their own teaching practice (Computing at School Working Group 2012, Day 2002, Ni & Guzdial 2012). Their perceptions regarding identity strongly influence their judgments (Beijaard, Verloop & Vermunt 2000); therefore, considering research on how teachers perceive themselves, i.e. their professional identity, is important when discussing responses to significant curricula change.

It is not unusual for studies on teacher identity to define the concept quite differently, or even not define it at all (Beijaard, Meijer & Verloop 2004). This makes the concept of identity problematic in itself due to these different (or omitted) meanings in the literature. Initial work on teachers' identity proposed that teachers derive their professional identity from the ways they see themselves as subject matter experts, pedagogical experts, and didactical experts; these are related to the professional, rather than personal, aspect of teacher identity and illustrate how teacher identity relates to the teaching profession (Beijaard, Verloop and Vermunt 2000). However, as the field became more established the importance of the teacher's personal conceptions of themselves, their roles and their reflections on these came to be recognised as equally significant; teachers are more interested in who they are rather than what they know (Beijaard, Meijer & Verloop 2004). Additionally researchers became increasingly aware of the considerable impact of emotion on teacher identity (Veen & Lasky 2005, Lasky 2005, Timostsuk & Ugaste 2010, Shapiro 2010, Reio 2005). The important role other people, the teacher's landscape and society in general played in teacher identity formation also became apparent (Beijaard, Meijer & Verloop 2004, Day, Stobart, Sammons & Kington 2006, Timostsuk & Ugaste 2010, Day, Elliott & Kington 2005).

Teachers' identity has two distinct aspects: the professional and the personal. The professional aspect reflects what teachers believe to be important to the profession and their subject whereas the personal aspect reflects what they

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

desire and consider to be important. It is suggested that teachers experience discomfort when the two aspects of teachers' identity come into conflict and changes that bring about such conflict between the professional and the personal will be the most problematic to implement (Beijaard, Meijer & Verloop 2004). Equally teachers experience tension between the rational models and constructions of knowledge they use to help form their professional identity and their personal knowledge of children, including their own childhood experiences (Day, Kington, Stobart & Sammons 2006). A further interesting feature is that though it is widely accepted that people feel threatened when they face changes that affect their teacher identity and develop complex strategies to protect themselves from such changes, individuals are able to further develop, adjust, and radically change their self-image (Beijaard, Verloop & Vermunt 2000).

It is recognised, however, that teacher identity is even more multifaceted (Day, Kington, Stobart & Sammons 2006); Mishler (1999) (as cited in Beijaard, Meijer & Verloop 2004 p. 113) specified that it consists of many sub-identities that may conflict or align with each other. Other researchers have noted that teachers can take on different identities, depending upon the social setting. This variety of selves is not problematic for teachers but the relationship between them can be; if all a teacher's selves cannot be accommodated harmoniously they will experience significant emotional and/or psychological discomfort (Beijaard, Meijer & Verloop 2004). Additionally, the fact that teacher identity reflects both the teacher's own and others' perception of them introduces a potential strain between agency (the personal dimension in teaching) and structure (the socially 'given') (Beijaard, Meijer & Verloop 2004).

The concept of teacher identity should not be considered without recognising there are potential issues. It still remains unclear how exactly the concepts of 'identity' and 'self' are related, despite the fact that the two constructs have been used alongside each other since the inception of the construct of identity (Day, Elliott & Kington 2005, Beijaard, Verloop & Vermunt 2000). Some suggest there is yet to be a unified concept of identity (Timostsuk & Ugaste 2010) and the variety of definitions included, or neglected, in papers on teacher identity certainly suggest a lack of agreement (Beijaard, Meijer & Verloop 2004, Timostsuk & Ugaste 2010). When considering professional identity formation most studies still emphasize the 'personal side' neglecting the context and how this plays a

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

significant role in forming the 'professional side' (Beijaard, Verloop & Vermunt 2000). Additionally researchers are yet to develop a comprehensive understanding of how teachers use their identity as a framework to guide their actions (Hong 2010). However, as a teacher's identity is something they use in order to make sense of themselves as a teacher and the context they teach in (Beijaard, Meijer & Verloop 2004, Flores & Day 2006) drawing on knowledge of teachers' professional identity may be useful in helping teachers cope with educational change hence smoothing the introduction of educational interventions and other changes (Beijaard, Meijer & Verloop 2004).

2.2.2 Beliefs as a driver – The restraining impact of teachers' beliefs on changing teachers' behaviour

It is the link between teachers' behaviour and beliefs that promotes them as an area of study. The implication, if not explicitly stated rationale, is that by establishing which beliefs are driving a teacher's behaviour they can be replicated in others to provide 'positive' teacher action or changed to correct 'negative' teacher behaviour. In this way they can be modified and then engaged to help ensure effective curriculum change. However, even in a case where 'positive' teaching behaviour can be established, e.g. supporting the Computing curriculum change, this modification is far from attainable. Research is yet to reach agreement on what the 'good' or 'right' beliefs are (Hobbs 2011); two teachers may support the change but based on different beliefs (Lloyd & Albion 2009). Individuals only change their beliefs if they can identify and reflect on existing beliefs (Hobbs 2011, Santoli 2009, Kagan 1992) yet because beliefs are hard to identify and isolate this process is far from unproblematic. Additionally, in order to effectively reflect upon their beliefs, teachers need to be provided with the resources to enable reflection, including time, supportive peers and alternative ways of viewing the situation (Brinkerhoff 2006) and even if such resources are provided individuals cannot be forced to reflect, on either their behaviour or beliefs (Hobbs 2007, Opfer, Pedder & Lavicza 2011).

Introducing alternative views of the situation is intended to establish within the individual the need for change, however, the nature of beliefs means this is not likely to happen (Opfer, Pedder & Lavicza 2011). Individuals interpret the world

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

through the filter of their beliefs (Funkhouser & Mouza 2013). Beliefs are what help them interpret and explain what they experience (Pajares 1992); two individuals viewing the same situation will 'see' two different stories. The result of this is that experiences are interpreted in a way to back up existing beliefs so the interpretation of what teachers have witnessed changes, not their beliefs (Lloyd & Albion 2009). Alternatively they may modify the incidents they are experiencing so their existing beliefs are reinforced (Collopy 2003, Song 2011). In this way beliefs so strongly influence perception that they can lead individuals to an unrealistic interpretation of what is happening (Pajares 1992). Furthermore, the non-consensuality of beliefs means they "...are simply not open to outside evaluation or critical examination in the same sense that the components of knowledge systems are." (Nespor 1987, 321). For these reasons it is no surprise that research that has presented evidence of behaviour change has shown that it is often minimal (Obara & Sloan 2009, Cohen & Yarden 2009) or short lived (Hobbs 2011) especially when individuals return to their original environment and routines. In such instances the external influences often lead to a 'wash out' effect where teachers fall back in line with previous practices or organisational norms (Morgan & Hansen 2008, Kerem Karaagaç 2004). This demonstrates that teachers' beliefs are not the only drivers of their behaviour and this means, though they may be important, they cannot be considered in isolation (Lortie 2002).

Beliefs are recognised as driving behaviour in a coherent way; they "are the best indicators of the decisions individuals make throughout their lives" (Pajares 1992, 307) and "strongly affect their behaviour" (Pajares 1992, 326). However, they are complex and difficult to define; in fact it is not always possible for individuals to be able to articulate, or even identify, their beliefs (Mumtaz 2000, Pajares 1992, Morgan & Hansen 2008, Kordaki 2013, Funkhouser & Mouza 2013, Talanquer, Novodvorsky & Tomanek 2010). This may contribute to the fact that although teachers can explain past classroom behaviour based on their beliefs, identification of teachers' beliefs does not predict behaviour (Kordaki 2013). Research has found a strong correlation between teachers' beliefs and their behaviours (Song 2011), though this appears to only run one way; identifying causes but not predicting effects. Additionally, research has identified multiple occasions where teachers' stated beliefs appear to contradict their classroom

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

behaviour (Kerem Karaagaç 2004, Hobbs 2011, Lloyd & Albion 2009, Morgan & Hansen 2008, Munby 1982, Lim & Chai 2008, Kordaki 2013, Blackwell, Lauricella, Wartella, Robb & Schomburg 2013) or even contradict other beliefs held (Brownlee 2001, Haser & Star 2009). These apparent contradictions may be due to the fact that some beliefs are more strongly held than others, which can be overlooked or changed in certain situations. These beliefs are prioritised because they are more connected to other beliefs within the individual's belief system (Pajares 1992), either due to their early formation and/or the fact they relate to their culture, religion or life philosophy.

2.2.3 Beliefs and curriculum change – The impact of teachers' beliefs and teacher identity on the implementation of educational interventions

Teachers' beliefs have been recognised as a significant influence in the successful, or otherwise, adoption of interventions on a large scale, such as curriculum change (Howard, Chen & Caputi 2015). In a paper on thinking skills Leat (2010) identified that teachers' beliefs had a major effect on the relative lack of take up and impact of such programmes. He stated that teachers needed a conceptualisation of both teaching and their subject that corresponded to that of the intervention before they would adopt it. Tew (1998) identified similar issues when he highlighted that shared philosophies and approaches were necessary when implementing Circle Time. Leat (2010) also recognised that teachers' beliefs on how well the change would be received by their peers, pupils and school could act as a determinant of whether, and how, they proceed. He also highlighted the impact of efficacy on whether the change is adopted. Teachers need to feel they have the subject and pedagogic knowledge and skills to implement the change (personal efficacy), the outcome efficacy of believing the change will be beneficial, and the teacher efficacy beliefs that they can overcome all of the problems that the teaching environment will place in the way. A significant change has the prospect of returning an experienced and successful practitioner to the role of a novice, with the added risk of not being able to regain the experienced role in the new landscape. This will have a major emotional cost to a teacher and hence may act as a significant influence on whether and how the intervention is adopted.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

The significance of beliefs in terms of congruence, emotion and social aspects are further demonstrated in a paper considering successful curriculum change (Wallace & Priestley 2011). The authors identified that, "...teachers quickly find ways to mediate the curriculum filtering 'change through their own values, which are in turn influenced by gender, social class, previous experience in the classroom, professional training and other historical and biographical factors' (Osborn et al. 1997: 57)" (Wallace & Priestley 2011, 360) and that this can have a diminishing effect on curriculum reform. Despite the recognition of the effects of teachers' beliefs on mediating curriculum changes this study examined how teachers' beliefs contributed positively to the adoption of interventions. The study identified that an initiative to promote Assessment for Learning was most successful when teachers' beliefs were congruent with the underlying philosophy of the reform, when they felt they were empowered to adapt and shape the reform and when they felt this was taking place in a zone of social interaction (Wallace & Priestley 2011). This research once more highlighted the significance of teachers' beliefs; the importance of their congruence with proposed changes, the emotions such changes instigate and their social construction.

Lang's 1998 study identified that teachers need to believe the intervention is firmly embedded in the curriculum and the whole school ethos and that there is awareness and support from the whole school community. The need for agreement across the whole school was also recognised by Lang (1998) in an earlier study that also identified that teachers need to believe this 'buy in' goes beyond the school community. It has further been suggested that teachers need to believe that the intervention is recognised as valuable by the entire educational or national society (Morse 2012).

From the preceding discussion it can be seen that the role of teachers' beliefs in the successful implementation of educational interventions is important as such changes can confront beliefs that teachers hold on everything from the resources available to accommodate the change to their own effectiveness and identity as a teacher. These beliefs will, in turn, influence how teachers will acknowledge and respond to the intervention in both the short and long term and hence will determine whether it is successfully implemented or not.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2.2.4 Beliefs and IT education – How teachers’ beliefs curtailed the integration of ICT into the classroom

The original National Curriculum vision of how ICT could be used to transform education and the way students communicated, learned and developed, failed to be fulfilled. The QCA’s vision of rapid access to ideas and experiences; collaborative pupils exchanging information on a wide scale; pupils showing initiative and independent learning, able to make informed judgements about when and where to use ICT to enhance their learning and the quality of their work failed to materialise. The prescribed (written) National Curriculum and the described (enacted) curriculum (Glatthorn et al. 2012) became so divergent as to be virtually unrecognisable to each other. Teachers’ adoption of ICT to support and improve both their teaching and their pupils’ learning has been far short of the transformation envisioned by governments (Yang 2012). By looking at this inconsistency the significance of teachers’ beliefs to the success of significant curriculum change becomes apparent.

Despite over twenty years of repeated initiatives and focused funding ICT is still not being integrated into the majority of classrooms in a way that effectively transforms and improves learning and teaching (Howard 2013, Yang 2012). This inconsistency has not escaped observation and a number of authors have carried out research to try and identify why this is the case. As early as 1999 Cox, Preston and Cox proposed using Davis, Bagozzi and Warshaw’s 1989 Technology Acceptance Model to examine how teachers’ perceptions of technology’s usefulness and ease of use would affect their attitude towards using ICT and how this in turn influenced their intention to use, and hence actual use of, technology within the classroom (Cox, Preston & Cox 1999). They suggested that teachers would not even question their current practice, let alone change it, unless they perceived ICT to be useful to them, or their students’ learning. Additionally, in order to actually change their use of ICT teachers needed to believe that systems were in place to ensure the ease of use for them personally within their classroom.

In a significant review of existing research into pedagogies associated with ICT use in both primary and secondary schools Webb and Cox (2004) identified a number of pedagogical issues that were influenced by teachers’ beliefs regarding

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

the affordances and value of ICT for learning. They acknowledged that teachers' beliefs were linked to their actions in the classroom and that social factors influenced teachers' beliefs meaning that certain beliefs appeared to be held within departments thus supporting a departmental approach to employment of ICT. This finding was supported by Howard, Chen & Caputi (2015). A significant number of studies, among and across subjects, highlighted the fact that teachers only integrated ICT into their practice when they felt it supported their existing beliefs regarding teaching and learning. Other studies found that teachers' beliefs regarding ICT's importance as a tool, and the affordances offered by ICT were important factors regarding whether they used ICT in their teaching, Blackwell, Lauricella, Wartella, Robb, and Schomburg's (2013) work found further evidence supporting the latter. Additionally this research found teachers believed that the pedagogical changes brought by ICT were a personal and professional challenge or threat. In their conclusions of this meta-analysis Webb and Cox (2004) stated that "Studies have shown that the adoption of ICT by teachers depends on their values and beliefs about the importance of ICT for learning" (Webb & Cox 2004, 276) and that "teachers' beliefs about the value of ICT for learning are important in their pedagogical reasoning" (Webb & Cox 2004, 278).

Nearly ten years later Yang (2012) carried out a similar cross-curricular meta-analysis and discovered that there was little improvement in the situation. Despite ever expanding evidence that ICT use can be transformational in many, if not all subjects, and also in developing communication and collaboration as well as higher order and meta-cognition skills, uptake by teachers is still relatively constrained (Yang 2012). Yang (2012) extended his review by carrying out his own research and by combining the results identified three primary drivers for this lack of progress. One issue is that many teachers feel there is a clash between using ICT and the ever-present drive for successful examination performance. Established teachers 'know' that their traditional methods deliver examination performance and they feel that this examination performance is the main focus of the institution hence they are not prepared to risk new methods which may prove to be less successful (Yang 2012). Additionally some teachers feel that as the higher order skills that ICT use helps students develop are not assessed in the current examinations time is better spent developing the knowledge and skills that are (Yang 2012). Another contributing factor is the perceived lack of

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

information regarding commitment to and support for risk taking of all kinds within schools which discourages innovative practices of all kinds, not only those regarding ICT use (Yang 2012).

From the papers discussed above it can be seen that research indicates that teachers are not likely to use technology in their teaching if they cannot envision uses that align with their own pedagogical and personal beliefs of teachers (Funkhouser & Mouza 2013). Then why can beliefs have such a restricting impact that they lead teachers to be so apparently resistant to change? Howard (2013) attempted to answer this question by considering how teachers assess risk when faced with using ICT in their teaching. Teachers' identities and self-efficacy beliefs are at risk when they make changes to their practice hence the perceived cost of ineffective change is both considerable and real (Howard 2013). As the potential costs are so high teachers need to have confidence that the changes they are being asked to implement are going to bring major rewards (Blackwell, Lauricella, Wartella, Robb & Schomburg 2013). Teachers feel that as costs are high then the rewards gained, in terms of student progress, need to be both large and guaranteed; this is in direct opposition to the relationship that occurs naturally where the greatest rewards are gained from taking the greatest risk (Howard 2013).

Perceived risk is an individual's estimation of the possibility of unwanted events. Teachers' perception of risk "...are socially constructed, domain specific and strongly influenced by emotion." (Howard 2013 p. 360). The beliefs teachers hold about themselves (in terms of their knowledge and efficacy), pedagogy, their subject and the school culture will all impact on the perceived risks they attach to a change (Howard 2013, Blackwell, Lauricella, Wartella, Robb & Schomburg 2013, Funkhouser & Mouza 2013). The beliefs that teachers hold act as filters through which they judge perceived risks. Such judgements are made on two levels: through an affective (emotional) response and an analytic process (Howard 2013). During the initial affective response, which takes place quickly, the individual will identify if the change personally benefits or threatens them and only if this is positive do they analyse what the impact will be. Hence, an individual's perception of a risk can be based on affect (emotion) or affect and analysis.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

In order for the initial response to be positive the individual must make positive judgements on goal contents, goal relevance and goal congruence. In order for a change to be adopted teachers must have a positive affective response to the change, see its relevance and feel it is in line with their own priorities. Only once this has been established will they consider the future potential of the change. The lack of ICT integration in the classroom is a result of the fact that teachers believe the risks, including failure and potential lost time when employing ICT, outweigh the unproven benefits of improved student performance (Howard 2013). Such emotional interpretations are further supported by social aspect (Twining, Raffaghelli, Albion & Knezek 2013), i.e. the fact that others also fail to integrate ICT into their practice (Howard 2013).

It can be seen that technology integration was, and still is, unlikely to succeed without a clear understanding of teachers' pedagogical and personal beliefs and their relationship with their teaching practices. However, little is still known about the ways in which such beliefs correlate with, let alone influence, specific types of technology use in the classroom (Funkhouser & Mouza 2013).

2.2.5 Summary

This section has considered the key principles and features of both teachers' beliefs and teachers' identity, as well as recognising significant challenges within each construct. The development of each concept, from their identification in the field of psychology, through the recognition of key aspects that have secured our understanding of them since, have also been discussed. The facts that beliefs differ from knowledge and that they combine to form belief systems were established. Teachers use their beliefs to make sense of the world and hence this can lead to subjective interpretations of both events and knowledge. Teachers' beliefs direct the decisions made and effort expended in all areas of their personal and professional lives and in this way influence teachers' judgements and actions both in and out of the classroom. Research has suggested beliefs on a wide variety of issues impede, or support, the introduction of educational interventions; these include efficacy beliefs, pedagogical beliefs and beliefs regarding how others view the innovation. Teachers' beliefs are considerably influenced by their environment and the society they live and work in and

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

changes that take place out of their usual environment are often reversed on their return.

Teachers' beliefs are closely entwined with their teacher identity – the way teachers view themselves or perceive they are viewed by others. Teacher identity is more than just a statement of what a teacher does, it establishes who teachers feel they are. A teacher's identity is multi-faceted, and teachers encounter emotional or psychological discomfort should these facets come into conflict, or should they be called upon to do something that conflicts with one, or more, of the facets. Teachers develop complex strategies to protect themselves from such situations and in this way teacher identity can become a significant barrier to change. A teacher's identity is not something they possess but how they make sense of themselves and their experiences hence it is unique to each teacher and in a constant state of flux. Despite the unstable nature of teacher identity directing change within it proves difficult as teachers' identities colour any experiences they participate in to encourage change and so act as filters in the same way as beliefs. Teacher identity is a key factor in motivation, job fulfilment commitment and efficacy it encapsulates the values, beliefs and goals that shape how a teacher makes sense of their teaching experiences. In this way it is a substantial influence on their willingness and ability to cope with educational change. The following section will extend this consideration of the literature by drawing upon it to examine how teachers' beliefs and identities are formed through their life experiences, expressed by them as their biographies.

2.3 The importance of biography – The role of past and present experiences and landscapes on teacher beliefs and identity

2.3.1 Studying teacher beliefs – How research on teacher beliefs developed to recognise biographical approaches

Original research on teachers' beliefs focused heavily on their impact on behaviour in planning lessons and within the classroom. Initial approaches focused on teacher observation and often inferred beliefs from what was observed (Munby 1982), however, this was soon extended to incorporate teachers' input to identify why they were planning certain activities or behaviours

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

or had participated in certain classroom activity (Hobbs 2011). These coherence system approaches (Hobbs 2011), whether based on decision making or cognition (Munby 1982) assumed that teacher behaviour was the result of well-defined decision processes and this is their significant weakness as this rational approach cannot always be applied to complex or fast changing contexts, such as a classroom (Munby 1982, Hobbs 2011, Nespor 1987). Moreover, research has suggested that human reasoning is not always rational (Munby 1982, Nespor 1987). A further concern with these approaches is that the researchers' views and interpretation of their observations and teachers' contributions biased results to such an extent to make them invalid (Munby 1982).

Alongside such 'process-product' research (Fang 1996) research was also being conducted using belief inventories, quantitative tools that had been developed within the field of psychology. Some researchers adopted these quantitative methods and a large number of teacher belief inventories soon built up. However these were criticised as they provided "...limited information with which to make inferences..." (Pajares 1992, 327). So though they may be able to answer the question of what teachers believe, they gave no insight into how these went on to drive teachers' specific classroom behaviours (Pajares 1992). A further criticism is that the lists of beliefs presented may not match with those held in reality by the teacher completing the inventory forcing them to select a 'best match' response or meaning they make no response at all (Munby 1982). Use of belief inventories can, however, be useful to identify when behaviours and beliefs appear to be inconsistent but only if they are used in conjunction with other, more open ended, approaches in order to obtain richer information on which to draw conclusions (Pajares 1992).

The recognition of these more open ended approaches saw researchers move their focus onto teachers' reflection where interviews, biographies and journals are among the tools used to uncover teachers' beliefs through encouraging them to reflect on their behaviour, thought processes and drivers (Hobbs 2011, Kordaki 2013). Such approaches brought their own problems: many beliefs are difficult to articulate (Kordaki 2013); the human tendency is for respondents to tell researchers what they think they want to hear; respondents may exaggerate what happened or omit things from their interpretation (Hobbs 2011). These flaws were not considered significant enough to cease the pursuit of qualitative methods,

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

such as case studies or oral histories, to gain additional insights as it was considered that eliciting stories, through biographies, journals and narratives, was the best way to discover teachers' beliefs (Hobbs 2011). Storied approaches were developed asking teachers concrete, rather than abstract, questions about their past experience to try and ground their reflective practice in existent beliefs (Hobbs 2011). More recently researchers are investigating the use of metaphor to help teachers consider their beliefs and classroom practice (Hobbs 2011, Pinnegar, Mangelson, Reed & Groves 2011, Levin & Nevo 2009).

2.3.2 The significance of biographies - How teachers' views of their previous experiences form their teacher beliefs and identities

"Beliefs are heavily grounded in past and present experiences..." (Opfer, Pedder & Lavicza 2011, p. 444) hence the role of an individual's biography is fundamental in identifying how their beliefs were established. Pajares' (1992) assumptions identified that beliefs are based on earlier life experiences. The assumptions also state that the nature and origin of a belief will determine how unassailable it is with the timing of when the belief was developed being particularly significant; the earlier a belief was integrated the more difficult it is to change (Pajares 1992). Additionally previous research has presented evidence that a teacher's beliefs regarding what makes effective education is based on their own experiences as pupils in classrooms and that their beliefs of what makes a good teacher is based on their recollections of teachers they had (Morgan & Hansen 2008, Lortie 2002, Jegede 2009, Koc 2013, Funkhouser & Mouza 2013, Twining, Raffaghelli, Albion & Knezek 2013). In fact this influence of episodic structure (Nespor 1987) appears to be a significant driver in why many selected teaching as a career (Santoli 2009, Khoh, Ling, Ch'ng & Chuan 2013). Additionally, previous careers experience may also be significant in developing teachers' beliefs (Robson 2002).

The fact that beliefs which are acquired early in life are harder to change is particularly significant for teachers. Lortie (2002) states that through their many years as pupils in classrooms individuals have undergone an 'apprenticeship of observation' and during this acquired very strong beliefs as to what teaching is. As these beliefs are formed in childhood they will be particularly enduring.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

Students enter teacher preparation courses with such beliefs (Opfer, Pedder & Lavicza 2011, Santoli 2009, Funkhouser & Mouza 2013) that are based on incomplete and non-expert observations. Yet, their view of what made good or bad teaching does not alter in the light of expert input from tutors on their teacher preparation course, they still judge their past educational experiences as good or bad as viewed through their 'pupil', rather than their 'teacher', eyes (Lortie 2002). This 'apprenticeship of observation' establishes beliefs as to what should be taught and how teachers should teach (Lortie 2002, Jegede 2009, Morgan & Hansen 2008). This consistency of teachers' beliefs is supported by another of Pajares' (1992) assumptions that states a student has already formed their beliefs about education before enrolling on a teacher training course and belief change in adulthood is rare.

Teachers' biographies are also significant in forming their orientations. A teacher's past professional experiences and the influence these have on their ever-developing orientation toward teaching their discipline will influence their actions both in the class and out of it (Rogers, Cross, Gresalfi, Trauth-Nare & Buck 2011). "It is a combination of their past teaching experiences and their individual beliefs and knowledge about how best to teach their discipline..." (Rogers, Cross, Gresalfi, Trauth-Nare & Buck 2011, p. 908). Additionally, a teacher's resistance or openness to modifying their orientations may be considered a result of their many and varied past professional experiences (Rogers, Cross, Gresalfi, Trauth-Nare & Buck 2011).

Becoming a teacher is the end point of a long process in which the individual has qualified or disqualify themselves from teaching based on their subjective warrant (Lortie 2002). It is during the apprenticeship of observation that individuals start to identify the skills, qualities and experiences they believe are necessary for teachers in each specific subject. These conclusions form the foundation of the judgements they will make regarding their subjective warrant, what people think they need, to become a teacher of that subject (Casey 2012). Those who establish a goal for themselves of becoming a teacher will constantly test and retest themselves against what they believe they need to be to be a teacher in order to identify that they match those criteria.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

Teacher identity reflects a subtle dimension of the complex and ongoing process through which teachers get to know themselves, their students, and the subject matter they teach (Ni & Guzdial 2012). In order to form their teacher identity, teachers draw on a variety of knowledge, including knowledge of affect, teaching, human relations, subject matter and their own beliefs. Recognition of this highlights teachers' beliefs, and the biographies that determine them, as major constituents of teachers' professional identity formation (Beijaard, Meijer & Verloop 2004, Flores & Day 2006, Lasky 2005). Researchers have found that such beliefs begin with the student teachers' personalities and are further shaped by immediate family and other significant individuals in their lives, their apprenticeship of observation, unusual teaching experiences, policy context, teaching traditions and cultural archetypes, and tacitly acquired understandings (Beijaard, Meijer & Verloop 2004 Day, Kington, Stobart & Sammons 2006, Lortie 2002, Nespor 1987).

Although research fails to present a unified definition of teacher identity the various meanings that are apparent share the idea that identity is not a fixed attribute of a person but an ongoing process (Day, Kington, Stobart & Sammons 2006, Flores & Day 2006, Hong 2010, Lasky 2005, Thomas & Beauchamp 2011). This process requires the individual to engage in reflective processes that involve interpreting oneself within a specific context (Beijaard, Meijer & Verloop 2004). As such a teacher's personal and professional identities not only change and develop throughout their life but also from school to school and classroom to classroom. The evolving and context specific nature of teacher identity means that a teacher's biography is important in the process of identity formation (Beijaard, Meijer & Verloop 2004).

2.3.3 What biographical research has shown – How research using biographies has increased our understanding of teacher beliefs and teacher identity

Though biographical research on teachers' beliefs is not necessarily widely developed a number of researchers have carried out studies that try to establish both how beliefs are formed and how they influence teaching decisions (Santoli 2009, Kordaki 2013) and their impact on how teachers adapt to curriculum

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

change (Dix 2012, Morgan & Hansen 2008, Poletini 2000, Song 2011). Santoli's (2009) use of biographical assignments on a social studies teacher preparation course identified that prior experiences in class motivated individuals into teaching social studies; that 'good' teachers inspired them to teach, and to teach social studies in particular. The fact that this appreciation of what made a good social studies teacher was clearly held before they commenced their teacher preparation course demonstrates that these beliefs were formed while they were students in social studies classes – during the 'apprenticeship of observation'.

Kordaki (2013) interviewed and observed twenty five high school Computing teachers to try to establish their beliefs regarding: themselves as teachers; the nature of high school Computing; their expectations of their students; and their own teaching approaches. The study revealed that in the case of most of the teachers their classroom practice did not echo the beliefs expressed in their interviews. Dix (2012) carried out semi-structured interviews with ten primary school teachers to identify how their beliefs on how children learn to write could position them within different writing discourses and how this in turn influenced their selection of strategies and how they adopted, or adapted, curricular guidance from government or their institution. This established that teachers' beliefs were a significant influence on their commitment and adherence to laid down curricula. An in depth case study of two mathematics teachers identified a strong link between teachers' existing pedagogical beliefs and the way they employ technology in their classroom (Song 2011). The research highlighted the fact that even though the two teachers agreed the lesson aims and objectives and even the activities to be carried out the way the lesson was run and the technology employed was totally dependent on the teacher's pedagogical beliefs on how their students learnt maths most effectively.

Morgan and Hanson (2008) used telephone interviews in follow up to questionnaires, to pursue their inquiries into primary teachers' beliefs regarding their effectiveness in teaching physical education. They highlighted the importance of the apprenticeship of observation on the development of primary teachers' pedagogical content knowledge. Many respondents identified how their own experience of physical education while at school formed the dominant resource for their teaching of physical education regardless of whether they felt it had been inadequate.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

The research discussed above demonstrates that individual teacher's beliefs have a significant impact on their behaviour and their responses to curriculum change and introduction of new teaching techniques. Kordaki's research also highlights the fact that the tacit nature of beliefs can lead to apparent inconsistencies between teachers' beliefs and their behaviour with teachers behaving in a manner that appears to the observer to contradict their stated beliefs.

Despite declarations that beliefs do not change research has shown that experiences, including introduction of new curricular or resources, day to day classroom experiences and professional development activities, have led teachers' beliefs to change over time (Donnelly 2008, Evers, Brouwers & Tomic 2002, Dix 2012, Nielsen, Barry & Staab 2008, Brinkerhoff 2006, Levin & Nevo 2009, Haser & Star 2009, Beijaard, Verloop & Vermunt 2000, Twining, Raffaghelli, Albion & Knezek 2013). However, other research has identified that beliefs are stable for short (Stipek, Givvin, Salmon & MacGyvers 2001, Funkhouser & Mouza 2013) and long (Cohen & Yarden 2009, Lee, Luykx, Buxton & Shaver 2007) periods of time and that their stability over time varies from teacher to teacher (Collopy 2003). Whereas beliefs regarding teaching practices can be changed through long term professional development programmes (Brinkerhoff 2006) beliefs regarding moral, cultural or religious values are much more unswerving (Mangubhai 2007, Abrie 2010, Goldston & Kyzer 2009, Funkhouser & Mouza 2013). These beliefs are not usually changed by opposing evidence, no matter how well founded in reason, logic or even experience (Pajares 1992, Nespor 1987). Such beliefs, and in certain circumstances beliefs regarding individuals' teaching practices, are closely related to teachers' identity (Howard 2013), worth (Lloyd & Albion 2009, Beijaard, Verloop & Vermunt 2000) and self-efficacy (Kordaki 2013). These concepts are particularly powerful to teachers as they are related to strongly held beliefs hence challenges to them can have negative consequences, including excess stress and burnout (Hobbs 2011, Evers, Brouwers & Tomic 2002, Lortie 2002).

Intuitively it might be considered that teachers within educational sectors would share common beliefs, however, research has not consistently proved this to be the case in either primary (Levin & Nevo 2009, Lim & Chai 2008, Kirkgoz 2008, McDougall 2010), secondary (Van Eekelena, Vermuntb & Boshuizenc 2006,

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

Cohen & Yarden 2009, Akar 2012, Veen 1993) or further and higher education (Jegede 2009, Robinson & McMillan 2006, Donnelly 2008, Bain & Mcnaught 2006). However, some research has highlighted some agreement within teacher educators (Hammond 2011), and that there are bigger differences of beliefs between teachers of different stages than within them (Vartuli 1999). Research has also identified this same lack of concurrence of beliefs between teachers of the same subject (Vähäsantanen & Eteläpelto 2011, Southerland, Gess-Newsome & Johnson 2003, Lloyd & Albion 2009, Jones & Eick 2007, Hennessey, Ruthven & Brindley 2005, Hammond 2004, Goldston & Kyzer 2009, Collopy 2003, Akar 2012); this appears to be true even within departments within single institutions who are a strong professional community (Rousseau 2004). In comparison to these findings research does appear to have established that to a certain extent some beliefs are shared between those at similar points in their teaching career, be that time teaching (Sammons, Day, Kington, Gu, Stobart & Smees 2007) or position held (Papaioannou & Charalambous 2011) though teachers' chronological age does not appear to be an influence (Wallace & Priestley 2011, Jegede 2009, Fluck & Dowden 2013).

Though far from exhaustive, or even necessarily universally agreed, research has identified a number of influences on teachers' identity, these include: the teaching context which consists of the ecology of the classroom, the culture of the school and educational policy; teaching experience and the biography of the teacher with major focuses on prior education and family and personal life (Beijaard, Verloop & Vermunt 2000, Day, Kington, Stobart & Sammons 2006, Day 2002). Flores and Day's (2006) research suggested that a teacher's personal history, pre-service training and school culture and leadership were particularly strong forces in teacher identity formation. They identified that though a teacher's personal history would inform their teacher identity this would be mediated by the context they taught in forcing them to reconstruct their professional identity (Flores & Day 2006). Pajares' (1992) assumptions identified that beliefs are acquired through a process of cultural transmission and in this way they once more demonstrate their closely woven relationship with teacher identity.

Lasky's (2005) research highlighted the importance of the social and political context during teachers' initial training and how changes to these during teachers' ongoing careers can impact significantly on their teacher identity (Lasky

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

2005). Her research, along with others, suggested that the landscape in terms of educational policy at the time of the teacher's entry into teaching has a significant impact on their identity and that there are shared features of teacher identity for teachers of the same 'cohort' (Day, Stobart, Sammons & Kington 2006, Day 2002, Lasky 2005). In contrast, other researchers have argued that the personal and social reflective nature of teacher identity formation means individual teachers use their stories of events and social interactions as a way of forming and confirming their teacher identity and, in this way individual teachers' identities are discursive (Beijaard, Meijer & Verloop 2004). Those advocating these views suggest that teacher identity is not a stable entity that a teacher possesses but a way they interact with others and their environment. This post-structuralist view claims that teachers' identities are essentially unstable and can be affected at any time by a change in their personal circumstances or their working environments (Day, Kington, Stobart & Sammons 2006). As such trying to identify, let alone classify, any similarities in teacher identity by age, amount of time teaching, educational stage taught, subject or any generalised sociological context is meaningless (Day, Kington, Stobart & Sammons 2006)

2.3.4 Summary

The previous section demonstrates the importance of teachers' biographies in the development of both their teacher beliefs and teacher identities. Teachers' life experiences, as expressed through their biographies, form their beliefs and identities. The way research on teachers' beliefs developed over time, from researcher observations and quantitative methods to participant research and qualitative methods, including narration and reflection on biography, was outlined. The longer a belief has been held the more stable it is; hence the importance of the apprenticeship of observation as the beliefs formed through this in childhood will be more resistant to change than those introduced in higher education or when working. The determinative role of biography means that there is little evidence of shared teacher beliefs in teachers of the same subject or educational stage, though there is some evidence of shared beliefs in those in the same stage in their career or in similar positions. Teachers' identity is established and shaped through their life experiences; by interactions with family and significant others in childhood; the apprenticeship of observation and

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

unusual teaching experiences. Hence teachers' identities change due to their biography, additionally, they are shaped by their landscape (including political context) so their teaching environments at key points are also formative.

Biographical research has shown that beliefs are drivers of teacher behaviour but not always in a way that is consistent to observers. It has also shown that beliefs regarding teaching practices are more susceptible to change and this is possible through professional development. However, beliefs related to moral, cultural or religious values are much more stable. Though curriculum change does lead to changes in teaching practice the rationale behind the change is often more closely linked to deeply held beliefs regarding the purpose of education and in these cases changes in teaching practice are highly unlikely. The subsequent section will examine whether there is evidence to support a claim that ICT teachers, and their beliefs and identities are an exceptional case.

2.4 What makes ICT teachers a unique breed? – Factors of ICT teachers' biographies that make their beliefs and identities different

2.4.1 A different 'apprenticeship' – How ICT teachers' experience sets them apart

From the research it is apparent that teachers' life experiences, and particularly their classroom experiences while students themselves, play a major role in influencing their beliefs regarding education, pedagogies and curricula content. Most teachers have experienced classroom life in their subject from both sides of the desk, with many having experienced lessons in their subject as pupils at a variety of levels, sometimes all the way through from primary school to degree level (Department for Education 2014). Even those teaching in out-of-field subjects will have experience as pupils at pre degree level and the introduction of the national curriculum will have made such experiences more alike. As ICT was only introduced as a discrete subject in 1995 (Hammond 2004, House of Commons 2016, Mitchell 2016) many current ICT teachers will not have been in a position to experience an apprenticeship of observation in the subject (Hammond & Mumtaz 2001). This will not only mean there is likely to be little

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

commonality between what ICT teachers recognise as the subject but will also mean they lack some of the fundamental experiences needed to establish a subjective warrant for themselves as ICT teachers. This is further compounded by the number of out of field ICT teachers who have followed an alternative route to the job and by the wide variety of career routes most IT professionals have taken (Valenduc et al. 2004), which, research suggests, is also apparent in ICT teachers (Hammond 2004, House of Commons 2016, Mitchell 2016). It is recognised that individuals' experience of how they were trained whilst working also shapes their beliefs on education (Robson 2002) and once more the multiplicity of IT training offered by employers will have led to diverse beliefs among those ICT teachers for whom teaching is not their first career.

2.4.2 A different landscape – How IT education's role sets ICT teachers apart

Disciplines are discursive and created out of people's ideas about what subjects are for hence the nature of IT and technology add further levels of intricacy to ICT teachers' beliefs. Computer science is sometimes referred to as "the fourth science" and it certainly reflects the more traditional sciences in that it involves the systematic study of structure and behaviour. Computer science education, like science education, combines the acquisition of a body of knowledge relating to such structure and behaviour with practical elements that help students develop both subject specific skills and an improved understanding through observation and experimentation. Its inclusion in the English Baccalaureate has certainly added weight to this interpretation of the subject (Kobie 2013). There are also parallels with another subject sometimes claimed as "the fourth science" – Mathematics. The use of abstraction and pattern and sequence development and rules to identify, describe, model and predict behaviour and outcomes and computer applications of trial and improvement algorithms are just some examples that could be used to support the view that computer science is applied mathematics.

Moreover, the potential role of IT within education is vast and how best to take advantage of its many aspects is widely debated (Hadjerrouit 2009, Hammond 2011, Wing 2008, Stephenson, Gal-Ezer, Haberman & Verno 2005, Ni & Guzdial

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

2012). Do students need to be taught computer science as an academic “fourth science” (Computing at School 2012); about how ICT works and how to use it ‘appropriately’ for conventional business type activities; should they be using it to support and supplement traditional learning in other subjects (Charlesworth 2011), should they be using it to support and develop their creativity or take advantage of its collaborative nature to help improve their cognition (Hadjerrouit 2009, Hammond 2011)? Every educator, or individual who holds an opinion on education, will see IT’s role within the class differently. Additionally, due to its transformational role in businesses there is much interest from commercial quarters in how IT is taught and this is accompanied by a pressure to adapt what goes on in the classroom to suit the needs of future employers (British Computer Society 2012). Even if the conflicts between educators regarding the role of IT within education and between those who believe there is more to education than developing work skills in young people and those who believe industry should influence what is taught could be resolved that would not eliminate the complexity. The rate of change with technology means that any agreement reached would be obsolete before a copy of the agreement could be circulated to all interested parties!

There has always been much debate about how IT should be taught and its purpose. When ICT was first introduced into the National Curriculum in 1990 the initial discussion centred on how it should be delivered. The introduction, in 1995, of ICT as a discrete subject within the curriculum addressed these issues in some way proposing that the best approach was that of combining discrete lessons with additional input in other subjects (Hammond 2004). However, the debate had already moved on to the nature of ICT and the purpose of teaching it at school. Some felt that the focus of ICT was to equip students with the relevant skills in the most commonly used applications whereas others wanted to focus on ICT’s potential in problem solving and cognitive development (Hammond 2004, Lloyd & Albion 2009). This dichotomy was evident in ICT teachers’ beliefs with the majority striving to develop activities that could allow both (Hammond & Mumtaz 2001). Such issues were not reserved to the British education system and the debates still rage across the globe (Stephenson, Gal-Ezer, Haberman & Verno 2005, Wing 2008, Wing 2006, Kordaki 2013).

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

As the way ICT education was delivered at secondary schools settled down to a 'mixed diet' of discrete and cross curricular input there continued to be "... issues in defining the nature and scope of ICT as a subject ..." (Hammond 2004, p. 30). These issues initially moved through whether ICT lessons should be teacher led with class activities or undirected with individuals progressing towards learning outcomes through trial and error (objective versus constructive view of knowledge acquisition (Lloyd & Albion 2009), the balance between theory and practical skills based lessons; whether students should be given simplified yet unrealistic tasks to help them learn the skills or see real life or simulated activities to see how ICT is actually employed; and the distorting effect of the examination curricular leading to the school ICT focus being on outdated material rather than the latest applications to day to day life (Hammond 2004). Some suggested there were three main strands to ICT within education: using ICT to support teaching, learning through ICT, and ICT as a subject (Hadjerrouit 2009). Yet this clear statement hides the complexity that not only concerns whether ICT is a tool or a subject but also what is included within the subject of ICT (Hadjerrouit 2009). Despite the recent government push to introduce Computing and with it computational thinking and programming it is not universally agreed that this is appropriate, the argument that it is necessary for the understanding of how computers work is countered by the fact that it is a difficult subject to master, calling on higher order thinking skills from the offset (Wing 2006) and hence may prove too challenging to some (Hadjerrouit 2009).

The relative novelty of the field of IT and its educational practice add further to the complexity in the field (Ni & Guzdial 2012). In their research on high school computer science teacher identity Ni and Guzdial (2012) identify a number of issues that challenge such teachers in forming their teacher identity. Though the research is based on teachers in the American education system many of the issues highlighted also affect ICT teachers in the UK. The comparative newness and evolving nature of IT makes it difficult for teachers to identify and become familiar with subject matter. Hence, the study of computer science as a scientific discipline can easily be confused with computer applications (ICT) education making it difficult to ascertain whether one is a computer science or a computer applications (ICT) teacher. Secondly, the current training system can make it difficult for teachers to identify themselves as computer science teachers as ICT

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

qualifications and experience will enable entry onto teaching courses that often specify qualification as both computer science and ICT teachers. In common with the American education system teachers with little or no computer science or ICT training are regularly called upon to deliver computer science and ICT classes. This confusion makes it difficult for teachers to identify what they are teaching and hence which 'classification' of teacher they are. Also, in common with America, we still have very few computer science teachers and so these teachers are especially isolated which can prevent teachers from using important social interactions to help form and reinforce their teacher identity as well as impeding a sense of belonging and affiliation with other computer science teachers. A significant issue that Ni & Guzdial's (2012) study highlights is that computer science teachers identify themselves as different from computer applications (ICT) teachers and feel they are more closely affiliated to the fields of mathematics and technology.

2.4.3 A breed worthy of study – The sparsity of research on ICT teachers

Despite their uniqueness, research on ICT teachers' beliefs is sparse (Kordaki 2013), concentrating on the beliefs and conceptions held by such teachers "... without relating these to their classroom practices" (Kordaki 2013, 142) let alone how such beliefs were formed. Research on teachers of other subjects has provided evidence of the reality that their beliefs act as a significant barrier or facilitator to change (Fullan 1993) and the relevance of this to teachers' adoption of ICT in their teaching has been highlighted in a number of studies (Mumtaz 2000, Hennessey, Ruthven & Brindley 2005, Cox, Preston & Cox 1999, Brinkerhoff 2006, Blackwell, Lauricella, Wartella, Robb & Schomburg 2013, Funkhouser & Mouza 2013). However, the transferability of such research to ICT teachers is questionable. For instance Cox, Preston & Cox (1999) highlight how the issues identified in Davis, Bagozzi and Warshaw's (1989) Technology Acceptance Model are clearly identified by teachers engaged in integrating ICT into their teaching. The model recognises that perceived usefulness and ease of implementation act as filters that determine whether external stimuli prompt or drive adoption of technology. In this way individuals' beliefs are more significant than any external drivers in the take-up of ICT. Perceptions regarding ease of implementation are focused on teachers' beliefs concerning the availability of

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

resources, including their own knowledge and skills (Cox, Preston & Cox 1999). One of the interesting issues regarding teachers' perceived skill levels for teaching with ICT is that research has highlighted that lack of skills in using ICT is not the primary concern, but a lack of pedagogical content knowledge skills (Moseley et al. 1999). Yet Kordaki's (2013) study suggests that this may not be the case for ICT teachers as a number of the teachers in the study identified "keeping pace with the rapid and continuous evolution in technology" (Kordaki 2013, p. 144) as causing them concern regarding their self-efficacy. This apparent inconsistency does not, however, mean ICT teachers do not share the perceived issue regarding their pedagogical skills within their subject. A number of studies have identified teachers believe pedagogical rather than subject skills constraining their practice (Morgan & Hansen 2008, Dix 2012, Mumtaz 2000) and this is reflected in Kordaki's (2013) work where once more ICT teachers' self-efficacy beliefs are challenged by the fact they feel they have insufficient pedagogical knowledge. This could be particularly significant for ICT teachers due to lack of agreement on what ICT is and hence how it is best taught (Hadjerrouit 2009).

So it can be seen that ICT teachers are different. Their lack of shared, or in many cases any, classroom experiences of IT as pupils while at school and the wide variety of qualification and career routes they have taken makes them a unique breed among teachers. Their ostensible uniformity is, in reality, concealing a diverse group influenced by various, very different, routes into ICT teaching, hence a breed of uniques would be closer to the truth. This difference is further exemplified by the multiple levels of complexity surrounding the debate regarding the purpose, nature and content of the IT curriculum at schools (Hadjerrouit 2009, Wing 2008, Stephenson, Gal-Ezer, Haberman & Verno 2005) and IT teacher training and development that can impede teacher identity formation (Ni & Guzdial 2012).

These defining differences in ICT teachers have not been addressed or investigated by previous research. Furthermore, their unique life experiences may mean existing research on teachers' beliefs and identities and their impacts may not have any resonance for ICT teachers. ICT teachers' exceptionality and, to some extent, the severity of the curriculum change mean there is no precedent that we can look to to suggest how these transformations may be realised. The

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

lack of research on ICT teachers means we cannot predict what beliefs they have and how these, and their equally unidentified identities, will come into play as the changes are implemented.

It is therefore essential that these omissions are addressed, and with some urgency, as the successful implementation of the new Computing curriculum depends upon such teachers. This new curriculum calls upon a seismic shift in the way ICT teachers conceive and think about their subject and this shift is expected to take place without any formalised training and only limited informal support from colleagues. ICT teachers' beliefs and identities will dictate how they respond to these demands and changes and hence how they go on to adopt or adapt the Computing curriculum. By considering ICT teachers' beliefs on the nature of IT education we can start to unpick this complex relationship as "... the investigation of teacher beliefs helps to bridge the connection between teachers' thoughts about teaching and their classroom behaviour" (Hobbs 2011, 156). Biographical and narrative research could go some way to fill the gap, helping us discover ICT teachers' beliefs and identities and how these were formed, however, this is not enough. At this point in time we need to examine both ICT teachers' beliefs and identities and how these were formed and how they have directed how ICT teachers have prepared for, and reacted to the curriculum change; it is hoped this thesis will contribute to starting this process.

2.4.4 Summary

This section has highlighted the fact that ICT teachers differ from teachers of other subjects in a number of ways. Their biographies often lack any experience as a school pupil of their subject, be that either ICT or computer science, they are often teaching out of the field of their higher education subject. The ever evolving nature of the subject, its relative novelty and its widely debated role within the curriculum are other factors that are not as substantial as within other subjects. These factors combine to make it apparent that ICT teachers are, in many ways, unique. This is likely to be reflected in both their teacher beliefs and their teacher identities and as such they, and their teacher beliefs and identities, are in need of examination. Yet despite this there is very little research on ICT teachers, and even less on their teacher beliefs and identities; at a time of significant curriculum

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

change in the discipline such an oversight is a considerable concern. The following section will consider literature related to the Computing curriculum change.

2.5 The systems development life cycle of the Computing curriculum so far – The Computing curriculum change, its history and development

The concept of the Systems Development Life Cycle (SDLC) is used by those who produce IT systems to provide a defined systematic approach to design and produce a new computer system. The concept is included in both computer science and ICT GCSE courses and often forms the underlying structure of coursework at this level, and more advanced levels. Given the potential parallels between the introduction of a new computer system and a new subject curriculum using a simple SDLC framework to consider the changes to a Computing curriculum was deemed to be both appropriate and informative; an overview of this is shown in Figure 4.

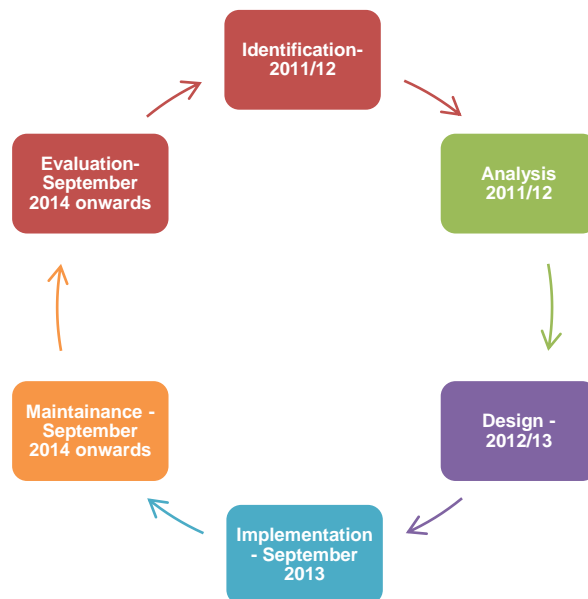


Figure 4 – The systems development lifecycle for the Computing curriculum change

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2.5.1 Identification – Why there was a perceived need for the change

Since the beginning of this century there has been global concern regarding the skills shortage for STEM subjects and Computing in particular (Zeitler 2013). Here in Britain IT industrialists (including the CEO of Google and the UK Director of Microsoft), politicians and educators have expressed concern over the lack of relevantly skilled individuals and the impact this is having on the competitiveness of the nation and its historic position as a nation that leads Computing innovations (BBC 2013, BBC 2012d, Cellan-Jones 2012). The concern is not merely with a lack of a shared body of scientific computational knowledge but with an ability to deconstruct problems and identify solutions, in other words to think computationally. Although there is evidence that a clear definition of computational thinking is yet to be agreed upon (Brennan & Resnick 2012, Grover & Pea 2013) there is some agreement that it is a fundamental skill that should be taught to all (Wing 2008, Guzdia 2008), not just because it has transformed disciplines such as statistics, engineering and science (Wing 2008) but because it provides theoretical underpinnings and concepts and processes that can be employed to solve problems, design systems and understand human (and other) behaviour (Wing 2006). It is argued that by employing computational thinking people see connections and adapt and innovate thus ensuring they are capable of dealing with the demands of a fast moving world and helping develop the creative individuals who will be the vital “ ‘human capital’ for the twenty-first century” (National Advisory Committee on Creative and Cultural Education, 1991).

The concerns regarding IT education have developed during a period when British, and arguably European and North American, political moves are to increasingly centralised control over education and the curriculum (Lasky 2005, Van Eekelena, Vermuntb & Boshuizenc 2006, Sammons, Day, Kington, Gu, Stobart & Smees 2007, Day, Stobart, Sammons & Kington 2006). In Britain this has been accompanied by changes in government to one that is promoting the need for traditional academically rigorous courses and qualifications. Within this context the teaching of ICT at both primary and secondary level in England has been causing considerable disquiet. IT academics and professionals, the Office for Standards in Education (Ofsted) and ICT teachers questioned the ICT curriculum at school and its effectiveness in engaging students, developing

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

understanding of IT and preparing students to work in the IT profession (Brittain 2012, Chakrabarti 2012, The Royal Society 2012, Office for Standards in Education 2011). Many blamed the quality of the curriculum and teaching on ICT's lack of popularity amongst students and the declining number opting to study the subject at Key Stage 4 and beyond (Charlesworth 2011, Shah 2011, Office for Standards in Education 2011). Still others proposed that the way ICT was taught was damaging students (Bayley 2012, Burns 2012), the IT industry (Sahota 2011, British Computer Society 2012) and the economy as a whole. This led to an apparent consensus among these parties that the curriculum had to change (BBC 2012a, BBC 2012b, British Computer Society 2012, Naughton 2012). The Department for Education proposed a new approach to the study of IT which was placed under consultation (Department for Education 2012) and was enthusiastically promoted by the then current Education Secretary (Brittain 2012, Burns 2012, BBC 2012d). This new syllabus was still to require students to develop effective ICT skills but would move the emphasis away from these to how computers operate and the underpinnings of programming (Robinson & McMillan 2006). The ICT programme of study that had outlined what was taught at Key Stages 1, 2, 3 and 4 was disapplied from September 2012 (Department for Education, 2013) to be replaced by a new Computing curriculum in September 2014. This new curriculum was intended to be much broader and less prescriptive in order to "...give teachers freedom over what and how to teach ... ICT" (Wakefield 2012, 3).

2.5.2 Analysis – What was wrong with the existing curriculum

The existing, 2007, ICT National Curriculum had high ideals seeing ICT "... as a powerful force for change in society" (QCA 2013, 121). The Programme of Study recognised the importance of ICT to enable "...rapid access to ideas and experiences from a wide range of people, communities and cultures, [allowing] pupils to collaborate and exchange information on a wide scale" (QCA 2013, 121); it also identified that "Increased capability in the use of ICT supports initiative and independent learning, as pupils are able to make informed judgements about when and where to use ICT to enhance their learning and the quality of their work." (QCA 2013, 121). However, despite such ideals the vast majority of students' time was spent using proprietary office software to produce

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

pre specified solutions to simplified business type scenarios (Charlesworth 2011). Over time the framework, and accompanying guidance, had developed to encompass four strands with ten sub-strands, resulting in one hundred and ninety nine learning objectives (Department for Education and Skills 2008). It was felt that this level of prescription was stifling innovation in both ICT teachers and students (Charlesworth 2011).

In their 'ICT in schools 2008 – 2011' report Ofsted carried out a review of ICT provision in both primary and secondary schools (Office for Standards in Education 2011); this report highlighted a number of key concerns across and at different key stages. Student attainment was recognised as good in over half primary schools but dropped at Key Stage 3 and, even more so, at Key Stage 4. This drop off at secondary school was identified to be due to a lack of challenge for higher-attaining students and poor coverage of the curriculum, especially at Key Stage 4. Issues with lack of vision, planning and leadership and inadequate measurement and recording of student progress were also noted as was the fact that timetabled ICT lessons with ICT specialist teachers could lead to a fragmented approach to both teaching and assessment and recording of student progress. The contrast between the good or higher provision in primary and the less than satisfactory secondary provision was identified as being due to clear vision, an integrated cross curricular approach, coverage of the full curriculum and planning and ICT threaded across the whole curriculum. However, the report also recognised that there was still poor attainment in some primaries as well as the many secondaries and attributed this both to the lack of factors discussed above and too much emphasis on the communication and presentation aspects of the curriculum with not enough on data logging, data handling, data modelling and control.

Ofsted acknowledged that there had been a significant drop in the number of students studying, the more academic, GCSE ICT between 2007 and 2011 and that this had been accompanied by an increase in numbers studying the subject on a vocational course. They stated that the qualifications selected by schools contributed further to the issues at Key Stage 4 as vocational courses were often used for all students hence leading to both a lack of challenge for higher attaining students and a lack of full curriculum coverage due to teachers selecting modules that concentrate on communication and presentation rather than the more

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

technical data logging, handling and modelling and control. This approach had contributed to a drop in numbers pursuing the subject at A Level and a lack of appropriate content knowledge and skills in those pupils who did wish to continue their studies in the subject post Key Stage 4. Significant voices in the IT industry were also expressing concerns at the way the ICT curriculum had developed, and was being applied, at schools. Both Microsoft's UK Director and the Chairman of Google spoke publically of how they believed the current delivery of ICT was adversely affecting the UK's competitive position within the industry through a lack of suitably qualified workers (BBC 2013, BBC 2012c).

2.5.3 Design – How the new Computing curriculum developed

A number of key documents have signposted the changes in thinking as the new curriculum was developed and communicated. In March 2012 the Computing at School (CaS) working group published a framework for computer science and information technology. This document identified three separate but equally significant strands to ICT education: computer science, information technology (IT) and digital literacy (Computing at School 2012); and attempted to clarify the differences and relationships between each strand. It also attempted to elucidate some of the terms used to describe the various aspects of the area and differentiate between teaching ICT and teaching using ICT. In the same month Computing at School, with the support of a number of significant IT associations and companies, published a proposed computer science curriculum (Robinson & McMillan 2006). This outlined what computer science was as a school subject and how it was characterised. The concept of computational thinking was introduced and its significance and importance, within the subject and beyond it, was discussed. The subject of Computing was clearly being discussed in the "fourth science" or applied mathematics vein with the curriculum clearly explaining how its foundational principles, ideas, concepts and techniques make it a unique and rigorous academic subject. Additionally it specified the key concepts and processes that the students should master as well as identifying course content at each key stage and level descriptors. Though it clearly identified the difference between computer science and IT at this stage in the development of the curriculum there was no claim that it was a more important subject (Computing at School Working Group 2012).

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

In November 2012 the British Computer Society (BCS) and the Royal Academy of Engineering published a draft ICT programme of study (BCS and the Royal Academy of Engineering 2012). This draft outlined the purpose of ICT education, the potential National Curriculum aims for the subject and a list of subject content for each key stage. Once more the three interrelated elements of digital literacy, information technology and computer science were identified but the significance of each and the differences and relationships between them was not addressed they were merely discussed as the components that make up ICT education (BCS and the Royal Academy of Engineering 2012). The term ICT was still employed as the broader subject title and ICT's importance was still being stressed (BCS and the Royal Academy of Engineering 2012). Based on the previously published Computing at School computer science programme of study the five aims contained 2 relating to IT, 2 relating to computer science and 1 to digital literacy and the subject content listed was weighted slightly towards IT at Key Stage 1 and computer science at Key Stages 2 and 3. The programme appeared to be attempting to integrate IT and computer science as two equal elements of ICT education.

The Department for Education (DfE) published its draft Computing programmes of study in February 2013 (Department for Education 2013). The aims were very closely modelled on those of the BCS and Royal Academy of Engineering's ICT programme, the only significant differences being the removal of one aim, the one relating to digital literacy; a change in order of the aims and some slight rewording (mostly to the IT aims). In the ICT programme the aims relating to IT had appeared first but now the computer science ones did with the fundamental principles leading the way from the analytical programming aspects. While the subject content was still visibly drawing from the ICT programme, changes in these had been more noticeable. Some content relating to IT had been removed or moved to later in the list and computer science content had been split into additional strands, the overall result being that now computer science took up much more of the subject content at every key stage, increasingly so as pupils move up through the key stages (Department for Education 2013). This apparent change in priority, computer science being more important than IT, is clearly stated in the purpose of study section: "At the core ... is the ... discipline of computer science ... Building on this core ... pupils ... apply information technology

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

to create products and solutions” (Department for Education 2013, 3). Media coverage has highlighted a variety of responses to the change in emphasis and the draft curriculum with Google’s director seeing it as a positive response to previous criticisms he had launched at existing curricular (Cellan-Jones 2012) through general welcome from ICT teachers (BBC 2012a) to concern regarding the pace and clarity of the changes (Wakefield 2012) to claims of insulting existing ICT teachers from unions (BBC 2012a) and panic among primary school teachers (Vaughan 2014).

2.5.4 Implementation – The new Computing curriculum

In September 2013 the DfE published the final Computing programmes of study that were to be followed from September 2014. There was relatively little change from the draft but the changes that were introduced seemed to emphasise computer science even more. In places the language became more subject specific and technical; extensions and explanations introduced more examples and focused on computer science aspects rather than ICT ones. Though the DfE’s programmes seem to have consciously emphasised computer science over ICT in both subject content, and arguably aims, the rationale for teaching it or even a clear explanation of what it is and why it is different from ICT is notably lacking when comparing DfE programmes with earlier Computing at School (CaS), and to certain extents the BCS and Royal Academy of Engineering, ones. The DfE programmes stress the importance of both computational thinking and computational principles when discussing the purpose of studying Computing, however, it is within sentences that combine them with ICT terms such as creativity and information. Equally, though many of computer science’s key concepts and processes are mentioned within the subject content strands there is no more emphasis on them than less fundamental skills and knowledge and this is noticeably more apparent within the Key Stages 1 and 2 programmes.

This apparent variation in the way the subject content is described at the different key stages can be demonstrated by considering the key concept of abstraction. Abstraction has been recognised as “The essence of computational thinking” (Wing 2008, 3717). Though it appeared to have been overlooked in the initial draft it is listed as one of the fundamental principles and concepts of computer

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

science within the first aim of both final Computing programmes of study. However, any specific reference to abstraction is minimal in the Key Stage 2 subject content and non-existent in the Key Stage 1 content (Department for Education 2013). Whereas in the Key Stage 3 subject content the term abstraction is not only apparent but used to define what students should be taught under the first content strand “pupils are expected to be able to design, use and evaluate computational abstractions” (Department for Education 2013, 1).

Implementation continued in September 2014 when schools introduce their new schemes of work based on the new curricular. The completion and continuation of the Computing curriculum systems development lifecycle will entail future stages of maintenance and evaluation. Teachers, and especially ICT teachers, will be the vital resource in these remaining stages and hence to the successful deployment of the new system – i.e. the Computing curriculum.

2.5.5 Summary

This final section considering the literature has discussed the history of the changes from the existing ICT curriculum to the Computing curriculum which will be taught from September 2014 onwards. It has discussed the British, and global, skills gaps and apparently widely recognised need for the change to address both these and students’ achievement and interest in IT. Literature has been interrogated to recognise the areas where weaknesses in the existing curriculum were highlighted. Key documents pertaining to the change, including the final curriculum itself, were studied to establish the development of the new curriculum and try to categorize its key features and how it differs from previous provision.

2.6 Chapter overview

The theoretical and conceptual framework for this study has been built from separate but interrelated fields of research in the areas of teacher beliefs and identity, teaching behaviour change and teacher biography and belief and identity development. This study also draws on the documentation that has accompanied the Computing curriculum change. For teachers dealing with significant change, such as the introduction of a new curriculum, is a highly complex, and frequently

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

2 Literature Review

fraught, process that affects not only their classroom behaviour but their emotions and identities. Teachers' responses to such imposed changes are influenced by past experiences and current contexts in combination with beliefs about the purposes and relative merit of the proposal and their identity as a teacher. Such teacher beliefs and identities are developed, reassessed and modified through an ongoing process of reflecting on and re-writing their experiences, interactions and contexts. This reflective process is all the more complex for ICT teachers due to both the nature of the subject itself and the lack of shared experiences with their colleagues. At this time of significant curriculum change it is important to consider factors that may impede or encourage adoption of new ideas; teachers' beliefs are widely recognised as such factors (Fullan 1993, Cox, Preston & Cox 1999, Hennessey, Ruthven & Brindley 2005, Brinkerhoff 2006). In order to establish how strongly held, and influential, such beliefs may be it is important to establish how and when they were formed and how interconnected to individual's belief systems they are (Nespor 1987, Pajares 1992). Within British IT education curriculum shift is upon us and hence it is an appropriate time to examine ICT teachers' beliefs and how they were formed so that their impact on the implementation of the new curricula can be considered and incorporated.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

3.1 Introduction – Why grounded theory

This study is designed to develop a theoretical model of the process of curriculum change precipitated by disciplinary shift from the perceptions of the teachers experiencing the transformation, and to identify the factors affecting this process. The study is carried out in the context of the movement from ICT to Computing, arguably the most significant disciplinary shift in the last two decades of the National Curriculum in England and Wales.

The research aims to investigate the experience of existing ICT teachers and to inquire into how their teachers' beliefs were/are formed and how they influence said teachers' reaction and responses to significant curriculum change. Its purpose is to:

1. gain an understanding of existing ICT teachers' beliefs regarding the IT curriculum prior to and during a time of significant change;
2. understand how such beliefs regarding the curriculum are formed through teachers' past experiences;
3. consider how these beliefs are impacting on how the teachers are negotiating the curriculum change.

There are three associated objectives.

1. To examine the nature of existing ICT teachers' beliefs regarding the previous ICT curriculum and the recent change.
2. To study how these teachers' biographies helped establish their beliefs regarding the IT curriculum and the change.
3. To observe how these beliefs have impacted on teachers' reaction and responses to the change.

Four major research questions inform these purposes and objectives.

1. What are the current ICT teachers' beliefs regarding the purpose of IT education?

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

2. What are the current ICT teachers' beliefs regarding how effectively the changed, and preceding, IT curricular achieve these purposes?
3. What particular biographic events were significant in shaping these beliefs?
4. How are these beliefs influencing how the teachers prepared for and are coping with the change?

As grounded theory methodology is intended to explore, analyse and generate concepts about individuals' actions and social processes (Thornberg 2012) it makes it an appropriate choice. Grounded theory supports the development of middle-range (Thornberg 2012) theory that is grounded in data that has been systematically gathered and analysed (Strauss & Corbin 1994). Such theory "evolves during actual research, and it does this through continuous interplay between analysis and data collection" (Strauss & Corbin 1994, 373). In line with other methods of qualitative research a variety of sources of data are legitimate: interviews, field observations, documents of all kinds; as are both qualitative and quantitative data and analysis techniques (Strauss & Corbin 1994). The method is particularly appropriate to the present study due to its effectiveness in generating substantive theories (Strauss & Corbin 1994) and a theory rather than the theory (Neal 2009) both of which are desirable in such an, as yet, neglected area of study.

This section will address the methodology and research design.

3.2 Rationale – Why grounded theory in this particular context?

At this time of significant curriculum change it is important to consider the factors that may impede or encourage adoption of new ideas; teachers' beliefs are widely recognised as such factors (Fullan 1993, Cox, Preston & Cox 1999, Hennessey, Ruthven & Brindley 2005, Brinkerhoff 2006). This cross-sectional research is intended to provide some understanding of the role of respondents' beliefs as barriers to, or facilitators of, ongoing curriculum change. Its objective is to elicit the individuals' subjective experiences and views regarding IT teaching and the curriculum, and identify both how they affect how the individual teacher negotiates curriculum change and how previous educational and career

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

experiences contributed to their development. Grounded theory is particularly appropriate to this research as it “is useful in providing rigorous insight into areas that are relatively unknown” (Jones & Alony 2011, 96); teachers’ beliefs in general and ICT teachers’ beliefs in particular are just such areas. This method will provide a “detailed, rigorous and systematic method of analysis [whilst] reserving the need for the researcher to conceive preliminary hypothesis” (Jones & Alony 2011, 96).

Beliefs and identity affect change because they colour an individual’s knowledge leading to subjective interpretations of events and knowledge and in this way they influence their actions (Sammons, Day, Kington, Gu, Stobart & Smees 2007, Lortie 2002, Kordaki 2013). However, it is unclear both how this occurs, and which teacher beliefs and aspects of teacher identity are most significant; existing research shows little agreement on these issues and, in fact, is often contradictory. Furthermore, research has failed to address the issue that neither teachers’ beliefs nor their identities operate in isolation and that an individual’s landscape influences and changes both.

ICT teachers differ from teachers of other subjects in a number of ways. Their biographies often lack any experience as a school pupil of their subject, be that either ICT or computer science (Department for Education 2014). Additionally they are often teaching out of the field of their higher education subject. These factors will affect their subjective warrant to be an ICT teacher. This is because they have not had the formative experiences to help them identify the skills, qualities and experiences needed to be an ICT teacher and hence they cannot test themselves against these to establish for themselves that they can ‘be’ an ICT teacher. The ever-evolving nature of the subject, its relative novelty and its widely debated role within the curriculum are other factors that are not as substantial within other subjects. These factors combine to make it apparent that ICT teachers are, in many ways, unique. This is likely to be reflected in both their teacher beliefs and their teacher identities and as such they, and their teacher beliefs and identities, are in need of examination.

Despite their uniqueness, research on ICT teachers’ beliefs is sparse (Kordaki 2013), concentrating on the beliefs and conceptions held by such teachers “... without relating these to their classroom practices” (Kordaki 2013, 142) let alone

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

considering how such beliefs were formed. Research on teachers of other subjects has provided evidence of the reality that their beliefs act as a significant barrier or facilitator to change (Fullan 1993) and the relevance of this to teachers' adoption of ICT in their teaching has been highlighted in a number of studies (Mumtaz 2000, Hennessey, Ruthven & Brindley 2005, Cox, Preston & Cox 1999, Brinkerhoff 2006, Howard 2013, Webb & Cox 2004, Yang 2012). However the transferability of such research to ICT teachers is questionable.

In order to develop a theoretical model of the process of curriculum change and to identify the factors affecting this process this research will be examining a number of multifaceted issues that exist and interact in a complex tightly woven relationship. For teachers dealing with significant change, such as the introduction of a new curriculum, is a highly complex, and frequently fraught, process that affects not only their classroom behaviour but their emotions (Wallace & Priestley 2011, Howard 2013, Leat 2010) and identities (Hobbs 2011). Teachers' responses to such imposed changes are influenced by past experiences and current contexts (Polettini 2000, Morgan & Hansen 2008, Lasky 2005) in combination with beliefs about the purposes and relative merit of the proposal (Tew 1998, Wallace & Priestley 2011) and their identity as a teacher (Cefai, Ferrario, Cavioni, Carter & Grech 2014). How strongly held, and influential, such beliefs may be is effected by how and when they were formed and how interconnected to individual's belief systems they are (Nespor 1987, Pajares 1992). Dealing with curriculum change is all the more complex for ICT teachers due to both the nature of the subject itself (Hadjerrouit 2009, Stephenson, Gal-Ezer, Haberman & Verno 2005, Wing 2008) and the lack of shared experiences with their colleagues (Hammond & Mumtaz 2001, Valenduc et al. 2004, Hammond 2004, Ni & Guzdial 2012, Kordaki 2013).

Beliefs are tacit (Kordaki 2013) in nature they are not always clearly defined, or even clearly named (Pajares 1992). It is not always possible for individuals to articulate, or even identify, their beliefs (Mumtaz 2000, Pajares 1992, Morgan & Hansen 2008, Kordaki 2013, Funkhouser & Mouza 2013, Talanquer, Novodvorsky & Tomanek 2010) additionally some beliefs appear to be much more strongly held than others. Beliefs are acquired through cultural transmission hence teachers' beliefs are considerably influenced by their environment and the

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

society they live and work in (Ramnarain & Schuster 2014, Talanquer, Novodvorsky & Tomanek 2010).

Teachers' beliefs are closely entwined with their teacher identity (the way teachers view themselves or perceive they are viewed by others); however, research has failed to clearly specify this relationship. Yet again the concept of identity is not clearly defined, in fact, there is no unified definition of teacher identity; furthermore, there is a lack of agreement on what identity is (Beijaard, Meijer & Verloop 2004, Timostsuk & Ugaste 2010). Nevertheless, it is recognised that teacher identity is more than just a statement of what a teacher does; it establishes who teachers feel they are (Beijaard, Meijer & Verloop 2004). Teacher identity is not a fixed attribute but a subtle dimension of a complex and ongoing process through which teachers get to know themselves, their students and their subject; it draws on knowledge including that of affect, human relations, subject matter and personal beliefs. There are many influences on identity: context (ecology of the classroom, school culture and educational policy) teaching experience, biography (prior education, family and personal life) (Timostsuk & Ugaste 2010, Day, Stobart, Sammons & Kington 2006).

A teacher's identity is not something they possess but how they make sense of themselves and their experiences hence it is unique to each teacher and in a constant state of flux (Beijaard, Meijer & Verloop 2004). Perceptions and emotions play a large role in teacher identity (Timostsuk & Ugaste 2010, Shapiro 2010) and such subjective and emotive factors are difficult to identify, examine and rationalise. Teacher identity encapsulates the values, beliefs and goals that shape how they make sense of their teaching experiences (Ni & Guzdial 2012). In this way it is a substantial influence on their willingness and ability to cope with educational changes. However, there is still little, if any, understanding of how teachers' identities frame and guide teachers' actions as the focus of research has often been on identifying what they are rather than establishing how they impact behaviour.

Qualitative methods are best suited for understanding such complex phenomena due to their purposes, approach and different researcher roles (Brown, Stevens, Troiano & Schneider 2002). The phenomena considered in this research are complex and the many aspects of this study do not divide neatly into discrete

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

variables hence qualitative methods of inquiry are the best suited for understanding this complexity (Brown, Stevens, Troiano & Schneider 2002). Qualitative methodologies are particularly useful to explore and describe the experiences of ICT teachers encountering significant change precisely because so little is known about them and such methods will help develop an understanding of their lives, stories, and behaviours as well as the organizational functioning, social movements, and interactional relationships that affect them (Brown, Stevens, Troiano & Schneider 2002). Grounded theory in particular is applicable in this situation due to both the lack of research in general on ICT teachers' beliefs and the significant gaps in existing research on teachers' beliefs and identities including: its focus on what teacher beliefs and identities are, not how they drive and influence behaviour; the fact it has repeatedly been established that teachers' behaviour does not reflect beliefs expressed in interview yet there is little concrete evidence of why this is the case; the apparent inconsistency that in some cases research has shown beliefs can change through the introduction of new curricular; and the failure to give appropriate consideration to landscape or context at all levels (micro – department, meso – school and macro – society) despite its major significance. In summary a grounded theory approach is necessary as there is:

1. a limited amount of research on how teachers' beliefs are formed;
2. scarce research on how teachers' beliefs act as barriers to, or facilitators of, curriculum change;
3. very little research on ICT teachers' beliefs in general;
4. no research on ICT teachers' biographies.

Furthermore there is no existing research, let alone theory, on how ICT teachers' beliefs and identities have been affected by their unique teacher biographies and life histories. It is essential that these omissions are addressed and with some urgency as the new Computing curriculum calls upon a seismic shift in the way ICT teachers conceptualise, conceive of and think about their subject.

The intent of a grounded theory methodology is to develop an effective theory which is grounded in the data collected and developed through the whole research process as the data is collected and analysed. "[T]heories are always traceable to the data that gave rise to them - within the interactive context of the

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

data collecting and data analysing, in which the analyst is also a crucially significant interactant" (Strauss & Corbin 1994, 278). The theory that emerges from the methodology should propose plausible relationships between concepts or sets of concepts and many such relationships should emerge (Strauss & Corbin 1994). In the case of this thesis the grounded theory methodology will be used to establish the relationship(s) between established ICT teachers' biographies, their teacher beliefs and their reactions and responses to the curriculum change. The proposed relationships will be presented through descriptive and conceptual writing and hence will be discursive in nature (Strauss & Corbin 1994); due to this they will better present the conceptual density and substantive nature of the multifaceted issues that exist and interact in the complex tightly woven relationships that are present as the participants experience the curriculum change.

The grounded theory methodology is an inductive rather than deductive approach (Brown, Stevens, Troiano & Schneider 2002) and is used to look for patterns of action or interaction between and among social actors, within processes and in response to changes of conditions internal or external to these (Strauss & Corbin 1994). As such it is well placed to look for such patterns among the established ICT teachers who are involved in this research as they work through the processes involved in, and their responses to, the changes in conditions brought about and influenced by the curriculum change. It will provide the means to connect the multiple perspectives with patterns, processes and consequences of action/interaction within a specified landscape (Strauss & Corbin 1994) that will be identified, analysed and characterised as part of the research process. The theory that will be produced will be midrange (Thornberg 2012) and substantive (Strauss & Corbin 1994); as such the patterns that will be developed into a theory will be inextricably bound to the Computing curriculum change and specific ICT department included in the research. By its nature the grounded theory that will emerge from this research will be interpretive and time and situation bound being neither universal nor permanent (Strauss & Corbin 1994). Hence, like all grounded theories it will be fluid in that it will call for each new situation to be analysed to see if the theory fits or not and as such will never be truly complete (Strauss & Corbin 1994).

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3.3 The role of the researcher

In quantitative methodologies the researcher is detached from the dynamics of the research process; however, in grounded theory, like in other qualitative approaches, the researcher is an integral part of the process. They are considered one of the instruments through which data is collected and analysed. Hence, the researcher's assumptions about the phenomenon being explored are critical to the research, in particular in their interpretations, and should be clearly stated and addressed throughout the research process (Brown, Stevens, Troiano & Schneider 2002).

In grounded theory a researcher must demonstrate "theoretical sensitivity" to the subtleties of the data (Brown, Stevens, Troiano & Schneider 2002). To achieve theoretical sensitivity, the researcher must begin the research with as few predetermined ideas, particularly hypotheses, as possible. This is essential so they can be as sensitive to the data as possible. This does not mean that the researcher must start with no prior knowledge but that they must maintain an open mind using their prior knowledge to inform, rather than direct, the data collection and analysis (Calman 2006). Theoretical sensitivity requires the researcher to be both an authority in the professional literature and able to combine this with their professional and personal experiences (Brown, Stevens, Troiano & Schneider 2002). To help develop theoretical sensitivity Strauss and Corbin (1994) proposed four techniques:

- "(a) basic questioning of the data (i.e., who, when, why, where, what, how, how much, frequency, duration, rate, and timing),
- (b) analysis of the multiple meanings and assumptions of a single word, phrase, or sentence,
- (c) making novel comparisons to promote nonstandard ways of looking at the data and providing for a more dense theoretical conceptualization, and
- (d) probing absolute terms such as never and always."

(Brown, Stevens, Troiano & Schneider 2002, 3)

With the recommendation that a researcher commence their study with no preconceived or priori ideas of the subject area, what they might discover, or where it may lead (Calman 2006) being next to impossible - the researcher's

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

knowledge and experiences will always influence their understanding, observation, and interpretation. It is therefore essential that researchers disclose information which may affect understanding in order to inform the reader of areas where objectivity may be at risk and to show they are aware of these potential biases and have tried to act in a way to counteract them (Jones & Alony 2011).

With the preceding consideration in mind relevant biographical details are discussed below. The researcher is an established out of field ICT teacher having taught ICT as a 'second' or 'third' subject since qualifying as a teacher in 1997. They completed their schooling before ICT arrived on the school syllabus but did study computer studies at O Level, computer science at A Level and some Computing Science modules as minors at university. They are a long standing member of the department which is the subject of this study, having taught in the department for over ten years, with some management responsibilities that reach across areas of the department.

The researcher's position as an insider brought both benefits and potential issues. In terms of managing the research benefits included the fact it made negotiating access, arranging and carrying out interviews and other data collections more straightforward and flexible than would be the case for those outside the organisation. It also meant getting clarification of issues raised in interviews and participants' ongoing views of the implementation of the curriculum was more manageable and hence could be carried out more regularly. Additionally access to documentation and other sources of data required for primary data sources and triangulation were readily available without additional negotiation or requests. Finally, it made observations of how the participants were responding to the changes in their practice an ongoing day to day occurrence rather than a series of lesson observations and follow up interviews.

In terms of completing the research being an insider meant the researcher did not have to familiarise themselves with, or acclimatize to, a new environment and culture. It also meant they already had an established relationship and rapport with the participants of the study. Moreover, as a colleague going through the same process it was hoped they would be seen to be aware of, and sensitive to, the sometimes complex and frustrating issues involved in the large scale

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

curriculum change helping participants speak freely and honestly without having to explain the previous situation or cultural impacts as they would to an outsider.

However, the researcher will also experience difficulties precisely because they are a colleague going through the same process. The researcher holds their own beliefs regarding the environment, culture and curriculum change and will be responding to its impact in a way that reflects these. Such beliefs and responses will not be shared by others even though the day to day behaviours may look the same, hence the researcher will have to endeavour to separate their own beliefs and responses to the change from the research process. As an insider the researcher will have to work hard to ensure they demonstrate theoretical sensitivity and lay aside any preconceived ideas that they may be tempted to bring to the study. They must ensure that they allow the data to speak for itself and do not try and force it to their previous understanding of the situation or issue. Additionally, the researcher will have to be aware of two potential biases: double hermeneutic and the Hawthorne effect (Jones & Alony 2011).

The double hermeneutic recognises the fact that individuals are all members of the world they are researching, this is especially so in the case of an insider, and as such they cannot be neutral. The world is already observational and interpreted, and recording of it only adds further layers; an individual observes and interprets the world, the observer interprets this interpretation and records their interpretation of it, finally, the reader interprets this writing (Cohen, Manion & Morrison 2007). Hence, all data observed and collected by the researcher must be recorded, analysed and written up bearing this in mind.

The fact the researcher can collect information informally and on a regular basis without the need for irregular extended interviews or prearranged lesson observations should reduce the Hawthorne affect. However, their insider role may affect the way the participants respond and behave in other ways. The researcher's known enthusiasm for the change may influence participants responses, by making them either voice concerns more strongly as they feel the views need counter balancing or be reluctant to share concerns for fear of conflict; this could introduce issues with inference validity (Coe 2012). Additionally the researcher's management responsibilities could lead to

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

respondents feeling a power disparity that could make them reluctant to respond openly (Mears 2012).

3.4 Participants and sampling strategy

The school involved in the study is a state maintained 11 - 18 comprehensive school in the North of England. ICT is taught as a discrete subject at all key stages, though it is only compulsory at Key Stage 3. At Key Stage 4 GCSE courses have been run in ICT for over ten years and Computing was added during the initial stages of this research; a vocational ICT course is also provided at this key stage. Applied A Level ICT is offered at sixth form and the College is considering offering A Level Computer Science once the first GCSE cohort proceed to this stage. All courses come under the jurisdiction of the Business Department which consists of nine staff members each of whom is responsible for delivery of ICT, though they are not all involved on all ICT courses. Table 1 identifies the participants and some of the dimensions of interest related to their education and career histories. All nine staff members were involved in the research. During the course of the study the department was cut in size to 8 members of staff.

Though the sample is a convenience sample - selected because it was readily available and had few, if any, access issues; in this case, against the norm, it is not the most undesirable sampling method (Mertens 2010). The fact that the department contains staff members illustrating a range of the dimensions of interest means it reflects maximum variation sampling (Brown, Stevens, Troiano & Schneider 2002), hence is a purposive sample (Coe 2012). The fact it is, like all other ICT departments across the country, in the process of implementing schemes of work to reflect the curriculum change means it is a representative case (Bryman 2008). Furthermore, as this study is investigative, and not looking to make claims that can be generalised, there is less of a need to use statistical sampling methods to ensure it reflects the make-up of the general ICT teacher population.

3 Methodology and Research Design

Table 1: Research participants and dimensions of interest related to their education and career histories

Name	Subject - Teaching qualification	Subject – Degree or equivalent	Experience of ICT/computer science as student (pupil)	Previous career	Years teaching	Years teaching ICT	Number of schools employed in since qualification	Number of schools ICT taught in
Adrian	Economics (with Business Studies) PGCE	Economics	None	No	24	14	5	2
Barry	Business & ICT GTP programme	Business Studies	None	Yes	8	8	1	1
Curtis	ICT - PGCE	Business Systems and Information Technology	Half a term a year in Key Stages 3 & 4 on office applications non-examined course IT solutions for business at degree	Yes	3	3	1	1
Denise	Business & ICT GTP programme	ACIS – Chartered Secretary	None	Yes	10	10	2	2
Ewan	Business Education - PGCE	Geography and Economics	Nothing at school basic spreadsheets and word processing at university	Yes	19	19	1	1
Fitz	Business Education - PGCE	Marketing	One lesson every two or three weeks in Key Stages 3 & 4 on office applications non-examined course Unit on databases at university	No	10	10	1	1

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

Table 1: Research participants and dimensions of interest related to their education and career histories

Name	Subject - Teaching qualification	Subject – Degree or equivalent	Experience of ICT/computer science as student (pupil)	Previous career	Years teaching	Years teaching ICT	Number of schools employed in since qualification	Number of schools ICT taught in
Greg	Economics - PGCE	Applied Economics	Six month non-examined course at school	No	14	14	1	1
Heather	Business Education - PGCE	Business	None	Yes	11	11	1	1
Iona - Researcher	Secondary Mathematics (11-18) PGCE	Marketing	O' Level Computer Studies A' Level Computer Science Computing science minor first year of degree, two modules (from total of 9) in further years	Yes	15	15	2	2

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3.5 Research ethics

Conducting a research project in an ethical manner is essential to the participants and the research community in general (Silverman 2010). To try to ensure research is conducted in an ethical way a number of general principles have been identified; these include: “voluntary participation and the right to withdraw, protection of research participants, assessment of potential benefits and risks to participants, obtaining informed consent and doing no harm” (Silverman 2010, 153). These principles were upheld throughout this research and Education Department Research Ethics Committee approval was sought and obtained from the researcher’s doctoral university, Durham, in the academic year commencing in 2012.

Access to the school involved in the research was negotiated through an initial email request to the Principal which was followed up by a more formal written request which included an access and informed consent agreement – Appendix A. Once this informed consent agreement was returned individual participants were approached for access consent and asked to sign informed consent agreements – Appendix B. Negotiating access to the College and gaining participants’ agreement to participate was straightforward with agreement being obtained without need for further negotiation after the initial request. There is no doubt that this was attributable to the researcher’s role as an established department member which meant they had established both rapport with the gatekeepers and participants, and professional credibility through their ongoing involvement in the establishment.

All the informed consent agreements were accompanied by an information sheet that outlined the purpose and scope of the research, its intended audience and distribution channels and provided assurances regarding anonymity and safeguarding of information – Appendix C. It also explained that respondents would be given the opportunity to review both their responses and the analysis of these, make amendments when they felt the need and receive a copy of the resulting work. The information sheet also made explicit individuals’ rights to withdraw from the study at any point.

3 Methodology and Research Design

One of the main ways to protect the research participant is through maintaining confidentiality and ensuring that reported responses or responses cannot be traced back to specific participants. Throughout the study conscious efforts to maintain confidentiality were made. Pseudonyms were used for both individuals and the institution to ensure anonymity. All the information participants provided was used solely for the proposed research, was stored securely on a non-networked computer and will be destroyed once the research and reporting is complete. These measures are needed both to maintain widely agreed ethical standards and to assure participants the research was being conducted in an appropriate manner and that their interests were being recognised and upheld. Even though the research topic does not initially appear to be harmful or threatening to participants asking them to reflect upon their beliefs regarding what teaching is and look back at their professional biography and identity to establish how such beliefs were developed could lead to feelings of vulnerability. In such instances these measure become even more significant (Tedder 2012).

Respondents were offered the chance to review transcripts of their responses. This member checking ensured that the responses that had been transcribed accurately recorded the subjects' responses and that they reflected their view point. This helped ensure the data accurately told the stories of the subjects contributing ensuring its validity and contributing to the strength and trustworthiness of the study. Respondents were also offered the opportunity to participate in the analysis of their responses and artefacts in order to try and improve validity still further though none took up this offer. However, written and verbal feedback on this analysis was presented to them and once more this member checking helped ensure the validity of the findings. This level of individualisation was not recorded in the final research but was completed both as a member check and as it was felt it might prove informative and of interest to the respondent. Respondents were also offered both written and verbal feedback on the analysis of all anonymised responses and artefacts. This offer was also made to the school. All respondents were shown their biographic details, attributed quotes and interpretations of such that were included in the thesis so they could confirm provide written confirmation they were content for them to appear in the published work. A written copy of the final research and any subsequent papers will be provided to the school and offered to the respondents.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3.6 Research design and data collection methods

A number of sources will be available for this grounded theory research to draw on including interviews; departmental documentation: schemes of work, lesson plans and other teaching and assessment resources; departmental minutes; observer's field notes; lesson observations; teachers' reflections on lessons they have delivered; previous and current curriculum advice from the Department for Education and Skills (DfES) and other relevant bodies and organisations. This study demands open-ended approaches to the collection and analysis of data in order to study the complex phenomena and intricate relationships involved when considering teachers' beliefs and how these influence their reaction to the curriculum change. They are also essential to identify when behaviour and beliefs appear inconsistent or to identify how beliefs drive teachers' specific behaviour as they obtain richer information with which to draw conclusions (Pajares 1992).

Biographies are fundamental in establishing beliefs as teachers' previous educational experience and careers are significant in developing teachers' beliefs. Teachers' life experiences, as expressed through their biographies, form their beliefs and identities. Interviews are recognised as being a relevant tool when trying to understand someone's experiences, impressions and understanding (Mertens 2010, Mears, In-Depth Interviews 2012). Many existing papers on teachers' beliefs have used this method to collect information (Hammond 2011, Song 2011, Dix 2012, Robinson & McMillan 2006). It has been particularly prevalent in the research that considers teachers' past experiences and biographies and beliefs such as the research proposed (Morgan & Hansen 2008, Poletini 2000, Dix 2012, Hammond 2004). The fact that beliefs are complex and difficult to define leads to the reality that it is not always possible for individuals to be able to articulate, or even identify, their beliefs (Mumtaz 2000, Pajares 1992, Morgan & Hansen 2008). This means a semi-structured in-depth interview, offering opportunities for clarification, prompts and probes, is most appropriate (Mertens 2010, Mears 2012). The desire to follow up on significant issues, return to conversations to check understanding, review respondents' responses to the change and adopt a constant comparison thematic analysis of

3 Methodology and Research Design

interview data meant it proved necessary to carry out follow up interviews with a number of the respondents (Thornberg 2012, Mears 2012).

Respondents were encouraged to bring relevant artefacts, for example previous schemes of work, guidance from the school, or other organisations, written records of their current thoughts on the IT curriculum, to the interview. Such artefacts acted as both a stimulus to the discussion (Polettini 2000) and triangulation (Coe 2012). As teachers' beliefs are influenced by the curriculum they deliver and resources they use (Lortie 2002, Polettini 2000) it may also prove necessary to refer to schemes of work, lesson plans and other teaching and assessment resources (Ashley 2012). Teachers' behaviour in the classroom can present evidence of their beliefs (Hobbs 2011) so lesson observations and teachers' reflections on lessons they have delivered were also a source of data. Once more these documents acted as triangulation (Coe 2012) helping to provide a fuller picture of what was happening (Bryman 2008).

The initial interviews took place in the autumn term of the 2012/13 academic year. The department was trying to adopt a proactive approach to the curriculum change and was planning to introduce new schemes of work for Years 7 to 9 in the 2013/14 academic year one year prior to the official launch of the new curriculum. All interviews were initially requested in person with specific times and locations arranged by email. These arrangements often had to be rescheduled due to participants' other commitments but whenever a change was requested an alternative was put in place almost immediately. The participants were all offered the opportunity to see the interview schedule in advance and they all took up this offer. Participants also filled in a short pre-interview data collection sheet regarding their educational and career history - Appendix D. Interviews took place within the standard school day in a location within the department that was agreed in advance. Details of the time, date and location of the interview was recorded on a database. All interviews were recorded using a digital recorder and subsequent recordings were transcribed as soon as possible after the interview. Respondents were given the opportunity to review their responses once they had been transcribed in order to check they reflected what they wanted to say and that their responses clearly communicated what they wanted to express (Mertens 2010, Coe 2012). At this point they were also free to add to, remove from or amend the transcript of their response. Participants were

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

all informed that this would be the case when asked to participate and were reminded of this at the end of the interview. No participant requested any change to their transcript. Respondents were invited to participate in the analysis process; none elected to take up this offer.

The semi-structured interviews formed the initial, and most significant, source used for collecting information and were carried out using an outline interview schedule to ensure all key areas were discussed - Appendix E. Though there is a list of questions included in this schedule the exact questions listed were not always employed word for word (or even necessarily in the same order) as they acted to identify what was to be discussed not to dictate the structure of the interaction or guarantee replicability. Equally the further prompts and probes were only relevant in certain interviews and in follow up to certain responses. Not sticking to specific word for word questions or supplementary questions enabled the discussions to develop more organically allowing areas highlighted as significant to the respondent to be explored.

As the responses to the initial interview were focusing on two aspects of ICT teachers' beliefs (the beliefs current ICT teachers hold and how these beliefs were formed) questions were developed to provide material to help explore each. The intention was to collect information on respondents' IT education in school and this focus was extended to IT education and training received in previous careers, when relevant. As a significant proportion of ICT teachers trained as teachers of other subjects it was deemed appropriate to collect information on their education and training in that subject for comparative purposes. When trying to identify ICT teachers' beliefs regarding the existing curriculum and impending change the purpose was to explore respondents' experiences and understanding (Mears 2012). In all instances broad over-riding questions were used to initiate a response: though some respondents needed additional prompts to clarify the focus of the question and the areas they might like to pursue. To break the questions down further was felt to be against the grounded theory dictum of commencing the research with open questions (Glaser 2012) and to be too prescriptive potentially encouraging shorter answers and not recognising the wide variety of histories, experiences and understanding present in the sample. Furthermore, it is recognised that "people tend to remember events that had importance to them personally" (Mertens 2010, 281) so structuring the question

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

too much might lead to a loss of meaning communicated by the order in which the respondent gave their response or the length of time they dedicated to different aspects of it.

Information was also gathered on the respondents' teaching and career histories; these questions were the initial questions as they may have informed how later question responses are followed up or even whether certain questions were necessary.

The initial interviews were followed up with regular, less formal, check-ins with participants to identify if their awareness and understanding of the curriculum change and its impact was shifting in any way and to check the ongoing situation as to how they were preparing for the change. One of these meetings was held with each participant at least each half term and they were recorded in field notes. If the participant was observed to be involved in work in preparation for, or in response to, the change (for instance participating in training, contributing to schemes of work or producing teaching resources) additional meetings would take place to discuss the activity and its impact. Field notes were recorded in a series of notebooks with records of times, dates, location, participant and some notes on the context of the recorded event. The researcher's field notes also recorded observations from departmental meetings; departmental documentation, schemes of work and lesson resource development; and informal interactions that took place within the working day. These sources acted as triangulation providing opportunities to clarify individual participant's responses and confirm if these responses reflected their behaviour as well as recording departmental progress towards the new curriculum.

3.7 Rigour and trustworthiness of the research

The unique nature of theories developed using the grounded theory methodology means that the result of research conducted in this way cannot be tested for reliability and validity, rather it has its own tests for the quality of the research based on rigour and trustworthiness (Brown, Stevens, Troiano & Schneider 2002, Calman 2006). To ensure rigour one must consider: fit and relevance, workability and modifiability. Fit and relevance examines how well the categories relate to the data and derive from constant comparison and conceptualisation of the data.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

When assessing workability one has to consider how well the categories integrate into the core category. Modifiability is concerned with how well all the concepts that are important to the theory are incorporated into it by the constant comparison process. A modifiable theory can be altered when new relevant data is compared to existing data.

3.7.1 Trustworthiness

Trustworthiness refers to how sound the concepts developed through the research are. Strauss and Corbin (cited in Brown, Stevens, Troiano & Schneider 2002) identified eight questions regarding the concepts established from the research to provide a way to gauge the trustworthiness of a theory generated through the grounded theory methodology. These questions are:

1. Are concepts generated?
2. Have the concepts that have been generated been systematically related?
3. Are there many conceptual linkages building up categories and are the resulting categories well developed and described thoroughly (i.e. do they possess conceptual density)?
4. Are differences within the categories explored, described and incorporated into the emerging theory?
5. Are the conditions where the differences exist described and considered in the theory?
6. Has process been taken into account?
7. Does the theory developed seem significant?
8. Does the theory become recognised among relevant social and professional groups becoming part of discussed and referenced theory?

(Brown, Stevens, Troiano & Schneider 2002)

Questions one to seven were considered and addressed at relevant points during the research in order to establish and maintain the trustworthiness of this research. Question seven was further addressed through feedback from the supervisor of the thesis this research comprises. Only time will tell if question eight receives a response to further elevate the trustworthiness of this study.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

Other features of this research that add to its trustworthiness are the amount of time the researcher spent in the field and with the data; triangulation of data (achieved by exploring data from interviews, observations, field notes and various document sources); the researcher's alertness to the subjective nature of the methodology (Brown, Stevens, Troiano & Schneider 2002). The researcher will explore cases that appear contrary to developing patterns in order to ensure the theory considers the multiple perspectives and more fully describes the phenomenon and this will further contribute to the trustworthiness of the final theory (Brown, Stevens, Troiano & Schneider 2002). Issues related to Strauss and Corbin's eight questions and the trustworthiness of this research are discussed in more detail below.

3.7.2 Triangulation

Collection of data that provided an accurate reflection of the multiple realities of the curriculum change was achieved through prolonged exposure to and interaction with the subjects and ensuring triangulation of the data collected. This triangulation included sharing interview transcripts and analysis, including the emerging concepts and categories and final theory, with the subjects. In this way the subjects acted as peer checkers and de-briefers helping to confirm their reality of the situation, test emerging hypotheses and offer different lenses to examine the data through (Brown, Stevens, Troiano & Schneider 2002). A further method of triangulation that was employed was comparing data from a variety of sources including interviews, observations, documentation and other field notes. Whenever triangulation was carried out particular attention was paid to any apparent exceptions that were studied in more depth to ensure the differences were understood and incorporated into the emerging theory. By approaching the data collection and analysis in this way the researcher hoped to ensure the resulting theory was indeed grounded directly in data that reflected the situation as perceived by the participants, and represented all the variety and contexts of their experience (Brown, Stevens, Troiano & Schneider 2002).

3.7.3 Dependability

An additional issue that needed to be considered in addressing trustworthiness was dependability. Dependability is attained when the data collected represents the varied and changing circumstances of the phenomenon being studied (Brown, Stevens, Troiano & Schneider 2002). The theory that is developed through this grounded theory study should integrate the many different properties, conditions and dimensions of the teachers' beliefs, identities and reaction to the changing curriculum. To ensure this was the case the researcher ensured that the processes followed were audited to ensure that the coding, categories and emerging theories were employed and identified appropriately. By following, documenting and auditing the process of the grounded theory methodology participants, readers and other researchers will be assured of the dependability of the theory that emerges.

3.7.4 Transferability

A further aspect of trustworthiness is transferability. Transferability considers the theoretical bounds of the research and hence how applicable the findings may be to another setting (Brown, Stevens, Troiano & Schneider 2002). The transferability of this particular research is aided by the researcher's commitment to representing all the participants' diverse perceptions; the use of participants as peer de-briefers will assist in this aim. Inclusion of detailed descriptions of the research, the participants, the methodology, the interpreted results, the analysis and the emerging theory further contributes to helping readers assess the transferability of the results.

3.7.5 Confirmability

One more issue that will affect the trustworthiness of the research and theory that emerged from it is confirmability that refers to the objectivity of the research. This objectivity can be said to be present if another researcher would bear out the findings of the study if given the same data (Brown, Stevens, Troiano & Schneider 2002). To assist confirmability an audit trail was developed and maintained throughout the research process. This trail included the interview schedule, the digital recordings, researcher notes and transcripts of the

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

interviews, researcher notes on observations and other field notes, department and other significant documentation and records of coding and memos from the analysis. Maintaining and reporting records as to how the key categories and core category were identified and how their interconnections were developed to produce the theory also aids confirmability. Record keeping in this way ensured that the theory was truly grounded in and emerged from the data that was allowed to speak for itself, and the participants. The research tells the stories of those being studied (Strauss & Corbin 1994) a true measure of confirmability.

3.8 Data analysis

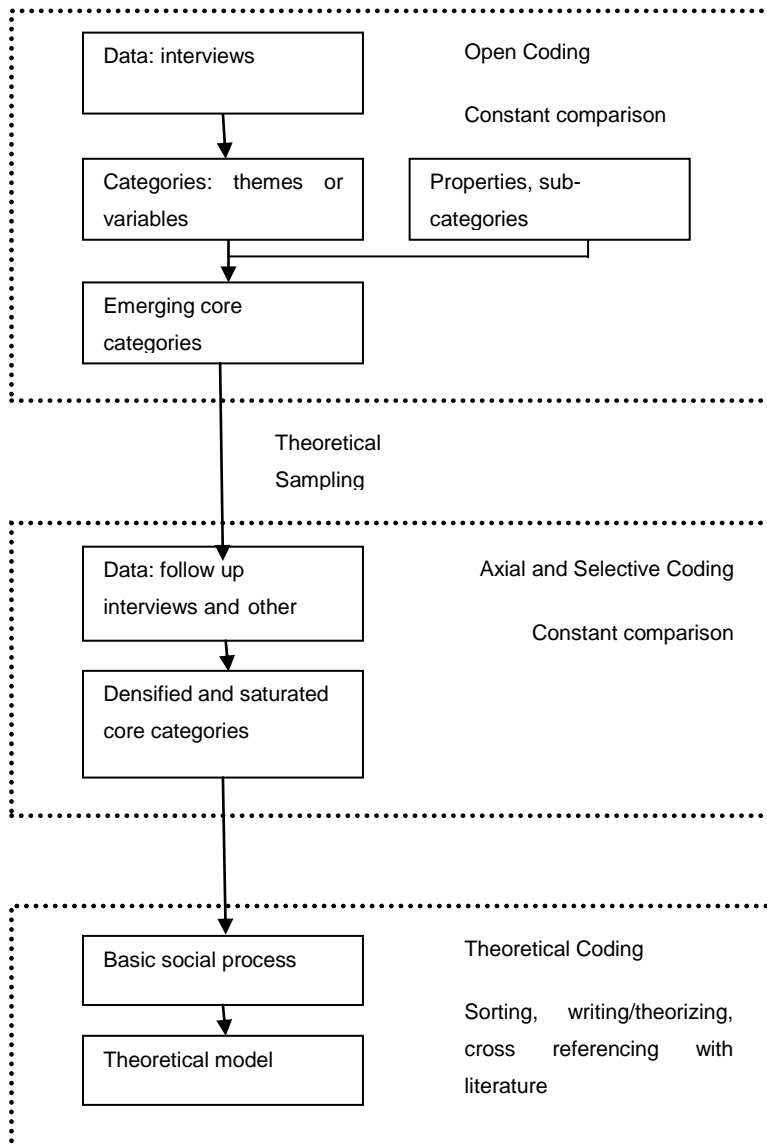
Unlike quantitative methods, where data is collected and then analysed, in grounded theory data collection and analysis take place simultaneously with analysis of one source potentially leading to identification of the next (Thornberg 2012). This identification of sources will eventually decrease and be called to a close in order to move on to the actual theory development, however, this interrelatedness of data collection and analysis is maintained throughout the whole project (Strauss & Corbin 1994). The data analysis processes employed in this study in grounded theory demand the researcher examine and re-examine data they had collected, looking at each piece of data and comparing it to other pieces of data, and looking for common themes or categories. In the early stages of this constant comparison process more questions were raised than answered and the researcher found the need to approach further sources to clarify issues, validate points or get alternative views, this process of identifying additional sources is called theoretical sampling (Thornberg 2012). As the process continued and patterns started to emerge the necessity for additional sources diminished (Calman 2006).

Though the analysis and data collection took place simultaneously and in an ongoing manner it was still possible to identify stages in the analysis process. The stages in this study, and how they are related, are shown in Figure 5 below and discussed in the following sections. Each of the three types of coding procedures is discussed separately, however, the demarcation between each stage was nowhere near as clear-cut as this would suggest. The nature of coding in grounded theory meant it was necessary to return to certain data for different

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

pieces of information at different points during the analysis to address new points raised or investigate variations. Due to this the distinction between each of the three stages is difficult to make out (Brown, Stevens, Troiano & Schneider 2002). It is not uncommon to read different interpretations of where the 'cut off' for each stage falls (Brown, Stevens, Troiano & Schneider 2002, Calman 2006, Thornberg 2012).



Modified from Jones & Alony (2011) page 102

Figure 5 - The grounded theory process for this research

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3.8.1 Data analysis – Open coding and constant comparison

The initial phase of the data analysis was the open coding of the data. The aim of open coding was to conceptualize and categorize the respondents' beliefs regarding, and responses to the curriculum change by asking questions of the data collected and making comparisons. Through the process of open coding the researcher started to label the many individual phenomena that were emerging from the study. The research is attempting to build understanding of three areas: the beliefs current ICT teachers hold, how these beliefs were formed and how they are affecting teachers' responses to the curriculum change. Responses from the interviews generated data on all areas. The interviews formed the initial data set and were analysed using thematic constant coding where each new piece of data was compared with existing data and theory to develop and revise codes (Coe 2012). To better represent the actions and processes being investigated the researcher used gerunds (verbs ending in 'ing') as codes wherever possible, this is recommended by both Charmaz and Glaser (Sbaraini, Carter, Evans & Blinkhorn 2011). Interview transcripts were analysed one at a time line by line to identify the initial codes. While carrying out this initial coding process the researcher interrogated the data critically and analytically to identify what was happening in the data and what it indicated. A number of questions were asked of the data at this stage in order to identify what the data was trying to say about the research topic (Thornberg 2012); a list of the type of questions asked of the data is included in Appendix F.

By analysing the transcripts line-by-line, and then interview-by-interview, the researcher was forced to verify the concepts and categories that were emerging. In order to achieve such verification additional sources of data were recognised as being necessary; this is the process of theoretical sampling (Jones & Alony 2011). Theoretical sampling drew on the following sources: further additional questions to the respondent, further interviews, observation of respondent behaviour, analysis of documents such as schemes of work, lesson plans and other teaching and assessment resources, lesson observation notes and teachers' reflections on lessons they had delivered. Whatever additional information sources were used the data collected was analysed with the same technique and emerging codes. Open coding in this way enabled the researcher to generate codes that were fully specified in that their properties and dimensions

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

were clearly identified and documented. In this way the abstract categories that emerged were fully defined and given meaning and the different ways they could vary was identified providing “richness and description to the abstract category” (Brown, Stevens, Troiano & Schneider 2002, 5). Line by line analysis of the data also ensured that important codes were not overlooked and that the codes became saturated (Thornberg 2012). The point of saturation was reached when no new codes were emerging from the data being analysed (Jones & Alony 2011, Calman 2006).

During this, as in all stages of the coding process, the codes that emerged were treated as interim; recognising the reality that they potentially needed to be refined or altered as the coding process progressed (Thornberg 2012). This reality helped ensure the eventual emergent codes, and theory, reflected and represented the data. As the transcripts, and any other data collected from the associated theoretical sampling, were analysed emerging and existing codes were compared with each other and with the new data. This is the constant comparison method and was employed to identify similarities and differences within the data and the codes (Thornberg 2012). A diagrammatic representation of the constant comparison method is given below in Figure 6. As more data was analysed using constant comparison initial codes were sorted and grouped to facilitate the development of more complex and sophisticated codes. As the process continued further, looking at subsequent transcripts and other collected data, this line by line and incident by incident analysis will become more focused and selective. Eventually saturation of the codes was reached and at this point the researcher began to identify the core codes (categories) through the next phase of coding – selective coding.

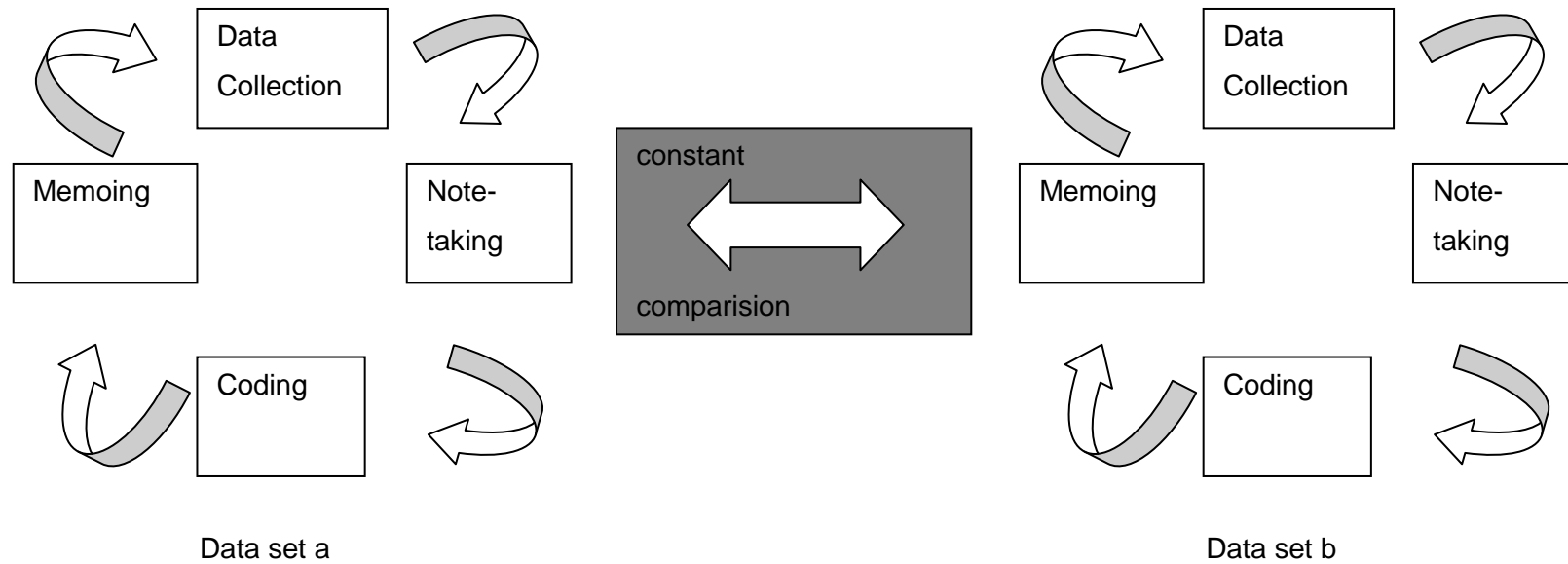
Throughout all the data collection, coding and analysis the researcher engaged in *memoing*. Memoing is the process of recording thoughts regarding the data, codes, relationships between codes, questions that still need to be answered, apparent inconsistencies and any other relevant concerns. This resource can then itself be sorted, ordered and reordered to help the researcher make a full interpretation of the data (Thornberg 2012). In this study case based memoing was carried out during and after each interview to capture the researcher’s impression of the respondent’s responses and reactions. The researcher also made conceptual memos about the emerging codes, to record their thinking

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

regarding processes, concepts and codes and changes in these. These analytic, conceptual or theoretical notes helped the researcher remember their thoughts or questions and were “the theorizing write-up of ideas about code and their relationships as they strike the analyst while coding” Glaser (1978) (as cited in Thornberg, 2012, p. 89). Memoing helped the researcher stand back and identify what was happening in the data and how they could make sense of it. The process drove the researcher to investigate their codes and the relationships between them as well as generating a resource of ideas relating to the analysis of the data which could itself be interrogated and analysed.

3 Methodology and Research Design



Modified from Jones & Alony (2011) page 105

Figure 6 - Constant comparison

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3.8.2 Data analysis – Axial and selective coding

The next stage of coding, axial coding, also employed constant comparison and memoing. This stage resulted in dense, saturated categories. This second stage of data analysis involved relating categories and linking them at the level of their properties and dimensions (Brown, Stevens, Troiano & Schneider 2002). The objective of axial coding was to produce a model that recorded the specific issues (cases, interventions and/or contexts) which gave rise to or influenced the ICT teachers' beliefs regarding the new Computing curriculum; the actions and interactions that were facilitated or constrained by these and; the consequences of these actions and interactions in terms of the introduction of the curriculum (Brown, Stevens, Troiano & Schneider 2002).

The initial axial coding followed the themes presented in the research questions, the results of these are presented in the findings. However, although this process generated a greater understanding of the respondents and their beliefs the constant comparison and memoing process resulted in categories that did not provide significant insight into existing ICT teacher's actions or the social processes surrounding the curriculum change. As such they only addressed three of Brown, Stevens, Troiano & Schneider's (2002) four analytical outcomes: (i) relating subcategories to their appropriate category/categories; (ii) comparing categories and subcategories with the data; (iii) developing dense categories by describing their properties and dimensions (Brown, Stevens, Troiano & Schneider 2002). In order to provide an understanding of the social processes involved in the curriculum change it proved necessary to return to the codes generated by the line by line analysis and start the constant coding and memoing process again. This reanalysing of the data under different groupings is common in axial coding and is often necessary in order to achieve the fourth analytic outcome - exploring variations, including contradictory cases. This second implementation of the axial coding resulted in a set of categories that addressed all four of Brown, Stevens, Troiano & Schneider's (2002) four analytical outcomes.

Selective coding built further on the open and axial coding already completed and moved the process forward further to identify the key or central category, known as the core category, and then relate this to the other categories that had

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

emerged (Brown, Stevens, Troiano & Schneider 2002). Though the second iteration of axial coding had resulted in dense categories that provided understanding of the social processes of the change no one core category emerged from the analytic process.

The core category is the one that relates all of the data. As the category did not emerge reflexively it proved necessary to adopt a more directed approach to identify the most significant of the initial categories that had emerged (Thornberg 2012). In order to identify the category the researcher went back to the aims and objectives of the research and used these as further constant comparison data to identify the category that related the data in order to identify the teachers' response to the curriculum change. This process eventually resulted in the identification of 'enacted support of the new curriculum' as the core category. Focused coding continued to identify the related categories which also involved rejecting other categories that had been established. Such categories involved ones comparing teachers' beliefs on their teacher efficacy in, the nature and teaching of the subject they trained in compared with IT education. Once the focussed coding was complete the core category connected all the categories together to form a systematic explanation of the ICT teachers' beliefs and their impact on how they were reacting to the curriculum change (Brown, Stevens, Troiano & Schneider 2002). The approach adopted meant that more than one category could be considered whilst conducting the research. It also maintained the interim nature of the categories and codes allowing the researcher to check the satisfactoriness of these throughout the focussed coding stage (Thornberg 2012).

As this analysis proceeded the most relevant initial categories and codes were compared and clustered to a more limited number of focused codes which were more "directed, selective, and conceptual than the initial codes" (Thornberg 2012, 88). During focused coding the researcher's role was to investigate and identify which of these focused codes best reflect what the data was telling them and establish these as the provisional conceptual categories. This was done by giving them conceptual definitions and beginning to explore the relationships between them. In order to establish and refine the categories in this way focused coding demanded the researcher consider a significant number, and variety, of constant comparisons as shown in Appendix G.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

During the focused coding the researcher ensured that the relationships that were identified and specified were validated and that any categories that needed further development were completed (Brown, Stevens, Troiano & Schneider 2002). During this stage the researcher also ensured that theoretical saturation was reached and that no new properties, dimensions or relationships were emerging from the analysis of the data and hence that the data collection analysis cycle concluded (Calman 2006).

3.8.3 Generating new theory

“Theory consists of plausible relationships proposed amongst concepts and sets of concepts (though only plausible, its plausibility is to be strengthened through continued research).”

(Strauss & Corbin 1994, 278)

In order to express the theory that was grounded in the research it was key to identify its “story” (Brown, Stevens, Troiano & Schneider 2002). This story articulated the accounts of those ICT teachers who had been researched (Strauss & Corbin 1994), established the most important facets of the data and produced general descriptions of these and their relationships. These descriptions were conceptually dense enough to relate the core code to subsidiary categories. The theory generated was interpretive, time and situation bound and hence substantive and not universal and permanent. It will develop and transform with further research that considers other actors, other situations and other plausible relationships. In this way it will be fluid and temporary in nature (Strauss & Corbin 1994).

During the theoretical coding the core codes were sorted, written, theorized and cross-referenced with literature. The result of this last stage of coding was a basic social process and a theoretical model; this was the final product of the grounded theory research (Jones & Alony 2011). This theory was developed as the patterns in the data were uncovered allowing the categories and codes to be specified and ordered. This allowed the researcher to stipulate the consequences of the various circumstances of the ICT teachers’ responses to the new curriculum by relating the concepts of the main categories at a property and

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

dimensional level. This examination formed the foundation of the theory which was validated against the data and key transition conditions, interventions and exceptions once these were all integrated the grounded theory had emerged (Brown, Stevens, Troiano & Schneider 2002).

The theory was generated from hypotheses of how the categories and codes related, to achieve this the researcher considered theoretical codes. Theoretical codes are analytical tools that can help to organise the codes and categories that have emerged from earlier coding stages and refer to the logic that has been used historically in theories. They helped to spell out the relationships between the concepts and codes in order to tell the emerging story in a consistent and reasoned manner and in this way started to develop a broader more general picture (Thornberg 2012). A number of theoretical codes are recognised. Glaser organised theoretical codes into 'coding families' (Thornberg 2012) and a list of these, with examples, is included in Appendix H. The appropriate theoretical codes were established through constant comparisons between them, the data and the codes, categories and memos that had been generated by the preceding analysis. These codes "must work, have relevance and fit with data, focused [core] codes and categories" (Thornberg 2012, 89). The resulting theory called on a combination of theoretical codes in order to fully, and accurately, capture the relationship between categories (Thornberg 2012) and hence provide a true account of the ICT teachers under study, their beliefs regarding and responses to the curriculum change.

The data collection and analysis timeline and the sources of data used are outlined in Tables 2 and 3 on pages 111 and 114 respectively.

3.9 Potential benefits of the research

Within British IT education significant curriculum shift is upon us and hence it is an appropriate time to examine ICT teachers' beliefs and how they were formed so that their impact on the implementation of the new curricula can be considered and incorporated.

Despite the fact that over twenty years ago Pajares (1992) clearly identified that teachers' beliefs were an area in need of further study research on teachers'

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

beliefs in general is still far from comprehensive and exhaustive. Furthermore, research has failed to address the issue that neither teachers' beliefs nor their identities operate in isolation and that an individual's landscape influences and changes both. What is more, research specifically on ICT teachers' beliefs is even more neglected. A key words search for "ICT teachers' beliefs" in the topic or title fields of any academic citation index returns only material relating to teachers' beliefs regarding using ICT in their teaching of other subjects. This demonstrates just how sparse (or possibly non-existent) work specifically on ICT teachers' beliefs appears to be. In fact it is recognised that research on ICT as a school subject is an area that lacks research (Hadjerrouit 2009) despite there being plenty of literature available on ICT use within education. It is intended that this study will contribute some understanding to these neglected fields.

This research aims to answer conceptual gaps in this field by taking a novel approach that is original in both its emphasis and context. It asked existing ICT teachers within one school to explain their beliefs regarding IT education and reflect on how their route to ICT teaching, including their own schooling, higher education and previous employment, influenced the formation of these beliefs. They were asked to articulate their beliefs regarding the role and purposes of IT education and the significance and impact of the curriculum change that is in process. This biographical and interview data was accompanied by an analysis of historical curriculum and departmental documentation and in this way considered the landscape in which the teachers were dealing with the change. The research also involved observation of how the teachers responded to the curriculum change as it developed and was implemented within their department to try and establish how their beliefs were affecting their responses.

This research has applications for both practitioners and policy makers (Strauss & Corbin 1994) both within, and beyond, the field of the study. By considering how the beliefs of those involved in the study affected their responses to the curriculum change other practitioners may better understand their own responses to such externally imposed changes. Equally policy makers can benefit from the findings of the research to consider how they can introduce changes in a way that support those who have to implement them to consider how they relate to their beliefs and how this will affect how they put the changes into place. The current

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

trend within 'Western' education systems of centralised control makes these potential benefits of the research far reaching.

3 Methodology and Research Design

Table 2 - Research process timeline

2012				2013											
Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Initial interviews with Adrian, Barry, Curtis, Denise and Ewan. Followed by transcription, memoing and alteration of interview schedule. Finally review of interview and transcript by researcher alone and with respondent.		Initial interviews with Fitz, Greg and Heath. Followed by transcription and memoing and review of interview and transcript by researcher alone and with respondent.		Line by line analysis and grouping into common themes						Open coding - constant comparison of interview data, preparation resources, PD records, department meeting records, field notes and reading to confirm and enrich initial codes			Axial coding - constant comparison of initial codes, interview data, preparation resources, PD records, department meeting records, field notes and reading to develop sub-categories relating to original research questions.		
Informal follow up sessions to clarify points raised and improve understanding of apparent similarities and differences highlighted in interviews and memoing.		Formal review interviews followed by transcription and memoing of review interviews		Formal review interviews followed by transcription and memoing of review interviews			Formal review interviews followed by transcription and memoing of review interviews			Formal review interviews followed by transcription and memoing of review interviews			Formal review interviews followed by transcription and memoing of review interviews		
Observation of preparation, including collecting resources being prepared, recording any PD activities being undertaken, recording discussions of progress on new curriculum in department meetings.										Observation of preparation, including collecting resources being prepared, recording any PD activities being undertaken, recording discussions of progress on new curriculum in department meetings.					
Further reading selecting readings focused on theories relevant to issues raised in interviews									Further reading selecting readings focused on theories relevant to issues raised in interviews and in initial codes						

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

2014												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Axial coding - constant comparison of sub-categories, initial codes, interview data, preparation resources, PD records, department meeting records, field notes and reading to develop categories relating to the original research questions				Identification that the categories and sub-categories reflecting the original research questions did not give an account of the process under study.		Axial coding – returning to the original initial codes and the constant comparison process to identify new sub-categories that did give an account of the processes of the curriculum change			Axial Coding - constant comparison of sub-categories, interview data, preparation resources, department meeting records, lesson observations, interview data, field notes, and reading to develop categories that gaver an account of the processes of the curriculum change			
Formal review interviews - transcription and memoing		Formal review interviews followed by transcription and memoing of review interviews			Formal review interviews followed by transcription and memoing of review interviews						Formal review interviews followed by transcription and memoing of review interviews	
Observation of preparation, including collecting resources being prepared, recording any PD activities being undertaken, recording discussions of progress on new curriculum in department meetings.								Observation of introduction, including collecting resources being prepared and used, recording any PD activities being undertaken, recording discussions of progress on new curriculum in department meetings.				
Further reading selecting readings focused on theories relevant to issues raised in interviews and in initial codes		Further reading selecting readings focused on theories relevant to issues raised in emerging sub-categories and categories										

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

2015												2016			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
Axial coding complete yet no one core category emerged	Compare categories with research purpose, objectives and questions to identify core category – ‘Teachers enacted support of the new curriculum’			Theoretical coding - constant comparison of research questions, categories, resources, department meeting records, lesson observations, interview data, field notes, and reading to identify selective categories and their relationship to the core category and reject categories that do not relate to the core category.						Description of the emergent theory followed by comparison of theory with categories, codes and data to confirm its legitimacy					
Formal review interviews - transcription and memoing		Formal review interviews followed by transcription and memoing of review interviews			Formal review interviews followed by transcription and memoing of review interviews					Formal review interviews followed by transcription and memoing of review interviews					
Observation of introduction, including collecting resources being prepared and used, recording any PD activities being undertaken, recording discussions of progress on new curriculum in department meetings.								Observation of introduction, including collecting resources being prepared and used, recording any PD activities being undertaken, recording discussions of progress on new curriculum in department meetings.							
Further reading selecting readings focused on theories relevant to issues raised in emerging sub-categories and categories			Further reading selecting readings focused on theories relevant to issues raised in categories, key category and relationships within the emergent theory												

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

3 Methodology and Research Design

Table 3 - Sources of data

Data source	Stage of analysis use
Initial interview data	<p>Open coding – line by line analysis to identify meaning</p> <p>Axial coding – grouping and regrouping by theme to build up sub categories and categories</p> <p>Theoretical coding – to check all exceptions and variations are integrated</p>
Follow up interview data	<p>All stages of data collection to clarify understanding and check interpretations</p> <p>Open coding – line by line analysis to identify meaning</p> <p>Axial coding – grouping and regrouping by theme to build up sub categories and categories</p> <p>Theoretical coding – to check all exceptions and variations are integrated</p>
IT policy documents, guidance from external organisations and existing ICT schemes of work	Data collection – to clarify points in interviews
Computing schemes of work in development resources,	Data collection – to clarify points in interviews, to act as triangulation with issues discussed at interviews and departmental meetings
Personal development records,	Data collection - to identify and triangulate any formal professional development activities undertaken
Department meeting records	<p>All stages of data collection to identify departmental progress and issues with the introduction</p> <p>Open coding – line by line analysis to identify meaning</p> <p>Axial coding – grouping and regrouping by theme to build up sub categories and categories</p>
Field notes	All stages of data collection to identify departmental progress and issues with the introduction. Triangulation of teacher activity as discussed in interviews
Computing scheme of work and other teaching resources	Data collection – to clarify points in interviews, to act as triangulation with departmental meetings, to act as a blueprint for lessons during lesson observations, to act as an artefact to initiate discussions in interviews
Lesson observations	Data collection – to act as triangulation with departmental meetings, triangulation of teacher activity as discussed in interviews, to act as an artefact to initiate discussions in interviews

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

4.1 Introduction

This chapter presents the findings of the investigation into the experience of existing ICT teachers during the process of curriculum change precipitated by disciplinary shift and to identify the factors affecting said teachers' reaction and responses to the change. This research was defined by three purposes. One purpose was:

- to gain an understanding of existing ICT teachers' beliefs regarding the IT curriculum prior to and during a time of significant change.

The research objective associated to this purpose was:

- to examine the nature of existing ICT teachers' beliefs regarding the previous ICT curriculum and the recent change.

The research questions guiding this purpose were:

- What are the current ICT teachers' beliefs regarding the purpose of IT education?
- What are the current ICT teachers' beliefs regarding how effectively the existing ICT curriculum achieved these purposes?
- What are the current ICT teachers' beliefs regarding how effectively the new Computing curriculum will achieve these purposes?

A further purpose was:

- to understand how such beliefs regarding the curriculum are formed through teachers' past experiences.

The research objective associated to this purpose was:

- to study how these teachers' biographies helped establish their beliefs regarding the IT curriculum and the change.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

The research question guiding this purpose was:

- What particular biographic events were significant in shaping these beliefs?

The remaining purpose was:

- to consider how these beliefs are impacting on how the teachers are negotiating the curriculum change.

The research objective associated to this purpose was:

- to observe how these beliefs have impacted on teachers' reaction and responses to the change.

The research question guiding this purpose was:

- How are these beliefs influencing how the teachers prepared for and are coping with the change?

The relationship between these purposes, research objectives and research questions can be seen in figure 7 below.

This chapter records the outcomes of an investigation into existing ICT teachers within one school. It reports their explanations of their beliefs regarding IT education and their reflections on how their route to ICT teaching, including their own schooling, higher education and previous employment, influenced the formation of these beliefs. The respondents were asked to articulate their beliefs regarding the role and purposes of IT education and the significance and impact of the curriculum change that is in process. This biographical and interview data will be accompanied by an analysis of historical curriculum and departmental documentation in order to both identify how the teachers contributed to the curriculum development and consider the landscape in which the teachers are dealing with the change. The research will also involve observation of how the teachers are responding to the curriculum change as it develops and is implemented within their department to try and establish how their beliefs are affecting their responses.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

In order to achieve the above the chapter will initially recount each respondent's route to becoming an ICT teacher, including their experience of IT as a student. As previous research has identified that teachers' life experiences, as students, teachers and in previous careers, play a major role in influencing their beliefs regarding education and curricula content it is important to report on these significant biographical experiences. Teachers' beliefs have been recognised as a significant influence in the success, or otherwise, of adoption of interventions on a large scale, such as curriculum change (Howard, Chen & Caputi 2015). Hence the following section present the respondents' reflections on their beliefs regarding the purpose of IT education and how effectively they feel the existing and new curriculum address these. The subsequent section reports respondents consideration on which particular life experiences were formative in these beliefs. The purpose of identifying such life experiences is twofold: firstly research has identified wide variety in the experiences teachers identify as significant in forming such beliefs (Morgan & Hansen 2008, Lortie 2002, Jegede 2009, Koc 2013, Funkhouser & Mouza 2013, Twining, Raffaghelli, Albion & Knezek 2013, Santoli 2009, Khoh, Ling, Ch'ng & Chuan 2013, Robson 2002); secondly because the nature and origin of a belief will determine how unassailable it is (Pajares 1992). The concluding section reports the respondents' activity and beliefs during the introduction of the new curriculum and as such demonstrates the impact of their beliefs on their actual behaviour.

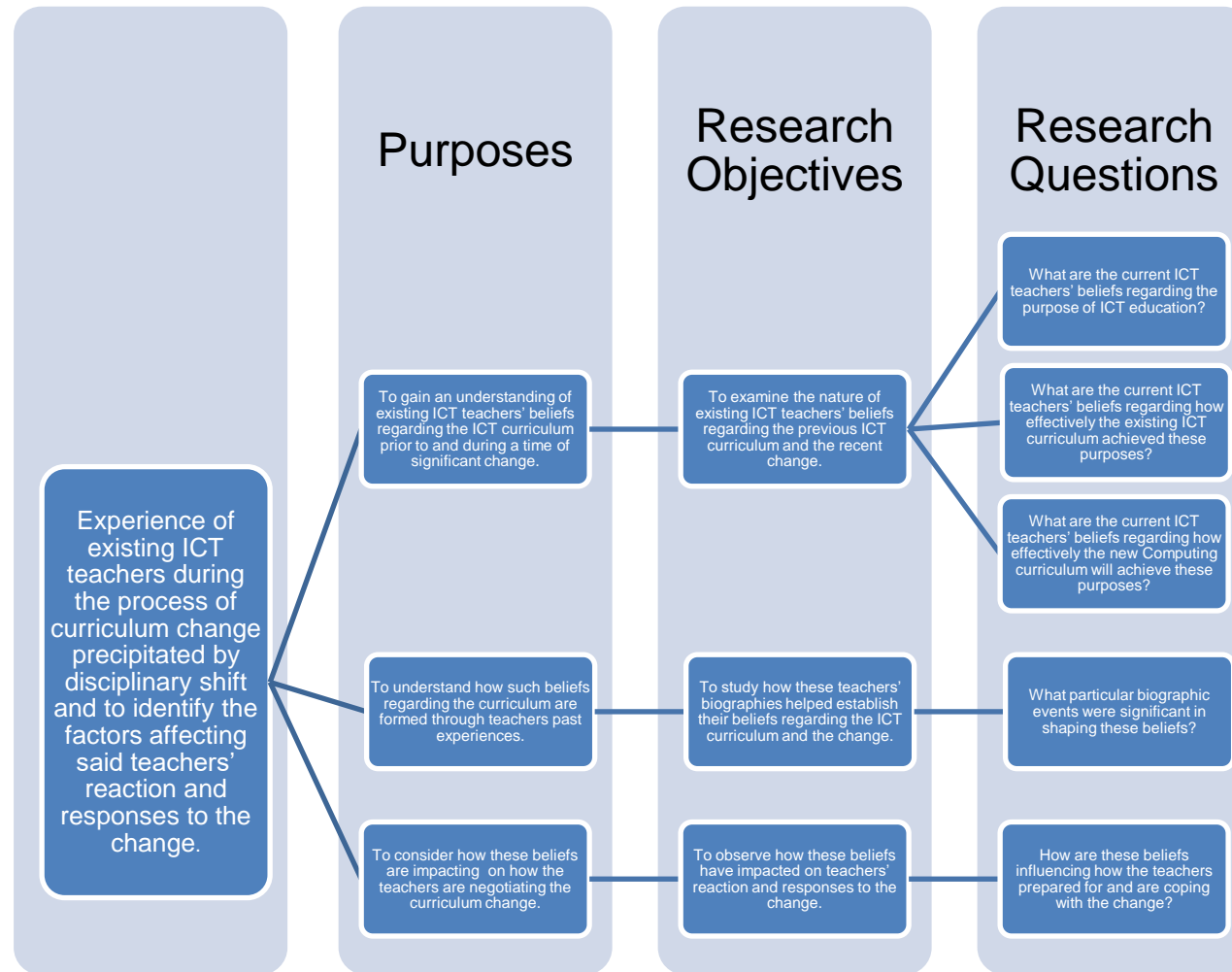


Figure 7- The relationship between the research purposes, objectives and questions

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4.2 Introducing Adrian

Adrian has been a teacher for twenty four years. He has been teaching ICT, business and economics at the school for the last thirteen years and also did so during his first year as a teacher; the other ten years he taught business and economics. During his first eleven years of teaching he had also taught geography and history. Teaching is Adrian's first and only career. He is involved in teaching ICT at Key Stage 3 and economics and business at sixth form; approximately one fifth of his timetable is made up of ICT teaching.

Adrian identifies himself as an economics and business teacher, primarily economics. He evidences this by referring back to the qualifications he obtained from his A levels on.

“That's my main, A-level Economics, a three year degree that was about 75% Economics, teacher training and economics and Business Studies.”

When recalling his route into ICT teaching he recognises that it was not direct, planned or intended but in both instances it was very much an unsought addition to a to a job he wanted.

“That's a roundabout route, right my first job they needed somebody to teach ICT along with the head of Department so I was co-opted into doing that and then I have ended up teaching ICT here because I applied for a job that was initially business with ICT which when I applied I wasn't sure whether I would go through with the application and then when I received the application form, the first requirement was that the candidate must be able to teach Economics which is my subject so I pursued the application and then from then onwards I've taught ICT”

Prior to being called upon to teach ICT Adrian had no experience of learning it himself, he did not study it at school and had no IT input or training at university or during his ITT. He identifies that even while he has been teaching ICT his training has been very limited and reactive; responding to the question regarding what training he had received with “Er Very, very little. I learned it on the hoof.”

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

Adding “No I never had a computer before I started teaching ICT and I never bought a computer until about seven years into teaching ICT.” During all his time teaching ICT Adrian has never received any formal input on, or encouragement to reflect on, the purpose of IT education.

Though not his choice of subject to teach Adrian feels no difference in self-efficacy between teaching ICT and teaching Economics. However, he notes that this is because he is only called upon to teach ICT at lower levels – Adrian only delivers on the Key Stage 3 ICT course.

“Actually I feel perfectly comfortable teaching them both because the levels that I am teaching them both to I’m confident with but if I was having to teach IT at a higher level I think I might find that quite difficult.”

4.3 Introducing Barry

Barry has been teaching for eight years and has taught both ICT and business for all of this time. He trained to teach both subjects on a GTP programme at the school and this is the only school he has taught in. Prior to teaching Barry worked in banking and risk management for ten years. He is involved in teaching ICT at Key Stages 3 and 4 and business at Key Stage 4 and sixth form; just over half his timetable comprises ICT lessons.

When asked if he thought of himself as an ICT teacher his response was “Yes but I think of myself as an ICT and Business teacher, I don't really separate the two.” Though he now considers himself a teacher of both ICT and business, on considering his route into ICT teaching he identifies ICT as initially being a subsidiary to teaching business which had been his longer term aim.

“Probably alongside the Business Studies having a Business degree and concentrating [on] going into teaching to teach Business Studies but I wanted to get some business experience first. So when I came out of that and into teaching it was pretty much Business that I was thinking in terms of but because of my experience in banking which was heavily dependent on ICT I found that it wasn't going to be too difficult to teach ICT as well. So it came in through kind of in behind the Business Studies.”

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

Barry had received no formal IT education or training during his compulsory or higher education. He had received some training on office and job specific applications in his previous career. He identified that his main preparation for teaching ICT was "...just the experience of using ICT so heavily in my job, coming to the school and realising actually I had already acquired most of the skills required for the curriculum..." Neither during, nor prior to, his ITT had he ever received any input, or encouragement to reflect, on the purpose of IT education.

When discussing his self-efficacy in teaching each of his subjects Barry highlighted the different levels of knowledge and skills needed to teach at the different key stages and recognised that his personal skills and knowledge had been developed at an appropriate level to the classes he was had customarily delivered.

"Well I tend to teach ICT to the lower end of the school where I teach business to the higher end of the school. If I was to reverse that I would probably I would be quite happy to teach Business to younger students. I think I would probably find it more challenging to teach ICT but maybe that's just a confidence thing, but I think as I would be required if I had to teach A-level ICT I think that would be more of a challenge to me to make sure that I was up to scratch as it were and my subject knowledge was what it should be, but maybe that's just because one would be stepping up and the other would be stepping down as it were, in age groups, and therefore the level of the knowledge required, I don't know. But I think I would probably say I would be more confident with my Business knowledge than I would be with my ICT knowledge and that's probably just reflects my training."

When asked explicitly about PCK Barry reiterated that he felt his PCK of business was superior to that for ICT. When discussing pedagogical approaches to both subjects he noted a difference in approach between the practical teaching of skills and the theoretical teaching of knowledge.

"Yeah, it's far easier to take a student and say here's how you use the software lets go and do it, whereas that's harder with Business Studies, although I would love to see students far more involved in practical application of business, whether that's them

4 Findings

practising it themselves or observing others. So I think business tends to be more theoretical.”

4.4 Introducing Curtis

Curtis was in his third year of teaching when the initial interview took place. The school is his first teaching post after completing an ICT PGCE; he had been teaching both ICT and business studies since commencing his employment there. Prior to teaching Curtis had a career in hotel management. He teaches ICT at all key stages and business at Key Stage 4; about four fifths of his timetable is spent teaching ICT. When asked if he identified himself as an ICT teacher he responded “Yes I would. I’m ICT trained, my PGCE was ICT.” This and his response to the question regarding his route to ICT teaching demonstrate that he considers ICT to be his main subject. Curtis’s route into ICT was more direct and premeditated than that of his colleagues.

“Well like I said my Degree was Business and ICT, I mean teaching was always something that I wanted - maybe not wanted to but had considered going into right from University but I fell into this job in the hotel and that stuck for a while and when I decided to make the move into teaching I looked at my Degree and I looked at what I felt more confident teaching with the qualifications that I had and the units that I had done at University and the ICT was the route that I decided to go down. I did apply for the Business one, the Business PGCE as well just in case I didn’t get on the ICT course but fortunately I did.”

Curtis’s IT education started at secondary school and continued, with a break during sixth form, right up to his starting teaching, though only his higher education studies were certificated courses.

“Prior to teaching, after leaving University with Business and IT Degree ... PGCE in ICT. It was my teaching at University, it was my Degree which was I suppose if I was to compare it to something that we would do now it would be similar to the Applied IT, sort of applying IT applications into business situations as well. Do you want specifics?”

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

Not GCSE or A-level, my IT before University, my IT academic history was probably a half term that each student had to do with Word and Excel up, until GCSE and sixth form there was no IT provision or lessons or anything offered.”

He also received limited training on industry specific software whilst working.

“Very little, training on the reservations management system, the room management system and that was basically it in the hotel but into IT and into how it all works and linked together none whatsoever.”

Although he had been exposed to IT education at various stages of his education he had never received any formal input on the role of IT education, nor had he been encouraged to reflect on such.

When discussing his self-efficacy and PCK Curtis identifies that he feels comfortable teaching but feels his degree’s emphasis on IT within business means he has better subject knowledge of ICT and also that his experience during his ITT mean his PCK is also stronger for ICT.

“Comfortable in both but far more comfortable in the ICT. I feel more expert in IT, in the delivery of the IT. I think that's probably because of the Degree that I did was weighted more towards the IT and the Business Studies although I do have the experience and working in business and I have got GCSE and A-level in Business so I'm more confident than with my knowledge of IT. Yes just what I have picked up through my training and watching other ICT teachers in the observation periods as well.

Yeah yeah definitely the ICT and I think that comes from my training, my training students who always had a computer in front of them, there was no Business Studies involved in my training at all. I requested to do a little bit at my second placement but they said you are here for IT we want you to do the IT which was fine but I am more confident with bringing different activities in and the way that I teach with students on computers rather than sat in the middle with an exercise book, I find that I do have to work a lot

4 Findings

harder on bringing, getting involvement and interest from the students while I'm sat teaching the Business Studies too.”

4.5 Introducing Denise

Denise has been teaching for ten years and has taught both ICT and business for all of this time. She trained to teach both subjects on a GTP programme at the school and then left it to teach at another school run by the same school foundation, returning to the school three years later. Prior to teaching Denise had “... spent a long time working my way up through the xxx Bank. When I left ultimately I was a Business Development Manager.” She is involved in teaching ICT at Key Stage 3 and sixth form and business at Key Stage 4 and sixth form; just under a quarter of her timetable comprises ICT lessons. When asked if she thought of herself as an ICT teacher her response was “Yes.” Once more, though she considers herself a teacher of ICT, on considering her route into ICT teaching she identifies that ICT was just part of the job of being a business teacher.

“I decided I wanted to teach in Business Studies so my degree and my past experience and ICT came with the job basically.”

Denise had received no formal IT education or training during her compulsory or higher education. She had received some IT training on job specific applications in her previous career.

“I did learn, you know, sort of to use the computer systems at work and in my job but there wasn't an awful lot of training in ICT... Yeah there was training sessions when there was new sort of work based computer systems that went in, but I mean a lot of that was to do with inputting data or, you know, the systems for managing customer transactions.”

Neither during, nor prior to, her ITT had she ever received any input, or encouragement to reflect, on the purpose of IT education, “Because I did a GTP in the school I kind of learned just as I went along.”

When discussing her self-efficacy in teaching each subject Denise highlighted that as her self-efficacy was closely related to her familiarity with teaching the subjects so although she had initially felt more confident teaching business she

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

was now equally comfortable teaching either. Following this train of discussion further she identified that should the curriculum change so might her self-efficacy regarding teaching ICT.

“I think perhaps in the earlier days when I was less comfortable with ICT there might have been differences but obviously with more experience. I think potentially if it was, you know, if we did change the curriculum then I think I might feel differently.”

4.6 Introducing Ewan

When the interview took place Ewan had been teaching ICT for 18 of the nineteen years he had been a teacher. He trained on a Business and Economics PGCE and then began teaching at the school. Prior to teaching Ewan had worked as an accountant for two years and then in health club and gym management for a year. He teaches ICT at Key Stage 3 and business at Key Stage 4 and sixth form; about a tenth of his timetable is ICT. Ewan thinks of himself as an ICT teacher “Only as a subsidiary subject”. Ewan identified that his ICT teaching was not intended or sought but just was part of being a business teacher. “By chance because I went into Business and Economics and IT was just bundled along.”

Though Ewan catalogues a number of instances of IT training or development during his higher education and career he classifies this as a small amount and identifies that he has had no formal education in the subject.

“Well I did a very small amount; I did nothing at school, very, very small amounts at University, very little. When I started working for the accountant firm we did spreadsheets and basic word processing and it was very much self-taught, here is a manual you have three days to sit down and learn how to use a spreadsheet. I learned on the job and when we were doing the club we used spreadsheets a lot for accounting and timetabling and issues. As part of my accountancy exams I did one module on data processing but really no formal IT education at all.”

When asked if he received any IT education during his ITT he responded that though he had to teach some ICT during his placements he had no formal

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

training and just developed the skills through doing it. "Taught a little bit of IT during teacher training but very little and then it has just been on the job."

At no stage in his education, commercial or educational career had Ewan received, or been encouraged to reflect on the purpose of IT education.

Ewan identified that he felt more self-efficacy when teaching business than ICT identifying that both his subject knowledge and his PCK contributed to this.

"I feel more comfortable teaching Business and Economics because I am not an IT specialist and I do feel it is that IT in a way is more linear, you teach this, you teach this, you develop it, whereas economics and business can sort of spiral off in different thoughts and ideas and concepts rather than a list of skills that we can teach, enhance and then apply.

Its innovative, you can do different things whereas with IT this is how you do it and the students do it then we make it a bit harder and you try to give them a task but you can start teaching an economics lesson and end up really teaching something different to what you planned because that's just the way that the conversation in the lesson went."

4.7 Introducing Fitz

At the time of the research taking place Fitz had been teaching eleven years all of which he had been teaching ICT. His ITT was a Business Studies PGCE; teaching is his initial career. He teaches ICT at Key Stages 3 and 4 and business studies at sixth form with ICT teaching comprising approximately 90% of his timetable. Fitz stated "I think of myself as a Business Studies and ICT teacher." Fitz sees his ICT teaching as having come about incidentally; during his ITT he delivered ICT lessons alongside his business ones then when he applied for the job of Business Studies teacher at the school it was stipulated when he was appointed was that ICT would form the majority of his teaching.

Though Fitz had some IT input (a non-examined ICT course) when at school along with some application specific training when at university he identifies that most of what he knows is self-taught.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

“I had one lesson of ICT every two or three weeks maybe and that was it, there was no GCSE or any ICT qualification at the school I went to. When I went to University there was one unit on databases, Microsoft Access and everything else I've taught myself.”

Neither during any of this IT education and training, nor during his PCGE course was he encouraged to consider the purpose or role of IT education.

Fitz identified that his self-efficacy is the same for both subjects. When responding to a question asking if there were any differences in the way he taught the two subjects Fitz's response starts by stating he felt they were very similar but then continues by highlighting that his subject knowledge is better in business studies and that his approaches are different in both subjects due to the age of the students he is teaching. This continuation, therefore, appears to contradict his opening statement.

“I would say myself very similar in both but I would have better subject knowledge in relation to Business Studies than I do with the ICT but I would like to think that I am getting stronger with the ICT as the years go by. With the ICT it is more of a practical, trying to get it as creative as possible only because I teach lower school ICT and I teach upper school Business Studies so with the sixth form with the Business Studies, it is more chalk and talk whereas with the ICT it is more get them in groups, get them to practise using the software, showing them how to use the software etc.”

4.8 Introducing Greg

When participating in the initial interview Greg had been teaching for fourteen years; he has been involved in teaching ICT for all this time. His ITT was a PGCE in Economics and teaching is his initial career; the school is the only school he has taught in. His ICT teaching is at Key Stage 3 and sixth form and makes up about 20% of his timetable. When asked if he thought of himself as an ICT teacher he responded “Absolutely not.” Greg stated his route to teaching ICT was

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

very much incidental, just being part of the requirements of being an Economics teacher at the school.

“Well the job that I have here was advertised as teacher of Economics which is the job that I applied for then when I got the job, Economics was within the Business Education Department which falls between Business and ICT and hence it was to make up my timetable.”

Greg had some Computer Studies lessons whilst at school; this was for a limited time period and was not formally assessed.

“When I was at school I did about six months with a computer, Computer Studies didn't really understand it, it wasn't examined, it wasn't assessed in any way. So my own personal sort of receiving tuition of ICT is very limited.”

Though Greg had to use a limited amount of IT during his degree and ITT he never received any training on this.

“Well I mean assignments and things had to be typed up but you just word processed that yourself; you didn't actually received any sort of formal training on how to use a computer, I guess because it was only word processing and statistics packages that we use you didn't really - you could teach yourself.”

Greg identified that his knowledge of IT was limited and that of computer science even more so. He feels his knowledge of IT is up to the job but recognises that at sixth form he is possibly less skilled than the students and his most useful expertise to them is in terms of his knowledge of how to help them understand and achieve the criteria they will be assessed against. In terms of computer science he specifies that there will be many students who are far more knowledgeable than he is.

“Well from a knowledge point of view definitely. My knowledge of IT is pretty limited I would say. I know enough to get by probably, the students that we have in the sixth form probably just know a bit more than I do and so I can deliver the courses and I can ensure that they meet the criteria and have the skills to meet the criteria but beyond that there will be some students in the School I

4 Findings

am sure who would know a lot more about, you know especially when you are thinking of the Computer Studies aspect of it, they know a lot more of the mechanics of computers than I do.”

When discussing his PCK in the two subjects Greg highlights a wider range of source stimulus for his economics teaching and also recognises a difference in approach between the two courses. However, he does not identify that he feels he is more confident in either subject, or approach.

“Yeah I think with the Economics there are a lot more sources of information to draw upon or maybe that's just because I'm more interested in it and therefore I read more widely about it and so I do have a lot more sort of stimulus material that I can draw off on to give them. Teaching it is definitely different because most of the IT is generally coursework so you are just setting things and then just keeping a monitor on it really for weeks and weeks and weeks at a time, whereas the Economics is definitely lesson by lesson and you have got certain targets to hit for each lesson and things that you want them to know by the end of each lesson. The Economics teaching I guess it is a lot of it is sort of traditional chalk and talk I would say but there is a lot more discussion and debate and again sort of higher order skills that you don't do necessarily with the IT kids that we have.”

When follow-up questions tried to draw out if Greg felt more confident when delivering one, or other, of the subjects the only contribution it brought forth was that Greg enjoys teaching Economics whereas he teaches ICT because it is part of his role and in order to teach the Economics that he enjoys he also has to deliver ICT lessons.

“I don't mind teaching the IT but I don't particularly enjoy it. I just feel that it's part of what we do in business education and therefore you just have to accept that and just get on with it whereas the Economics I love teaching it and the kids that we have great and ultimately when I applied for the job here to start with it was to teach Economics and so I'm really happy to be teaching Economics; I love doing that.”

4.9 Introducing Heather

At the time her initial interview took place Heather had been teaching for eleven years; she had been engaged in teaching ICT all of these. She had completed a Business Studies PGCE for her ITT securing her initial teaching post at the school after having completed her long block placement there. Teaching is Heather's second career having worked in administration in the public services for a number of years.

“I worked in the public sector for the Benefits Agency for five years and prior to that worked for the Lord Chancellor's Department for three years; the Lord Chancellor's Department was a typing office-based job, the Benefits Agency was an admin office-based job.”

She teaches ICT at Key Stage 3 and it accounts for 35 to 40% of her timetable alongside business. When asked if she considered herself an ICT teacher she responded “No”. Once more she identifies her ICT teaching as supplementary to her business teaching and not sought.

“I did a degree in Business, a PGCE in Business and when on first placement was told I had to teach ICT as I was a Business teacher at the school I was in and then the second placement was also the same and then the job that I got after second placement was also the same in that you had to teach ICT to be in Business teacher in that school.”

When recounting her IT education and training Heather identified training she received on office applications whilst in employment specifying she has received no training during her teaching roles. When asked specifically about her time at school she identified that ICT was not taught at GCSE at her school and that, although computer studies was on the syllabus at GCSE she did not have the opportunity to opt for it.

“IT training from the Benefits Agency in all of the Windows based office software products, Excel, Word and so on. No training at all from any teaching based job, it was all from a previous employment.

4 Findings

As a school child? No. I did GCSE typing; the boys did computer studies, the girls did typing.”

When asked for her feelings as to any differences in her teaching of ICT and business Heather specified that she felt her subject knowledge was much stronger for business and this made her feel she delivers the two differently, she recognises that it may well be a mistaken view but her own qualifications make her more confident in delivery of business lessons. When the discussion moved on to PCK she once more specified that she felt she had more devices to deliver business and also that her self-efficacy was greater in business; though her response once more rapidly turned back to her perceived relative lack of skills in IT.

“I personally feel I haven't got as big an understanding about IT and how it feeds into each level as compared to the Business Studies and how I deliver them. I think I would have delivered them slightly differently because I feel that I haven't got the skills, the skills aren't as great in IT as they are in Business but that could be purely in my mindset because I know I haven't got the same level of certification.

Perhaps purely a piece of paper to prove it but that gives me the mind-set that I have got better skills in Business.

Yes for Business yes and I am more comfortable doing it in Business compared to IT and sometimes depending on the set you are teaching in IT you get the general consensus that the children know more about what an icon does, things like that because they are purely self-taught or they have done it in primary school. And they are very eager to show off in class about what they know.”

4.10 The nature of existing ICT teachers' beliefs regarding the previous ICT curriculum and the recent curriculum change

This section records the respondents' interview responses when asked to articulate their beliefs regarding the role and purposes of IT education and the significance and impact of the curriculum change that is in process. The beliefs

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

related to each research question identified by the analysis are given below. Silverman (2011) identified using unreliable data as one of the main criticisms of some qualitative research. In order to address his concerns responses are presented in as full a manner as possible identifying the questions that initiated the response, whether there were pauses or if further prompting was necessary. As far as possible the researcher has tried to avoid summarising respondents' comments, instead including full data extracts.

4.10.1 What are the current ICT teachers' beliefs regarding the purpose of IT education?

Adrian

Adrian's initial response to the question of the purpose of IT education showed a certain amount of uncertainty, both explicitly stated and implied by the generic nature of his response which was subject independent and could well have been the response to a question as to the purpose of any subject. In order to draw out a more specific purpose follow up questions were asked regarding which of the potential purposes he felt was most significant and if the age of the students made any difference. From these responses it became clearer that Adrian felt the purpose of IT was to prepare students for the workplace; to develop students who knew how to operate software in ways that it is used in businesses so they had a skills base to call on when they enter employment.

“Well I am not 100% sure I have got like a variety of ideas right. It maybe you teach a subject because of its own intrinsic value, it may be the place that you teach the subject because it has got a cross-curricular application or you may teach the subject because it's vital to the future performance of the UK economy and enables students and young people to be more effective participants in the economy.

In what I do the main one is actually teaching the students as a subject in themselves so they can use the software.

So as the students get older there is a different emphasis in terms of - I think like the lower or younger students it is mostly a case of software skills and understanding the systems and then maybe as

4 Findings

they get older there is more a case of how this will help them become more effective citizens.”

Barry

Barry clearly articulated that at present IT education is primarily concerned with providing students with skills so they can competently operate common packages that they will need when working. Prior to this though he identified this understanding of what IT education is was solely based on his experience of teaching in the school, when pressed on whether this purpose was more widely applicable he reflected on his other experiences of IT education to substantiate this.

“I think I can only really speak about the ICT that I have taught so to date from that point of view I think I would say that the kind of number one sort of focus is that we are preparing students to be able to be competent in using commonly used software in a business environment or in a work environment so it is quite utilitarian in that sense... I would find that hard to comment on really because not having taught at any other school so but my impression, the impression I get through media, the impression I get through what my own children are doing in their schools whether that is in primary school through to secondary school is that it is very similar although obviously that's kind of perhaps changing. But that seems to be the priority.”

In his initial response on the purpose of IT education Barry immediately highlights his beliefs as to additional purposes that need to be integrated into IT education.

“But I think as time goes on I think there should be more emphasis on the use of the ICT, not just the skills so understanding how we use ICT, not just in business but in society, the consequences of using ICT, the consequences of using more and more technology, becoming more dependent on it, the use of information in that context and the effect on society and community of the use of ICT. So I think there is much more to it than simply just saying you can use this package. And then I would say something else that you know I have been looking out

4 Findings

over the years is really just the kind of moral and ethical dimension to ICT and preparing students so that they understand how it can or can't be used or how it should or shouldn't be used in society, in their communities.”

Curtis

A lack of formal input on the role of IT education did not mean Curtis had not established a clear picture of what he believed its purpose was. Though he used different terms Curtis sees the role of the subject being to equip students with the skills to be able to effectively use common office applications in their later studies or future careers. He does, however, add a caveat that he believes there is more to IT education than this and that it could be used much more to help students create and unlock their potential.

“I personally see it as - I would like to say it is an enabler. At the moment what we teach is an enabler. It is there to enable students to access the facilities, the systems that they will need in the wider world when they go on to University they will need to know all about the Office tools that they will be using for typing up of Dissertations & things. Also it can get students ready for going straight into the workplace, you know if they have a good background in Excel or Access they can often goes straight into low level jobs and already know how to use these systems and give them a bit of a head start. So at the minute I would probably say it is an enabler which I don't necessarily sort of agree is the best thing for use for IT. I would say IT, it needs to be used as a more creative tool as the route on its own rather than an enabler so students can come up with ideas of their own and hopefully start businesses of their own and go somewhere and create something using IT.”

Denise

Once more despite her lack of formal input Denise clearly articulated her views on the present role of IT education. She identified it is concerned with providing students with skills so they can competently use common software packages that

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

they will need when working or continuing their studies and to enable them to keep up with and use new technologies as they are developed.

“I think we should be giving them the knowledge of ICT that they need to take into their adult life. So I think they should have the ability to use the software that is most commonly required within the workplace or within study and also the ability to look at the changes that are happening within the technology and Computing and also be able to put students in a position that they have the ability to use that new technology and work with it.”

Ewan

Ewan articulated clear beliefs regarding the purpose of IT education, regardless of the fact he had received no formal input regarding these. He identified two purposes that applied to all students. Equipping them with the software skills necessary to be able to participate in their working life and ensuring students know how to use the Internet effectively and safely. He also identified a further role that was only relevant to some students that of teaching programming. When asked to clarify if he felt that this less widely applicable role should only be taught to some students he replied that this did not have to be the case and referred back to the need for every student to achieve the other two purposes implying that they should not be sacrificed for programming skills.

“I think there are two very different strands. One is teaching children basic needs so that the skills that they need to go in their working life and I think every student should have that which is basic, this is a computer this is how it works, an awareness of basic packages like word processing and Internet use and spreadsheets. Also an awareness of Internet issues, safety on the Internet I think that is an important life skill and I think there is a smaller group of students who are genuinely interested in IT as a job or career and that is where more in-depth, more programming based type IT should take place.

Not necessarily but everybody I think whether they like it or not needs basic IT skills.”

4 Findings

Fitz

Yet again a lack of formal input on the role of IT education had not prevented Fitz developing clear views on the purpose of IT education. Once more he highlights its purpose as providing students with the skills to operate effectively outside of education. However, his remit for IT appears to be wider than most of the other respondents in that he does not appear to be solely focusing on office applications and he explicitly talks about IT education's role in teaching students to be responsible users.

“At present I would say that it is to make sure that students can use ICT effectively so that is in their social lives and also in the world at work so that's responsibly as well. Also I think there's two different parts before the changes take place so you have got ICT which is the using of the software, the using of the technology to solve problems and then you have also got digital literacy, trying to make students think about how they should use technology responsibly.”

Greg

Greg could articulate clear views on his understanding of the purpose of IT education despite having never had any formal input or encouragement to reflect on this. He feels the role is to teach students how to use common business applications; he specifically states that it is not about teaching how computers operate.

“I have to say that I have always thought of it as just a mechanism to teach people how to use various Microsoft Office packages. I've never neither enjoyed or thought of it as something whereby I have got to show the students how to open up the base unit and identify the different components and so on and that's not something I would personally be either comfortable or confident doing anyway so I guess that's probably why.”

To try and establish a fuller understanding of Greg's beliefs regarding the purpose of IT education he was asked to identify features of a good IT lesson. He noticeably found this question a challenge initially stating that he couldn't identify any before asking two further questions to clarify what he was being asked to

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

provide. The answer this clarification instigated just reiterated Greg's difficulties at identifying such features so a further prompt was needed which suggested he consider essential elements or activities within such a lesson. This led to him identifying that the student should leave the lesson having developed a new or existing IT skill.

"No. What sort of year group are we talking about here? Any year group?"

Oh dear. This is a tricky question. I do remember having to write a thing for write a thing for a booklet a few years ago which said this is an outstanding IT lesson.

Well you think you are always trying to teach them some type of skill so if they come into the classroom knowing a little bit more by the end of it than they did at the beginning with regard to be it using a formula or query or whatever it might be then that would be a success."

Further discussion regarding how students are now arriving at the school with more advanced IT skills led to Greg reflecting on how the role may change so there is no need for set aside IT lessons rather that subject teachers would just instruct students how to use a specific package that would be beneficial to their subject within their subject lessons.

"Yeah I mean I think the more years go by now and the kids are coming in especially in year 7 they are quite IT literate really and so the actual call to remove the necessity of teaching ICT as a key discreet subject I can see you know I can see where that is coming from, I could understand if that did actually happen and we were then left with no IT to teach because it was just delivered across curriculum.

Not that I want to do myself out of a job; It is understandable."

Heather

Despite the fact Heather had had no formal input, or encouragement to reflect, on the purpose of IT education she had very clear beliefs regarding this. The purpose she identified moved beyond teaching students to be capable users of

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

office applications considering its role as not just developing students understanding of the operation of ICT applications but also computer systems. Her response shows an appreciation of changes to how IT is being delivered across Key Stages 1 and 2 have altered its purpose at Key Stage 3 and beyond.

“To give the learners an understanding of how ICT operates in the real world, be it how it is used or how to build up a computer or how to program it.

I used to think that they didn't do a lot at primary school but then last year I found out that they are actually doing what our year 7's are doing ... PowerPoint and a Publisher document and a Word document as well as the year 7's that we have on our scheme of work, so if anything, I think we need to upping our game a little bit. Because I used to find out when we got year 7's 10 years ago they didn't really know how to do a PowerPoint or a Word document unless you got top set, whereas now I've got bottom set 10 years later and they come and they can more or less do it because the primary school has got the kit whereas they never used to have the facilities. [At] GCSE and A-level I think personally I feel that they are too pitched at too low a level, they talk about how ICT is used in the real world but at GCSE and A-level from what I understand that, it's not getting into the computer science side of it which I personally think it should be.”

Heather's discussion of a good IT lesson clearly identified both a specific lesson she had observed and her rationale for judging it as good which was that the teacher had communicated knowledge to the students, demonstrated skills, given an opportunity for students to practise these skills and spent time checking students' understanding. She further emphasises that she feels all lessons should have some practical element and that she has yet to experience a perfect lesson.

“I don't know if I've seen a perfect one; the best one I have seen was delivered by a colleague who is now Head of IT on databases and I was teaching the same course with a different class and he said why don't you come in and watch how I teach databases because the children were struggling with it, because

4 Findings

it's not something they would use as an application like PowerPoint or Publisher, and the way he put it across delivering it purely through the use of a projector and this is what you do and this is what happens if you click on whatever was one of the best IT lessons I have had but I think that was partly to do with the way he delivered it and his knowledge.

That particular lesson had him talking at the beginning explaining for maybe 20 minutes and then 20 minutes of them doing what they had seen and having a go with a case study and then him doing a re-cap at the end so yeah it had a mix of listen and then do and then show understanding at the end. I think all lessons should be a practical so that they have to do something. I don't think I have ever seen a perfect one."

Summary

Despite the assertion that beliefs are difficult to identify and specify all of the respondents in this study presented their perceptions and beliefs without difficulty. The teachers included in this study appear on initial enquiry to hold common beliefs regarding the purpose of IT education with all, excepting Heather, recognising the focus of IT as to equip students with the relevant skills in the most commonly used applications. However, a more in depth consideration of their responses reveals much more multiplicity; they each extend this focus in some way. Adrian, Curtis and Ewan note the need for students to develop such skills as to enable them to take up employment and contribute to society; Curtis also identified developing students' creativity as a goal. Denise recognises a need for the subject to ensure students are able to adapt to new technologies as they are introduced. Barry feels a need to address the ethical and moral dimensions of IT use in society. Fitz recognises a need to focus on IT's potential in problem solving and cognitive development. Greg's dichotomy is slightly different in that he did not identify an additional purpose but rather questioned the purpose itself suggesting that now students use IT so much they develop the skills without the need for formal input. Though Heather did not identify the same key focus as the other respondents she still identified a duality of purposes: ensuring students understand how IT is used and operates in the real world and knowing how computers are constructed and programmed. The responses of the

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

ICT teachers in this study reflect the complexity that is present when considering the purpose of IT education.

The current study suggests a number of distinctive different teaching orientations exist in practice within ICT teachers, though the complexity of each respondent's multiple beliefs would make naming such orientations and classifying the teachers within a distinct one problematic. This complexity is hardly surprising given that teachers' orientations regarding their subject are shaped by multiple beliefs, and a belief system that contains many dimensions including beliefs about the goals or purposes of teaching the subject.

4.10.2 What are the current ICT teachers' beliefs regarding how effectively the existing ICT curriculum achieved these purposes?

Adrian

In discussions of whether he felt he was achieving the purposes he had identified in his own teaching of ICT Adrian responded that he felt so in his teaching but this only extended to the end of Key Stage 3.

“Yes. I think in terms of examination performance of students and student participation and student engagement, the students seem to enjoy what they are doing. They get a pretty good grasp of the experience of using the software that we do here so which is about Key Stage, end of Key Stage 3 and then beyond that it's a bit difficult for me to comment because I have not taught GCSE IT for about three years.”

Barry

When asked if he felt he was achieving the purposes he identified in his own ICT teaching Barry recognised that he was only doing so to a degree with the focus of his response being the extended, moral, purpose he identified.

“In part, in part because some of it just comes through in the kind of hidden curriculum as it were in the way that I teach. I would like to do it more but it simply time really has prevented me from kind of spending a lot of time looking at that, that is something that I would like to do and it is something I do on an ongoing

4 Findings

basis. So what is perhaps increasing but no it's not something I would say I am anywhere near to having arrived.”

In response to a follow up question to clarify his comment on what is preventing him achieving the aim he identified that the current curriculum could accommodate this extended purpose.

Curtis

Curtis states with some confidence that he feels his application of the current curriculum meets the purpose he outlines. This response, however, ignores the fact he had previously stated that he felt there was potentially more to IT education than the current main focus on skill development.

“Yeah I think so yeah I definitely think so, I think the courses that we teach, well up to year 9 with the functional skills and previously with the Applied, I definitely think that the children are left with more skills and the ability to be able to use those skills and recognise places to use those IT skills in the workplace. I think they are at the moment yeah.”

Curtis’s response uses the first person plural, we, rather than I even though the question clearly articulated his teaching rather than within the department. This implies he feels his experiences and understanding of what he is trying to achieve, and is achieving, is shared by other department members.

Denise

When Denise was asked if she felt she was achieving the aims of IT she had outlined in her own teaching she again recognised that she was only doing so to a degree. “Not all of them. Some of them, but not all of them.”

In response to a follow up question to clarify which aims she did feel she achieved she identified that she felt that most success was achieved when looking at teaching students skills to use software extending her response to identify that the other aim she had identified was lacking.

“I think, I think yes with sort of the ability to transfer the knowledge of using appropriate software but I think we could do more with teaching towards the way technology has changed and

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

in terms of video and audio and web design, things like that, that we don't do.”

When identifying what is preventing her achieving the aims she identified she spoke about both skill levels and resources.

“I think because it's two things, I think one, the lack of teachers' knowledge and opportunity to gain that knowledge and two, I think it is the ability to deliver that without the actual resources.”

Though the question specifically referred to her teaching and her lessons like Curtis Denise's responses use the plural first person pronoun, we, and also the depersonalised noun, teachers with the same implications as discussed previously. In Denise's case it could also demonstrate a need to attribute a lack of success to, and share it with, other members of the department hence protecting her self-efficacy and esteem.

Ewan

Though Ewan explicitly states that he thinks the aims of IT education are being achieved most of the component parts of his answer suggest that this is not necessarily his true belief. His answer starts by stating he can only comment on the basic skills as he only delivers on the Key Stage 3 courses he follows this with his assertion that the aims are met in terms of delivering content. Yet this is immediately countered by a questioning of whether delivery is successful and an implication that what is being delivered is no longer relevant to what the students need. Again his responses use the first person plural, we, implying he feels his experiences and understanding is shared by other department members and potentially attributing and sharing any lack of success with them to protect his self-efficacy and esteem. Taking all of these factors together it appears Ewan's statement that he thinks the aims are achieved does not reflect his true beliefs.

“I am not involved in a specialist strand and I haven't been for a number of years but in terms of the basic skills I think we do when we deliver Key Stage 3 we are trying to teach them, with what degree of success I don't know, but we are trying to teach them basic work skills, basic life skills. So that is certainly an aim. I think we have got to be careful that there is a divergence between what is happening in the classroom and what is happening in the

4 Findings

real world and it does worry me that we are teaching basic skills when kids out in the real world are doing things that are really probably quite complex.”

When he was asked to consider what constraints prevented him achieving the stated aims he identified the students and their ability as the most significant constraint.

“I think sometimes the groups themselves can hold you back. You have got to be able to get the basic skills and basic understanding ... with the weaker groups we have really struggled to get that basic knowledge ...so I think it is mostly student ability rather than desire.”

Fitz

Fitz identifies that he achieves a purpose in providing students with the skills and guidance to obtain their qualification but his response demonstrates that he does not feel this is a full measure of achieving the purpose of IT education. He identified that the current qualifications don't help students develop the creativity and problem solving skills that he feels should be incorporated into IT education.

“I do feel I achieve that as in students leave with a GCSE or a BTEC or Applied GCSE qualification. I am not 100% sure that students are leaving with the creativity, the problem-solving skills that I think they should be leaving when they have done an ICT qualification but due to the fact that we used to have to do four big huge bits of coursework that did basically the same thing all the way through, it just felt a little like we were jumping through hoops for the students to get the qualification rather than teaching problem-solving creative skills that they should be getting taught.”

Greg

Greg is confident that he achieves the purpose he has recognised for IT education.

“Yeah I definitely think that they get the skills definitely and I think that all of the kids we come into contact with do end up with a

4 Findings

good understanding and ability to use basic Microsoft applications so yeah.”

Heather

Due to Heather's belief that IT education's purpose is to ensure students are in a position to use IT in their future employment she found it hard to say confidently that she was achieving this purpose as her knowledge of how IT was used in commerce was out of date. She is hopeful that she is but without the up to date workplace experience she is not sure.

“I would like to think I do but I couldn't say for definite yes because I have been in teaching quite a while and I don't know what is actually going on in the outside world. I would like to have a good guess and think that I was right but without actually going working back in an office and seeing the wider environment it would be a guess. I wouldn't have a clue what goes on in business now and how it works. It would be nice to go out and see it. Because what I am basing my opinions and assumptions on as far as getting across what I know is possibly 10 years out of date.”

Summary

Once more at face value there appears to be considerable agreement between teachers that the current curriculum does achieve the aims of IT education with all respondents recognising that, to a greater or lesser extent, students are achieving the main purpose of developing skills in common used applications. However, when full answers are considered this apparent consensus seems less convincing. Only Curtis and Greg do not add any caveat to their statements that the purpose is achieved. The other respondents all either state clearly that purposes are only partially achieved or provide extended responses that show they do not believe the curriculum is wholly fulfilling its purpose. This could be attributed to the fact that the respondents recognised multiple purposes and only the initial, development of software skills, one was being addressed. Due to the fact that they had each identified different additional purposes their beliefs on what purposes were not being achieved were all different. Each respondent

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

identified a different additional purpose for example “...teaching problem-solving creative skills that they should be getting taught.” Fitz; “...there is a divergence between what is happening in the classroom and what is happening in the real world and it does worry me that we are teaching basic skills when kids out in the real world are doing things that are really probably quite complex.” Ewan; “...I think we could do more with teaching towards the way technology has changed...” Denise. Due to this there is significant disagreement as to how and/or where the existing curriculum was failing to meet the purpose of IT education.

As well as the explicit statements given above additional caveats demonstrated respondents were not confident the existing curriculum was achieving the purpose, such comments included that they were only commenting on part of the full curriculum: “...end of Key Stage 3 and then beyond that it's a bit difficult for me to comment because I have not taught GCSE IT for about three years.” Adrian; “...I think we do when we deliver Key Stage 3...”; or that their own real world experience was out of date so no longer a useful benchmark “Because what I am basing my opinions and assumptions on as far as getting across what I know is possibly 10 years out of date.” Heather. Hence, despite first impressions, there is actually a lack of concurrency as to how effective the existing curriculum was in achieving the aims of IT education.

A number of the respondents constructed their responses using the plural first person pronoun, “we”, and the depersonalised plural noun, “teachers” indicating the need to associate and claim commonality of their experience or beliefs with others.

4.10.3 What are the current ICT teachers’ beliefs regarding how effectively the new Computing curriculum will achieve these purposes?

Adrian

During the initial interview Adrian responded to the question of whether he was aware of the proposed curriculum changes with an undeveloped affirmative, “Yes”. Further probes revealed that he initially heard about it on the news in January or February. His explanation of his understanding of what the proposals

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

were was also relatively brief giving little away about his perceptions of the differences between the different subjects involved.

“The proposed change is moving away from ICT in the sense of software and ICT Systems towards Computing and computer science... my understanding of it is that there will be a much, much, much greater emphasis on Computing and computer science rather than teaching software.”

Adrian’s response when asked if he thought there was a difference between the two subjects was a non-committal “I don’t know.” requiring yet more prompts to extract the differences he could, or would, identify. In this further explanation he substituted the term programming for computer science when making comparisons with ICT implying that he believes computer science is exclusively programming. He clearly identifies ICT as being about using software.

“I think there is. I know nothing about programming, programming does not appear in what I teach, really. ICT is the actual use of the software and programming is the actual creation of it and its application at an industrial or a business level.”

In further discussion Adrian was asked if he felt one of the two subjects, Computing or ICT was more important. He identified they were both important as everyone needed to be able to use ICT but that there were distinct skills shortages that Computing might be able to fill.

“I think they are both important because people need to be able to use ICT, have an understanding of the impact on society but in terms of competitiveness in the economy, industrial applications, the country needs to train more people, so there is almost sort of a vocational need I think for Computing and computer science.”

When contributing his views on whether he personally felt the curriculum needed changing Adrian provided one of his most developed unprompted answers of the interview. This response recognises that though he understands the need to move down the Computing route due to the current skills shortages he identifies that by moving from ICT to Computing there is the possibility of just substituting one skills gap with another. He also takes this opportunity to challenge some of

4 Findings

the criticisms being levelled at ICT teaching in general and highlights the fact that the current body of teachers will need training to accommodate the move.

“I'm not sure whether it's necessarily all completely a good idea. I think there is a need for Computing and computer science but you could lose a lot of skills if you don't teach people basic ICT skills, so we might have lots of computer scientists who can't word process; I am being flippant but that's where I see it going. I don't agree with Michael Gove when he says that bored teachers are teaching students who are bored with lessons, basic word processing because when I teach students basic word processing they do seem to enjoy it. I think there is a big staffing/training resourcing issue as well that would need to be addressed and where the funding from that comes from I don't know.”

In a follow up to this discussion Adrian was asked if he thought how the two subjects were taught would be different. He responded that his feelings were that they would be yet he was unsure of how these differences would manifest themselves.

The discussion then moved on and started to focus on the positive and negative effects of the proposed change on Adrian and his teaching at a personal level. He identified it may influence what he does as a teacher and that this may involve some retraining. Adrian did not specify if he felt these consequences were desirable or undesirable he merely identified them as possible outcomes of the proposed curriculum change. The reason for this failure to classify and lack of certainty on the personal impact might be accountable to the fact that he is not certain that the proposed change will, in fact, take place.

“I'm not sure, I'm not sure, because I am getting the impression there may be a little bit of backtracking in terms of what's actually going to happen with the curriculum and I also think that ICT that we teach does have a lot of value and to lose it would be a bad thing to do.”

4 Findings

Barry

In his initial interview Barry identified he was aware of discussions regarding the curriculum change, though he recognised that his appreciation of the discussion was limited, responding to the direct question regarding his awareness with “Yes but not in any great detail but yeah.” When asked if he, personally, thought there was a difference between ICT and Computing he responded “Yes. Don't ask me what the difference is.” Bearing in mind that his understanding of what IT is was based on what he had been called upon to teach it is not surprising that he would struggle to make a concise explanation of the difference as he had never delivered a Computing curriculum. However, when explicitly asked to try and explain the difference he reiterated his understanding of what ICT is and its near universal usefulness and discussed the fact that Computing was less universally relevant but failed to explain what Computing was.

“Well it's kind of what we were talking about before. You are kind of teaching people to work in an office you know if you teach somebody to use Microsoft Office what you are really doing is teaching them to use ICT in their studies at University, so it is really the kind of focus on, you know technology being tool to support what you do elsewhere. Whereas I think with Computing that is a different matter. I'm not sure that it is as universally useful as teaching ICT in that for most people, the vast majority of people, will need to use, you know, office-based ICT wherever they are whether in a charity, government, at home, business, wherever. Whereas I think Computing the emphasis or the direction it's going, you know I think less people, less students will see its relevancy I think to their future and so it will be a narrower group of people perhaps who want to study it further. So I think you will probably see less people engaged with it.”

When pressed further to identify what he thought Computing was his initial statement showed a reluctance to commit his views even though he clearly had an unambiguous appreciation of what Computing was to him. His response states that computer science is predominantly about programming and though he does refer to there being other aspects to it his appreciation of these seems

4 Findings

vague at best. In his response he identifies tacitly that ICT is concerned with being able to use software.

“Unfortunately you are recording this. How do I sum it - I mean it represents to me everything that is involved with programming and you know the kind of science behind it all. Yeah that's what it represents to me. And so I think it's one thing to kind of be able to use software, it's another thing to know how to program it and the usefulness of those two different things are very different and the application is very different.”

When asked to identify which of the two, ICT or Computing, were more important Barry identified the subjective nature of such responses and a somewhat philosophical response, which was in marked contrast to his previous responses relating to the practicalities of ICT and teaching it. He also implies Computing and computer science are the same in his view.

“More important for me, more important for students - I think it's a kind of relative term isn't it. Clearly without the Computing, the Computing science, you know, you are not actually going to have the packages to use so in that sense the chicken and the egg I suppose, yes it's important but is one more important generally from a kind of practical day-to-day are we producing students that can work anywhere - I think the ICT is probably more important because the skills are more generally applicable to people's kind of daily life, whatever they do but then if they wanted to pursue a career in Computing can obviously students are not being given as it stands are not being given the opportunity to kind of discover that area of knowledge. So yes I think it's probably important that we have both but you know at a general level, certainly the level I teach at lower school and I would feel that the ICT is probably more important.”

Barry was asked if he felt the current curriculum needed changing. His answer identifies his reluctance to move to a Computing curriculum. Though he attributes this to his personal lack of knowledge taken with earlier responses it also implies a level of satisfaction with the current curriculum, despite the recognition it needs expanding.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

“I think I wouldn't like to see the curriculum stay as it is but I would prefer to see the curriculum developed in not just how to use ICT but how to use the information wisely you know, the impact on society and so on. I think that's something that needs to be developed more but then specifically to the changes towards Computing, I probably am if I'm being honest, I probably am nervous about it because you know my knowledge probably is not what it needs to be if we do go down this route”

Having established that Barry identified there would be differences between ICT and Computing in what was taught he was asked to consider if there would be differences in how Computing was taught; he expressed that, though he could be wrong, he didn't feel there would be much difference.

Following on from this discussion Barry was asked to identify the positive and negative implications of the change; he was encouraged to consider how the change would affect him and his teaching at a personal level. Barry's responses clearly identified that he felt any personal benefits of the change were not significant enough to outweigh the personal drawbacks they would bring.

“It might improve my subject knowledge. I don't know it's not something that really excites me; it's not something that I am saying this provides me with a great new opportunity and a new direction in my teaching. It's not something I would particularly choose to pursue.”

Barry's lack of enthusiasm for the change and the new focus on computer science was further demonstrated in a response to an apparently unrelated question. When asked when he had identified the purposes of ICT and Computing education in the way he had his response focused on the fact that Computing was focusing on areas of IT that had never been in his realm of interest rather than the timing of the development of his beliefs.

“If I'm being honest it is not something I would choose to do. Yeah it's not something I would probably choose to do, if I had to then I would probably get on with it from a sort of pragmatic point of view but it's not something I would choose or relish to get into and that's probably been the same looking back on it when I was

4 Findings

in industry. There were those that I worked with who were much more interested in sort of the developmental side of the systems we used and also there were others that were much more interested in the use of them, the application of them and I am definitely being in the latter and I think that probably is still the same.”

Despite this implied negative view of the personal implications of the change when explicitly asked what the negative implications were for him personally his response, identifying his lack of skills, was brief and implied that he felt it was an issue that could, and would, be addressed.

“The skills gap I think that would be something that I would need to address either just by myself or perhaps for others if it is something that needs to be tackled collectively by the School... but on the other hand I am saying to myself well that's fine I get on with it and I'll do it and you know if it requires additional training and knowledge and skills acquisition then I will do it and get on with it.”

Curtis

Curtis was aware of the curriculum change at the time of his initial interview. He understood its implications in terms of the disapplication of the current National Curriculum and moving to a prominence of computer science at all key stages so that students could move beyond capabilities in office applications to being able to create their own applications.

“My understanding is there is no longer a national curriculum to follow currently at Key Stage 3, there is an emphasis in Key Stage 4 moving on to computer science, sorry throughout the curriculum as well computer science rather than ICT, wanting to give students the skills to be able to go and create with computers and understand how ICT actually works rather than going and carrying out a task on an office application.”

When asked if he personally felt there was a difference between the two subjects Curtis responded “Yes”. To a further question asking him to explain his

4 Findings

interpretation of the difference between the two subjects Curtis identified that Computing focused on why things worked in certain ways rather than teaching how to do things using common office applications.

“With the ICT the information communication technology I think is the enabling force, it is there, the skills to be able to go into an office and write or create a PowerPoint, design a website using WYSIWYG software, whereas I think the Computing it is the more holistic approach like the Business Studies, it is more how it works, why it works, the steps that you need to go through to get to actually do something, the why and how rather than the do of ICT.”

On discussing his personal response to the change Curtis said that initially he did not perceive a need for the change but that as he reflected more on the proposal his thoughts changed.

“I kind of was a bit well they don't really need to know that because the majority of students they will go straight into work and they will be expected to know how to use all these other systems but that will come with the Computing knowledge when they understand how things work, what's on the screen will become quite simple for them anyway.”

In a follow up question to clarify his opinion he clearly specified that though both were important but that understanding why things happened would help students develop the ICT skills meaning that in the bigger picture computer science was more important.

“Like I say I think they both have a place but I certainly think that currently there needs to be an emphasis on getting students involved in computer science. I just think it will give students a far broader understanding of computers and from that will come the ICT knowledge as well in there.”

When discussing if teaching ICT and Computing will require different classroom approaches Curtis very quickly moves on from talking about a different environment to the impact this, and the change in content, will have on students. He then proceeds to state that both teaching and expectations of students will

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

change to a more academic approach requiring accumulation of a body of knowledge.

“Yeah I think you'll find the environment will change, it will become a lot more of a technical environment. I think the language that will be used in the classrooms will be different. It will probably feel more like technology or a science lesson to begin with a lot of the time with students or maybe even a maths lesson. You may find students finding IT computer science whatever we want to call the lessons a lot harder to begin with and a lot harder to get their heads round but once they do get their heads round something you may find the students, they value the success slightly more than they will of wow I have created a PowerPoint that can run on its own. It might not be every student, some students might just find it very dull, very boring and not interested in this, why can't I just make PowerPoints but other students will really get into it. I think you will see teaching will change, I think it will become a lot more academic. There will be a lot more emphasis on students remembering sequences work, not necessarily formulas but to use maths students will remember formulas and science they remember the periodic table, in Computer Studies in computer science they might have to remember a lot of tags that go into certain elements of coding. So I think we will see that difference in the classroom.”

In response to a subsidiary question regarding the activities the students would be engaged in he identifies the fact that students will be creating code rather than making documents on common office applications.

“Yeah there will be a lot more I say they are making, there might be a lot more creating rather than making if you know what I mean, if I am saying making a PowerPoint you are writing you are creating a piece of code that does something on the computer rather than using and making a PowerPoint I think definitely that will be a change in the activities they are doing.”

4 Findings

To further explore Curtis's beliefs about the curriculum change he was asked to identify what he thought would be the positive and negative outcomes of the change at a personal level on him and his teaching. He recognised that the change will be a challenge but that it is a challenge he is relishing; looking forward to developing new skills and refreshing his teaching. He doesn't perceive any negative implications; he is aware of the need to re-skill but does not perceive that as a negative thing rather a natural and ongoing process for a teacher in the field.

"I think it will be a challenge but it will be I think it could, it will probably reignite a little bit of, I am looking forward to it I know that already. I think it will probably improve me as a teacher, it will mean that I will have to develop my teaching further, probably pick up more skills into how to offer these possibly more logically thinking minded lessons to students rather than my current ICT teaching at the moment. So I'm very much looking forward to it and hopefully the changes that come with it with me as a teacher. I don't necessarily foresee problems. I know that I will need a serious knowledge update and some re-skilling but I don't necessarily see that as a problem. I've always thought that would be par for the course for being an ICT teacher with technology moving on and changing anyway continuously."

Denise

When asked in her initial interview if she was aware of the proposed curriculum change Denise's response not only specified that she was but also identified how she had developed her understanding of the change and outlined this in terms of a move from ICT to Computing.

"Yeah. Yes kind of. I've read a little bit about it. I understand, you know, that they want to move away from a lot of what we are doing now and make children more able to study Computer Studies as opposed to what is traditionally thought of as ICT."

When prompted to clarify further the difference between Computer Studies and ICT her response started by emphasizing that she felt there was a very distinct difference in that the former was predominantly concerned with writing and

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

understanding programs whereas the later is concerned with using computers effectively.

“I think there are differences definitely. I think computer science is more interested in being able to write the programs and understand how they operate than actually just being able to use a computer which I think is a bit more what ICT is about.”

Responding to an enquiry if one of the two subjects was more important Denise’s response was clear and specific in identifying they were both of equal importance; “Not particularly. I think we should be doing a balance of both actually.” When asked if this were the case for all students she answered in the affirmative; “Yeah I think all students should get some kind of input from both sides.”

Denise identified that there would be differences in the classroom if the change took place identifying the main areas of change being student engagement though she notes that there is also a potential to put students off if the change is too extreme.

“I think it will make it, in terms of a student, I think potentially it has got the opportunity to engage them more, a bit more relevant. Yeah it’ll definitely make it more interesting but I do think that, you know, there is the potential to jump too far the other way as well. So I think as I said it probably needs a balance.”

When asked if she felt the curriculum needed changing Denise’s response was “Yes”. In order to clarify this response she was asked why and she highlighted the fact that students’ experiences of using IT outside of the classroom had changed so much it had made much of the existing curriculum redundant.

“Why because I just think that some of the things we do have lost relevance because of the things the students will have a huge amount of knowledge of already, in the fact that they live on computers at home, so things like teaching them how to search the Internet etc., doesn’t to me seem very relevant anymore because they all, you know are pretty capable of doing that on their own. I suppose it’s just seeing the skills the students already bring to the classroom and the knowledge they have already.”

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

In a supplementary question, Denise was asked how she would like to see the curriculum change. She not only identified the changes she would like to see but also why these would be beneficial. She expressed a desire to see the curriculum become more relevant helping students develop skills to understand and write programs and proposed that this would both improve all students' experiences and help with student progression.

"I would like to see us you know sort of getting more involved in a certain amount of relevant, you know, ability to understand what programming is and for the students to be able to do it or have an understanding of you know how it works and to learn some basics which I think if nothing else might engage them and interest them, so that those who have that ability can, you know, sort of move into that subject, which I don't think we are necessarily encouraging students to do at the minute."

In discussion of the positive and negative implications of the proposed change Denise identified a number of repercussions at a personal level. She expressed that she felt it would involve training which would improve her skills but in reality just meant that she had more to learn.

"Yeah I think the benefit for me is that hopefully I will become, well I will get some training I will actually have better skills as well ... For me just something more to learn."

Ewan

Ewan responded "Oh yes" when asked during his initial interview if he was aware of the proposed changes. When a follow up question asked what his understanding of the changes was he started by outlining his understanding of why the changes were deemed necessary concluding his response that the changes were to introduce programming and not just focus on teaching office applications skills.

"My understanding is that IT has been accused of being very much teaching students how to use Microsoft packages which is utilitarian, it is basic, it is brand based, it isn't challenging and it is academically [not] considered to be a valuable subject and the changes therefore are trying to bring a higher degree of thought,

4 Findings

creativity and academic rigour by trying to introduce more programming rather than simply learning how to use the current packages.”

In reflections on his own interpretation of what ICT and Computing were Ewan identified that he did recognise there was a difference but that he was unsure if it was as pronounced as was being implied and identified in the debate regarding the curriculum change.

“The difference, the way I understand the difference is that IT has been seen as how to teach people how to use computers whereas Computing is teaching people how to program and develop computers. I'm not so sure I necessarily agree with that but that to me is the distinction. I'm not, I'm not convinced, yes there is a difference but I'm not convinced it is as stark as how he is expressing it.”

When discussing the relative importance of each subject Ewan specified that that would vary depending on the student in question; all students would need ICT but some would desire the more specialised skills that Computing delivers.

“It depends on the kids. Those two groups of consumers, there's those that need basic IT skills and I think everybody needs them but then there are those who want more specialised skills and I don't think most young people need specialised skills, but I think they all need the basic skills.”

During discussions on how the changed curriculum might affect what goes on in the classroom Ewan initially identified personal uncertainty and then the fact that the changes were not going to be introduced as rapidly or dramatically as some parties believed due to the lack of clarity regarding the new curriculum and related GCSE specifications. This leads him to identify how the curriculum may change rather than how classroom and pedagogical practices might.

“I don't know. We were told from September 2012 there would be changes. I think there is a perception of people not directly related to those changes are happening, have happened, actually the exam boards, the curriculum has not followed the kind of expectation. There's nothing I mean [the principal] was asking at

4 Findings

a meeting are you looking at these new courses then, are you choosing a new course to do, there is never new courses. So at the minute I haven't seen any change. I suspect there will be; perhaps we will go back to the kind of GCSE that we taught 10 years ago that was a bit of both.”

Even on further probing Ewan focuses on the new areas, skills and activities that might be introduced rather than any change in purpose or approach. Only on a third request for clarification regarding the nature of the subjects does he specify that he still feels the course will predominantly be sitting at computers learning skills and that the programming will be taught in this way rather than as an academic discipline and even this comment comes at the end of a response predominantly focusing on what packages the students will be asked to operate.

“I think there will be more things like writing an app, perhaps doing a little bit of control. There will be a less sort of databases I think, that kind of stuff. I'm not convinced it is going to be massive.

Oh I think it will be on the computer but I think they will be doing different things, I think they might be doing more interesting things. I think they will be doing less kind of Microsoft based packages but I don't think it suddenly going to change from not working on computers and doing really look book based academic learning programming no.”

Ewan's appreciation that a discipline's purpose and role is synonymous with what the students are asked to learn is reflected in a conversation regarding what a good Computing lesson would look like where he stated “Without access to a curriculum to know what is involved it's difficult to know.”

When asked what his own views were on the necessity of a curriculum change he observes that courses have moved away from a mix of theory and practical skills and talks of adjustments to the curriculum to reintroduce some of the theory that was present in previous GCSE courses. He also takes the opportunity to highlight his disagreement with the implication that what is taught at present all need replacing.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

“I think the curriculum has probably slipped a bit too close towards teaching students to use the computer and not enough background theory to it. I think it probably needed realignment. I think the way it has been presented in the media is everything that is done is rubbish, it should be scrapped and we need to do it properly. I don't think that's the case I just think it needs a bit of movement back towards a more theoretical basis, rather than scrapping everything.

I think a little bit of movement away from basic skills and more inclusion of computer science would be good. I think it would be wrong to go totally towards computer science because then the kids don't have the basic skills that they need.”

When questioned on why he feels there is value in what is being taught at present Ewan once more asserts that all students need basic ICT skills.

“Because I think the children need to know the basic skills, they need to know basic skills - yes the programming and the more theoretical background is good but most students don't need to know it but they all need to know the basic skills.”

Further discussion uncovered the specific elements that Ewan would like to see reintroduced referring to the historic inclusion of programming in the control elements of previous GCSE specifications.

“I would like to see GCSE IT courses become a little bit more theory orientated so the students should do a little bit of programming, a little bit of control, a little bit about input/output process systems, a little bit about more applications of IT, how the networks work, how is IT used in industry. The kind of course that we used to do 10 or 15 years ago.”

In justifying his suggestions he cites the need to provide students with educational experiences that are of use for a period of time and that teaching them package specific skills fails to achieve this as packages change so rapidly whereas the knowledge of how and why computer systems operate has more longevity.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

“This is my hobby horse. I think if we are teaching those things about IT then they are not transient, they stay with the student. The basic idea of how does an IT system work, how can it be used, how can it help people are the same now as they were when we were talking 15 years ago. If you just teach them how to use a package, the package changes and changes and changes and those skills become useless but I think if you include the theoretical core and understanding of why things are done and how to analyse a problem in IT and how to solve it then that is a basic course skill that stays with the student forever.”

When Ewan responded to the enquiry as to how the curriculum change would affect him and his teaching at a personal level his response initially focussed on students, highlighting that it would enable students to progress further with the subject. When he did move on to how it would impact him he observed that it would be harder to teach, though he went on to stress that he feels the general opinion is that this will be much greater than it will be in reality.

“I think it will make it easier for students to progress if they want to take IT further I think it will make it easier. I think it will make teaching IT harder but I also think there is a lot of panic that's going to make teaching IT much, much harder. I don't think it will be much harder. I think it will still be accessible and I think the same teachers will still be able to teach it, they might just have to do a bit brushing up.”

Fitz

Fitz had considered some aspects of the proposed curriculum change earlier in the interview. When discussing the role of IT education he had already referred to the changes and his views regarding their purpose. At this time he had not only identified some of the content changes being put forward but also some of the changes to when students meet Computing both of which he identified as constructive. However, he also highlighted the fact that he believes some of what is currently on the curriculum is of value and that it should not all be changed. As the discussion progressed Fitz specified that each of the three strands being proposed had a different but interlinked purpose.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

“I think that the decisions that are being made are positive in that I think that there is a place for IT, there is a place for digital literacy and there is a place for Computing all to be taught from like I say from the age of five all the way up to Key Stage 3 and I do still think that there is a place for ICT etc., in the curriculum, whereas in the past when it all got announced that there was all this change it was everything you have been doing is a load of rubbish basically, you know certain politicians were coming out and saying everything needs to change whereas I don't think it needs to be as radical as that.

I think they are there for different purposes but I think that they can be brought together so you have got the digital literacy of making sure that they can access and use the different digital technologies and they are using them responsibly as individuals in society and all of that sort of thing and the Computing gives them the context of this is how a computer works and this is the programming behind it and all of those different things and then you have got the IT of actually going and using the different pieces of software etc.”

When asked specifically, later in the interview, if he was aware of the proposed curriculum change Fitz replied “Yes I am aware of the curriculum change.” When invited to give his understanding of the proposals he referred back to his previous discussion of the changes which were contributed during the exchange regarding the purpose of IT education. He identified that the curriculum covered three distinct strands, all of which will be covered from Key Stage 1 to 3 with students being given the choice to specialise at Key Stage 4.

“So the proposed change, there is a draft that has just come out in the last, well just reading articles over the last week or so, the proposed change is basically what I said earlier that there is going to be three distinct parts of digital literacy which I explained earlier, IT and also computer programming and then they are looking to start that at the age of five, go up to Key Stage 3 and then those three distinct areas are going to break off and be taught at Key Stage 4 separately.”

4 Findings

Fitz expressed that he did feel there is a difference between ICT and Computing. His explanation of his interpretation of the difference suggests he views Computing and computer programming as the same.

“Yes I do, as I said in that the IT is the use of the software to solve problems through the technology and the computer programming is how the computers work, how it has been made through data and programming etc.”

When discussing which subject was more important Fitz went beyond discussing just ICT and Computing to consider digital literacy as well. His contribution started by emphasising each had merit and recognising the significance of Computing to all before disputing the implication that it was most important and then justifying his views regarding the importance of both digital literacy and ICT. Once more he substitutes computer programming for Computing implying he feels they are one and the same. Further discussion established that though he felt all three areas were of significance to all students he recognised that the relative significance of each would vary from student to student.

“Myself personally, I think that they have all got a role to play and you know when I said before the announcement was made it was sort of everything you have been doing has been a complete load of rubbish, you need to all move to computer programming, I do understand the merits of computer programming and how it can help students who aren't even going to take it later on at Key Stage 4 but I still do think there is a place for digital literacy because they need to know how to use social networking, different technologies responsibly for like it says individuals and society; for the ICT I think the survey was last week that 66% of employers say that students leave with very poor ICT skills, all of my friends that have their own businesses will say that, not from our school here but from other schools, leave with very poor Microsoft Office skills and that's what they want in their businesses. So I do think there is a place.

I think yeah I think for different students, different parts of it will be more important than others; it is the same in other subjects.”

4 Findings

Fitz identified that he saw a need for change within the curriculum but that he did not see just the content as being the cause of problems with the current curriculum but also the way that courses were designed, and assessed, which encouraged teacher demonstration and student practice of set skills to produce business documents rather than students using different skills in different ways to solve more open problems. Discussions of his thoughts on this identified that these more open tasks should be designed to run over comprehensive periods of time and that students should be encouraged to exchange their thoughts on solutions both in and outside of the classroom. He also identified that this would require a significant change in what many teachers did in the classroom.

“I think that we should be moving towards lessons of problem solving skills where students are given a problem so in relation to the computer programming and things like that there is not just one right answer in relation to a problem, in relation to programming and things like that. They should be given a problem, they can work in groups, they can as a group, you know, this is the way that I think it should be done, this is the way, you know, getting their communication skills improved, things like that. At the moment I feel that for me for my ICT it is more of a case of students working individually on their coursework whereas I think it should be more opened up for them to work as groups because it is going to help them when they leave College. Also I just think they need to be coming back to analysing, designing and implementing but also problem solving, evaluate.

I feel that, yeah the tasks are too closed and in some cases, not all cases, there is pretty much only one correct way of doing the task, whereas if you looked at some of the computer programming tasks there will be multiple correct ways of getting the correct outcome and using different software etc.

Extended period of time yes, not just in a lesson but over a period of time and then I'd like to think that outside of lessons they would be communicating between themselves and discussion boards and things like that.

The teacher's role would change so for example if I am taking bottom set I feel as though I am leading the lesson and

4 Findings

sometimes I feel as though I do talk a little bit too much, whereas it would be more student led and the teacher would be there more to facilitate the learning and help out and give advice when needed.”

When considering how the proposed change would actually affect how lessons played out in the classroom Fitz considered that the change would be an opportunity to get away from the large amount of individual project work envisioning a curriculum that would enable group work and help facilitate students’ personal communication and problem solving skills. As the discussion developed Fitz identified that he did see the change as a chance to remove some of the weaknesses he perceived in current courses but also to widen the scope of students’ studies.

“Yeah, as I say, on the perfect lesson I would like to think there is going to be a lot more communication, a lot more group work, a lot more trying to get to the bottom of a problem, things like that in relation to a lot of lessons, I am not saying all lessons will be like that but as I say in a lot of the Key Stage 4, don't get me wrong I think the GCSE ICT course is a good course but you have got 40 hours of controlled assessment where students are working pretty much well on their own in the BTEC ICT it is 100% coursework so a lot of the time the students are just sitting on their own getting through their coursework.

Broader curriculum as well yes, but I think we have moved in the right direction anyway from the old GCSE ICT course to the new one but there’s still improvements that can be made but I think you can say forever, you know you can always improve.”

When looking at the personal implications of the proposed change Fitz’s thoughts are regarding the fact that he feels he is relying on colleagues due to his own lack of knowledge and experience regarding the material and skills that he may be called upon to teach.

“I would say my thoughts on the change are that somebody such as myself, I feel as though I am relying on certain members of staff that I feel are excited by the changes, that have got a passion for it.”

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

Greg

When Greg was asked in his initial interview if he was aware of the proposed changes he responded "I'm aware yes." When asked to summarise his understanding of the proposals he identified that they were to stop teaching office applications skills and rather teach the construction and operations of computers and teach students how to program. During this response he once more refers to the fact that he would not personally respond to this change positively.

"Well my understanding is that we are going to abandon the pure skills teaching of Microsoft Office and move more towards the, what I was talking about earlier with regards the thing that I would really not like or enjoy which is the mechanics of what is inside the base unit and giving students the opportunity to program and code and that type of thing."

Greg's personal reflections on whether there is a difference between ICT and Computing identified that he believes there is a clear and identifiable one though his explanation of this focuses on the staff capabilities required to teach the two subjects. The difference in content, the knowledge of what's in the base unit and how to program are secondary in the answer though it is the fact that this knowledge is possessed by fewer staff than being able to use the applications that leads to his assertion that fewer staff members at the school could deliver Computing.

"Definitely because I think most people here could probably teach ICT as we teach it at the moment but I would say there will be very few who would be able to open the base unit and say that's the such and such and it does this and this is how you would program it to do X, Y and Z."

Further discussion clarified that Greg identified that teaching students about the hardware and operations of computer systems was the purpose of Computing education whereas teaching the skills of how to use software applications was the purpose of ICT education.

Though Greg appreciated the logic behind the change he individually felt it unnecessary. He attributed this both to his own personal lack of interest in the computer science elements that were being proposed and the fact that the office

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

applications skills that students were developing on the current courses were generally more useful than the knowledge and programming skills that would result from the changes.

“I suppose from a purely sort of selfish point of view we are happy and comfortable just to teach the skills then I would probably be happy just to leave it and I think there still is grounds for leaving, I mean I think there are a lot of kids who you know they go on to do secretarial courses whatever it might be and having those basic Microsoft Office skills you know, it is a really good qualification for them to have, a good skill for them to have. Having said that I suppose if you're going to make the curriculum a little bit tougher and a bit more rigorous then obviously Computer Studies would certainly do that for people. But I don't think it's something that could be - I don't think everybody who does ICT could just automatically be transferred to a Computer Studies course.

I think it's valid yeah but I can also see why you might want to maybe just ratchet up the rigorousness of it I suppose.”

When discussing how the proposed changes will affect what goes on in the classroom Greg's first thoughts, again, were related to staff skills and he noted that many staff will need re-skilling to deliver the new courses. In terms of class activity he noted that the subject was still going to be a practical subject but that that would manifest itself more in working practically with the hardware rather than with the applications, he foresees that at times it will reflect a technology lesson where the students actually build elements of the computer system.

“Well, they'll probably have to retrain all of their staff so they can actually deliver what they have been asked to do. I guess, I mean it is practical subjects I guess anyway but it's sort of moving more towards maybe you know a sort of structure that they have or the setup that they have in technology, that type of thing.

Yeah I guess it would be a lot more hands on in terms of getting to grips with bits and pieces of hardware and that type of thing. I don't know.”

When considering the personal implications of the proposed change Greg identifies that he would have to participate in a lot of additional training. He

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

recognises the new skills he would need to develop as improving his professional development, though this was not personal development he would pursue out of choice.

“Well, my knowledge of what is in the base unit is zero probably so it would just be a lot of additional training work for me.

Well I mean if push comes to shove and I had to do it then obviously I would have to learn about it so in that respect, for my own personal development I guess although it wouldn't be the way I want, it is not something I would want to pursue if there was a choice but if I had to do it than I guess it is another string to your bow in that respect. But I wouldn't be sort of volunteering to do it unless I really had to.”

Heather

When Heather was asked during her initial interview if she was aware of the proposed changes she replied “Yes.” When explaining the difference she initially only referred to a move from teaching ICT to teaching computer science. It took further probes for her to articulate her understanding of the two subjects. Her description of the difference identified notions of ICT being about using computer systems and computer science being about knowing how computer systems operate and how to develop them.

“The government would like to see ICT teaching change to involve more computer science or programming rather than application.

At the moment I think ICT is all about how to use it, whereas computer science would be not just, should be how to use it but also how to put it right, take it apart and build it up again, program it, how to fix it.”

As the discussion developed Heather specified that she did not feel either of the subjects was more important as there is a need for both those who operate computer systems and those that create and maintain them.

“I think they are both important in that you always need people to operate them and you will always need someone to program

4 Findings

them and put them right and you need to have the right person doing the right job.”

Heather specified that she did believe the existing curriculum needed changing. Her rationale for this is that the current curriculum ignores certain fields that students may well find they have ability in and this is a missed opportunity. She stated that she hoped the proposed changes would address this.

“I think it does need changing because there are some students that leave school not knowing how to do certain things and they could actually be very good at programming and they never get the opportunity to find that out.”

During reflections on how the proposed changes would alter what went on in the classroom Heather identified that though students will still need to know how to use common office applications the lesson focus would not be on skills in these. Rather the focus of the lesson would be on examining hardware and looking at how to program it.

“I think it will be in that they won't just be sitting doing application work. I'm guessing that if it changes then they will still have to know how to use it but they won't be as heavily focused on that because perhaps they will already have the skills because they are self-taught or they have learnt it in primary school and our lessons will be more regarding this is what the inside of the computer looks like or a printer or whatever and this is how to program in whatever.”

Further prompts identified that she thought there would be more time spent on theory but also that there were still significant practical elements involved though these will change in nature and be related to programming.

When discussing the personal implications of the proposed change she stated she saw no personal benefits but saw the need to retrain and re-skill as a problem.

“I think I would need to re-train in some way, do extra research and read up because it would be a completely new thing for me.”

4 Findings

Summary

Disciplines are discursive and created out of people's ideas about what subjects are and most of the existing ICT teachers who participated in this study provided descriptions of computer science that demonstrated they viewed it as a scientific discipline: "...the theoretical core and understanding of why things are done and how to analyse a problem in IT and how to solve it" Ewan; "...how the computers work ... through data and programming etc." Fitz. Closely related to this interpretation of computer science was the identification of it as a more rigorous and academically challenging discipline than the existing ICT one: "...if you're going to make the curriculum...tougher and ... more rigorous then obviously Computer Studies would certainly do that ... But I don't think ... everybody who does ICT could just automatically be transferred to a Computer Studies course." Greg; "... students finding ...computer science ... lessons a lot harder ... it will become a lot more academic. There will be a lot more emphasis on students remembering ...[in] maths students will remember formulas and science they remember the periodic table, in ... computer science they might have to remember a lot of tags that go into certain elements of coding." Curtis.

When discussing what computer science is they perceived it to be a combination of the acquisition of a body of knowledge relating to the structure and behaviour of computers with practical elements that help students develop both subject specific skills and an improved understanding: "I mean it represents to me everything that is involved with programming and you know the kind of science behind it all." Barry; "...wanting to give students the skills to be able to go and create with computers and understand how ICT actually works..." Curtis; "...being able to write the programs and understand how they [computers] operate..." Denise; "...how a computer works and this is the programming behind it..." Fitz; "...the mechanics of what is inside the base unit and giving students the opportunity to program and code and that type of thing." Greg.

Ewan and Heather, however, perceived Computing as an extension to the existing ICT curriculum; adding skills, such as programming, onto the existing skills development curricula "...trying to introduce more programming rather than simply learning how to use the current packages." Ewan; "Computer science ... should be how to use it but also how to put it right, take it apart and build it up

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

again, program it, how to fix it.” Heather. Ewan went even further and specified that he did not see this as a distinctly different discipline to ICT “The difference, the way I understand the difference is that IT has been seen as how to teach people how to use computers whereas Computing is teaching people how to program and develop computers. I'm not so sure I necessarily agree with that but that to me is the distinction. I'm not, I'm not convinced, yes there is a difference but I'm not convinced it is as stark as how he is expressing it.” Ewan.

Many of the respondents questioned whether the proposed change in discipline was appropriate for all students: "... my ... concern is cutting some students off from actually getting some ICT or some computer qualification ... My concern is that at the low end of ability." Curtis; "It does worry me about the lower ability students that benefit from the much, much more vocational courses." Ewan; or even if it was necessary at all: "I think there still is grounds for leaving [it], I mean I think there are a lot of kids who ... having those basic Microsoft Office skills ... is a really good qualification for them to have, a good skill for them to have." Greg. They identified that the existing curriculum taught skills of universal value whereas the new curriculum introduced knowledge and skills that were really only relevant to those wanting a career in Computing. “Because I think the children need to know the basic skills, they need to know basic skills - yes the programming and the more theoretical background is good but most students don't need to know it but they all need to know the basic skills.” Ewan. This highlighted that, despite what they may have expressed, they still perceived the purpose of the new curriculum to be the same as the preceding one to equip students with skills for their life after school, especially their working life. Others questioned if changing the curriculum for all students was appropriate suggesting it was inaccessible for a significant proportion of students "Well it might be too difficult for some students possibly, if you are only going to put sort of really able students in I guess that would be fine.” Greg.

Denise's observations that “I think we should be giving them the knowledge of ICT that they ... to look at the changes that are happening within the technology and Computing and also be able to put students in a position that they have the ability to use that new technology and work with it... but I think we could do more with teaching towards the way technology has changed...” and Ewan comments “This is my hobby horse. I think if we are teaching those things about IT then

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

they are not transient, they stay with the student. The basic idea of how does an IT system work, how can it be used, how can it help people are the same now as they were when we were talking 15 years ago. If you just teach them how to use a package, the package changes and changes and changes and those skills become useless...” reflect that the ever evolving nature of the fields of ICT and computer science and their educational practice affect how effectively its purposes are met.

This research suggests that current ICT teachers all question if they have the personal efficacy (subject and pedagogic knowledge and skills) to implement the change “Well I guess it's probably just because of my lack of knowledge on the sort of the programming and the hardware side of it. So I always say in my own mind I know I can teach the skills bit but I also know that if push comes to shove, if I had to teach the mechanics of it then from my own point of view that would probably require a lot of training for me to do that.” Greg. Many of them also questioned whether the change would be beneficial (the outcome efficacy) “I'm not sure whether it's necessarily all completely a good idea. I think there is a need for Computing and computer science but you could lose a lot of skills if you don't teach people basic ICT skills, so we might have lots of computer scientists who can't word process; I am being flippant but that's where I see it going.” Adrian. Yet others identified problems in the teaching environment that would constrain their effective introduction of the change demonstrating that they did not have teacher efficacy in regard to the introduction of the new curriculum “I think because it's two things, I think one, the lack of teachers' knowledge and opportunity to gain that knowledge and two, I think it is the ability to deliver that without the actual resources.” Curtis.

Teacher efficacy of ICT teachers in this study is further eroded by an apparent lack of understanding of and commitment to the change by the wider school community. Comments from Ewan “We were told from September 2012 there would be changes. I think there is a perception of people not directly related to those changes are happening, have happened, actually the exam boards, the curriculum has not followed the kind of expectation. There's nothing I mean [the principal] was asking at a meeting are you looking at these new courses then, are you choosing a new course to do, there is never new courses.” and Fitz “...but I do worry ... that it is going, what ends up being out there is very vague and we

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

end up basically prepping the students again so for what is going to happen at Key Stage 4 because if it is very vague and you can do whatever you wish, then I know the nature of the beast at this school that they'll just want results, results, results..." suggest that they do not feel the larger school community are informed on or value the new curriculum.

All of the respondents identified the need to retrain or develop new skills as their primary personal concern. The perceived scale of this varied and though many noted the fact that this would be good for them in terms of personal development the majority of them identified it as a negative impact on them personally. The exceptions to this were Adrian and Heather who recognised the need for additional training without attaching a positive or negative response to this and Curtis who identified the professional development opportunity as positive

4.11 How teachers' biographies helped establish their beliefs regarding the IT curriculum and the change

This section reports respondents' reflections on which biographic events shaped their beliefs regarding the purpose of IT and business education and the existing ICT and proposed Computing curricula. Such events were drawn from their own education, previous career (when relevant), teacher training and teaching experiences. They were asked to reflect on both how beliefs were formed and the length of time beliefs had been held.

4.11.1 What particular biographic events were significant in shaping these beliefs?

Adrian

As previously identified Adrian had received no form of IT training, this may have contributed to his rather generalist initial explanation of the purpose of IT education. He recognised that his understanding of IT and its purposes were wholly based on what he had had to teach and not on a reflective approach analysis of the subject.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

“...when I came here I was under prepared and completely in the dark as to what I was meant to be doing and learnt as I went along.

It's framed from what I have been doing rather than looking from outside and having a wider view of what is the purpose of it is.

I'm really lazy ... because I just do as I'm told so I don't really investigate what I should be doing...”

When discussing his understanding of the role of IT education Adrian specifies that his perceptions were influenced by the practicalities of what he is called upon to deliver rather than any philosophical stance.

“I think I sort of look at the implications of something and in this case the changes are something that directly impact upon me so I am looking at it in terms of more the practical implications.”

Adrian recognised that the current debate on the curriculum change and the way it was reported in the media had influenced his thoughts on ICT, its purpose and its relationship with Computing. He identified that his views on the need for a curriculum change were “...not something that I would necessarily have come to the conclusion myself.” Recognising that his “...thinking about what the implications are if these changes do get enforced” was initiated by an awareness of the government's support of a change to the curriculum.

“What made me do this? Possibly an awareness of where the government is going with it or what the education Secretary wants to see in schools. Rather than what I have actually thought about from my own point of view.”

Apart from his own teaching Adrian could not identify any influences on his understanding of the purpose of IT education. However a series of follow-up questions looking at his understanding of the proposed change elicited a number of factors that coloured his understanding of the purpose of the changes and their implications including the government, employers and his own reflections

Barry

Despite the fact Barry had not had any formal input on the purpose of IT during his training or teaching there was very little uncertainty regarding his views on

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

this. Barry's response when asked to identify when he acquired his views regarding the purpose of IT education states that they started to be formed when he started his ITT and refer to both his faith and the ongoing nature of the development of this understanding.

"Well I think right from the first year of teaching, because I did the GTP I felt that I didn't have much of a kind of academic input into how to teach, I was really just really seeing how it was done by others and I was conscious of that, that there should be more of a theoretical and academic kind of input to my own understanding of teaching and as a Christian I had the opportunity to do one or two units from the Masters programme from the Christian Institute of Education, sorry the National Institution of Christian Education in Australia, so that started off looking at, you know kind of world views of education and because I was teaching IT and business and that's my interest area, I started to kind of take that forward into the subjects and looking at world views within those subjects and out of that comes a kind of moral and ethical dimension to not just the way I teach but also the subject matter and how the subject matter is going to be used by me and my students. So it is really something that has just evolved right from the beginning of my teaching but probably not before that because I think when I was in business I was aware that there should be more of an ethical and moral dimension to my business practice but probably not really aware of how I could do that in any self-substantive way, it was only really once I got into education that I started to look at ways of how to analyse, you know, world views of education and business and ICT."

When asked to identify influences on his understanding of the purpose of IT education Barry struggles to identify any specific influences and also recognises that he could be more proactive in trying to identify and read sources to more explicitly develop his understanding.

"No I probably couldn't actually. I think it's just probably just being observed, observation really. It's probably something I should read up on more but again you know time is such that the focus is

4 Findings

on what you need to be doing now in your teaching, you know again I would love to be able to spend more time on that. Yeah. I don't know if that answers your question really.”

When asked directly Barry recognised that experiences in his previous career, which involved a large amount of IT use and with his previous colleagues and employer may have been influences.

“Yes but partly because that was the area I was working in so there would be other areas of the business where it would not have mattered but it was yes, it was important to have skills. For example something like Microsoft Access, you know that was something in the 90's which wasn't widely used and you certainly wouldn't need it to become going into business or whatever although it might be useful, whereas in our department it was used on a daily basis. So yes people would come in, the employee is will come in and we would need to do quite a bit of training to get up to speed so yes it would impact. And also I think it would probably be different today so seeing what students are coming out with now I quite often think well actually that would have been great if everyone had those skills back then, you know that's the way it is, yeah... Maybe that has formulated it, another business might have structured things differently but that would be my experience of it yeah.”

During further discussions which focused on the purpose of business education Barry cited some books he had read on his course which specifically regarding IT education further demonstrating the role of his masters in helping establish his understanding of the purpose of IT education.

Curtis

Once more Curtis's lack of formal input on the role of IT or business education had not prevented him forming his very concrete ideas on the matter. When discussing when these ideas were formed he initially cited the discussions on the curriculum change as being the point when he realised what IT teaching was. However on further discussion he recognised both the role of his own IT

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

education and press coverage of the subject in the intervening years as being formative.

“Well I suppose it was when the proposed changes were first brought to light, I suppose that's the first time I had ever actually sat down and thought this is what we do. We don't teach students about computers or about IT we teach them how to use it. It was at that point when that first came to light to me anyway and I really thought that is all we do. That's what ICT teaching was yeah.

Yeah I think that is very much it [the small amount of input he had at school] and I think sort of in the years in between, you know the sort of noise from the government about business wants students coming out with skills ready to go into the workplace to start using Microsoft Office packages that's what business wants. And I think yeah I mean my input at school was negligible really, there was very, very little so yeah that's exactly where it came from. That's why we were taught spreadsheets and Word and a little bit on PowerPoint so that if we could go into a job you had this little bit of skill to go with it.”

Once more Curtis cites the start of the discussion regarding the proposed curriculum change as being the point when he identified the difference in purpose between ICT and Computing. He also notes that initially he felt some resistance to the change on the basis that the new curriculum was not universally as practically useful to students; however, on reflection he now considers that the two are just different mechanisms of getting to the same place.

“ When the changes first were announced as I said earlier that's when I kind of saw ICT as this enabling tool rather than compared to the Computing and I think that was the point when - I kind of was a bit well they don't really need to know that because the majority of students they will go straight into work and they will be expected to know how to use all these other systems but that will come with the Computing knowledge when they understand how things work, what's on the screen will become quite simple for them anyway. I suppose it was when they were first announced I

4 Findings

really sat down and thought that's, not necessarily that what we are teaching is wrong and what we have been teaching is wrong but maybe there is a better way of getting to that point.”

Denise

Again Denise had not had any formal input on the purpose of IT or business education during training or teaching yet there was little uncertainty regarding her views on the purpose of either. Her response identifies the start of her teacher training as being the point when she began to formulate her ideas but also refers to the fact that she has had to reinterpret her understanding of the purpose of IT education as new technologies have come along. This evolving understanding is reflected in other respondents' answers as well.

“Probably just from working within the school, from when I first started and obviously what we were teaching then and then just kind of as technology has changed.”

When asked directly whether experiences in her previous career may have impacted on her understanding of the purpose of IT education Denise recognised that it may have had an impact but didn't relate any specific personal experiences in support of the statement and highlighted that her experience of employment was very distant in technology terms. When prompted further if she was aware at the time of young people entering employment with inadequate skills she only recognised it was an issue to a point and identified that young people with programming skills might still present a problem for employers.

“Yes to a certain extent in that I do believe that you know students ought to have some good basics of things like spreadsheets and word processing software and perhaps even other types of more commonly used software now, that, yes but it's difficult for me because 10 years is a long time in ICT and it is 10 years since I was out in the workplace. So you know it is hard for me to know how much change there is and what employers want now.

To a certain extent yeah you know, but then I'm not sure that making computer games is massively relevant to the workplace either, so.”

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

Denise cites the start of her teaching at a new school once qualified as being the point when she identified a difference between ICT and Computing.

“Well I was always aware that there's a difference between ICT and Computer Studies, I mean even going back to when I first started at XXX they delivered two different subjects so you know I knew there were two different topics”

She quotes her understanding of the proposed changes came from “Probably just from what I've read and what I've listened to on the news.” Recognising the influence of this coverage and discussions of the change as being instrumental in the development of her ideas on how the curriculum should be changed. Her contributions during these discussions were less certain than her identification of how the purposes of her more established subjects were established.

“Probably in the last couple of years as things have changed a lot more and social networking and, I don't know, web design and things like that are becoming more important and you know more people feel that they would like experience of.”

Ewan

Though Ewan had had no formal input, or encouragement to reflect, on the purpose of IT education he appeared no less secure in his beliefs regarding this than the purpose of business education, which had been formally covered on his ITT. He identified that he had these beliefs regarding the role of IT education prior to entering teaching stating explicitly that his own experiences on entering employment had established in him the recognition that he had been ill equipped to deal with the technologies he was called upon to use in his job.

“I think I came into teaching with a belief in the need for the basic skills because as soon as I started working at the firm of accountants I was sat in front of a computer, this is nothing to do with accounting, this is just skills you need to know and I had never touched a computer hardly and I think that's when it hit me that I was lacking, my education was lacking, I didn't have basic skills so as far back as 1990 when I started working there.”

4 Findings

When reflecting on how he came to understand the difference between ICT and Computing as he now does Ewan cited the media, specifically the internet, as his main source. He went on to observe that the main stream media seemed to be portraying a different conception of the relative merits of the two disciplines when compared to educational forums.

“Media because you have been reading Internet sites, because you have been reading the articles, because you have been sort of following discussion forums that is where it has come from. To me this is a distinction that's come out over the last few years really. I think the popular media certainly the news etc., seems to have berated IT as a worthless subject that suddenly this computer science is valued, it is academic challenging but IT is not. I think if you look at education based literature that distinction isn't nearly as clear, nearly as distinct.”

On discussing this different conception Ewan identified the main stream media as identifying a larger distinction between the two while educational forums recognised that the perceived issues were contributable to the weaknesses in courses rather than the actual subject.

“Yeah but not as big an issue. It was there but I don't think there was such a stark distinction between this is IT and that's rubbish. I think there was different courses and I think I suspect there are some vocationally based courses that are very, very skills-based and there have been GCSE courses that haven't been as skills-based and I have taught GCSE IT courses where they were a mix of the two but I think particularly some of the more vocationally based GCSE courses have become very learn how to use Microsoft office but not necessarily the pure GCSE courses, the more what is the word, applied BTEC type courses.”

Ewan identified that though he had been aware of the shift away from a theoretical base in the ICT curriculum he only considered that it was a problem when the proposed change started being discussed.

“I think it was when it was discussed. I think you just get on with it and it is only when people start raising it you think ah actually that might be a point.”

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

Fitz

Fitz's lack of formal coverage of the roles of IT and business education has not led to significant uncertainty in his beliefs regarding either. He does however, identify that his main understanding of the purpose of IT education was just drawn from and defined in terms of the material he has been asked to teach. He states that he does not see himself as an ICT specialist and hence this is why he has had to develop his understanding in this way. The debate regarding the curriculum change has made him start to think about why he is teaching what he is rather than just how to deliver it.

“I think that for a long time I have just - I do not see myself as an ICT expert. I've come into ICT I believe and just basically run with what the curriculum's being put in front of us and in that way and really for me personally I think that it's more of me thinking about it a little bit more and reading more behind it since I know that we are going to be moving to Computing.”

From these comments and his response to a clarifying question that enquired if the current debate had established his understanding of the purpose of IT education it can be concluded that he has only really started to consider the purpose of IT education in the past couple of years, prior to this he defined the purpose as being almost synonymous with the content.

“I think I was aware of it beforehand but I'll be honest that due to time and things like that I mainly concentrate on what I know that students need to do at Key Stage 4 and Key Stage 5 and what we do at Key Stage 3 is basically making sure the students are at is the place to be able to be successful at gaining their qualification.”

During his recent contemplations regarding the purpose of ICT and Computing education, prompted by the debate regarding the changes to the curriculum, Fitz has adopted a more proactive approach seeking out information from various sources.

“Basically because I don't have a great deal of past ICT knowledge, it is mainly from just reading information about what is out there from the Internet, from books, from information passed on from colleagues etc.”

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

Fitz's changing and still developing understanding of the purpose of IT education has been drawn from a number of sources over his teaching career and has always been prescribed by his identity as a non-specialist.

Greg

When attempting to identify how his beliefs regarding the purpose of IT education were developed Greg recognises the fact that though he didn't consciously consider the purpose of IT education until called upon to teach the subject his experiences at school still had influenced his understanding. Though he didn't have ICT lessons at school his computer science lessons had coloured his attitude to and beliefs regarding both subjects

“Well yeah and you know University oh you have to type an assignment or whatever even then I didn't really think about it much. I certainly never thought I would end up having to teach that's it, that's for sure.

I guess when I was at school because we didn't have like an IT suite per se that we could use regularly so I wouldn't have been familiar using computers then and the little bit of Computer Studies which we did I think and it was either in second form or third form I didn't enjoy it, I didn't even understand most of it either.”

Greg states starting at the school as being the point when he became aware of the difference in purpose between ICT and Computing education, though he also recognises that the recent debate regarding the changes has made him more aware of the differences. He reflected on the fact that the ICT courses he was delivering at that time had elements of Computing in them and these were the areas of the curriculum he was least confident in delivering.

“Well when I first started working here the IT course that we did was a little bit more like that in that I used to do the, teach the skills and so on but you also had to explain how some of the hardware worked and what was inside the base unit to a limited extent and that was something that I was never very confident with or happy about doing. So from then but obviously as it's

4 Findings

become more prevalent in the media what is going to happen with regards to the change then obviously it brings it more to the fore.”

Further discussion encouraged Greg to reflect on why he came to demark the subjects in the way he had when the initial ICT courses he was called upon to deliver were, in his view, a mixture of both ICT and computer science. These discussions attributed the demarcation to a personal stance on what he understood and could deliver without considerable additional training. Greg was using his own experiences of the ICT skills he had needed and developed as a benchmark as to the purpose of IT education.

“Well I guess it's probably just because of my lack of knowledge on the sort of the programming and the hardware side of it. So I always say in my own mind I know I can teach the skills bit but I also know that if push comes to shove, if I had to teach the mechanics of it then from my own point of view that would probably require a lot of training for me to do that.”

Heather

Heather identified her teaching experiences as being the significant influence on her beliefs regarding the purpose of IT. When she became involved in delivering one of the Key Stage 4 ICT courses she noticed the students' discomfort at having to move on from just using the applications to considering how IT was affecting how people lived. This reaction from the students led her to reflect for the first time on why IT was taught and what it was trying to achieve.

“When I taught on the applied GCSE the ICT and society module, it was the first time that the children had been kind of introduced to it, at year 10, end of year 9 into 10 and it came as a bit of a shock to them in that all of a sudden we have got a change from using the software to actually talking about it and there was no kind of lead in at the end of year 8. I think I had been here for about four or five years, so about six years ago.”

Though she only started considering the purpose behind IT education a number of years into teaching it she had been aware of the difference between ICT and Computing a lot longer. She states she had always thought computer science

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

was different from ICT though seeing as she had no experience of ICT until she started teaching it we can interpret 'always' as being since the start of her teaching career. Though she had not studied it herself Heather had some second hand knowledge of computer science from her own school days so as soon as she became aware of ICT she realised there were significant differences between the subjects.

"I've always believed that computer science or programming was different to the way ICT is taught going back to the late 1980's when it was GCSE Computer Science and you had to program something to work. Not that I did it but my husband did it and he said that this is what computers is about whereas IT is all about how to use ... I've always had that since leaving school and the boys did the hard programming science side of it whereas the girls just did the application side which wasn't even on a computer, it was on a typewriter."

Despite holding her beliefs regarding the purpose of Computing and ICT education for a number of years she also recognised that the current debate regarding the change had brought the matter back to the forefront of her mind. Once the debate began she became aware that her own lessons were going to have to change and hence started reading around and using her networks to help clarify her understanding.

"As soon as they started talking about the changes I thought my IT lessons are going to change."

Summary

Though individuals' life histories are unique some significant events are common to some or all of them. In this study experience of ICT or computer science lessons whilst at school: "I mean my input at school was negligible really, there was very, very little so yeah that's exactly where it came from." Curtis; "I guess when I was at school because we didn't have like an IT suite per se that we could use regularly so I wouldn't have been familiar using computers then and the little bit of Computer Studies which we did I think and it was either in second form or third form ..." Greg; "I've always believed that computer science or programming was different to the way ICT is taught going back to the late 1980's when it was

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

GCSE Computer Science and you had to program something to work.” Heather; IT use in previous careers: “Yes ... because that was the area I was working ... it was important to have skills. For example something like Microsoft Access ... people would come in, the employee is will come in and we would need to do quite a bit of training to get up to speed so yes it would impact ... that would have been great if everyone had those skills back then...” Barry; “I think I came into teaching with a belief in the need for the basic skills because as soon as I started working at the firm of accountants I was sat in front of a computer ... that's when it hit me that I was lacking, my education was lacking, I didn't have basic skills...” Ewan; and the nature of courses they have previously delivered emerged as such events “...when I came here I was under prepared and completely in the dark as to what I was meant to be doing and learnt as I went along. It's framed from what I have been doing rather than looking from outside and having a wider view of what is the purpose of it is.” Adrian; “Well I think right from the first year of teaching, because I did the GTP I felt that I didn't have much of a kind of academic input into how to teach, I was really just really seeing how it was done by others.” Barry; “Probably just from working within the school, from when I first started and obviously what we were teaching then and then just kind of as technology has changed.” Denise; “I've come into ICT I believe and just basically run with what the curriculum's being put in front of us...” Fitz.

The common significant life events identified: experience as pupils, previous careers and past professional experiences; took place many years prior to the current curriculum change and due to this chronology of belief formation many of the ICT teachers in this study will find accepting the changed purpose of their subject difficult as it challenges many long established, and hence more unassailable, beliefs.

A number of the respondents in this study have experienced an apprenticeship of observation, though these were all curtailed in that each of them only received limited experience of the subjects as pupils at school. This, however, will not have made their beliefs any less influential, developed or strongly held, even though they are based on a different situation and structure. Heather and Greg may find the transition less traumatic as they had at least a limited computer science apprenticeship of observation. Those respondents who have not experienced any apprenticeship of observation in ICT or computer science will

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

have developed their beliefs through other experiences. As these will have been acquired later in their lives they may be more open to change. However, such beliefs will still have been established prior to the introduction of the new curriculum so would take precedence over any new ideas it may introduce.

The fact the respondents did not complete a significant, or even any, apprenticeship of observation also impacts their subjective warrant for ICT and Computing. Respondents had a limited or no pupil experiences to identify the skills and knowledge needed for ICT or computer science teachers and only one of them had established themselves the goal of becoming an ICT teacher (and that was set on entry to their teacher training rather than at school). This means none of them had been through the recognised process of testing and retesting themselves to see if they were equipped with the skills they perceived necessary to teach ICT or Computing. Despite this none of them question their subjective warrant to teach ICT, with one teacher explicitly stating that any teacher has a subjective warrant for the subject "...ICT generally speaking does have a tendency to be delivered just by sort of anybody who is available and has a little bit of a notion how to you know use Excel or Word and so on..." Greg. Some, however, did question their subjective warrant for computer science and hence Computing based either on personal interest or lack of skills "I know nothing about programming, programming does not appear in what I teach, really." Adrian; "Well I guess it's probably just because of my lack of knowledge on the sort of the programming and the hardware side of it." Greg. Nevertheless, they didn't see this as a reason to discount themselves from teaching it "So I always say in my own mind I know I can teach the skills bit but I also know that if push comes to shove, if I had to teach the mechanics of it then from my own point of view that would probably require a lot of training for me to do that." Greg.

None of the teachers in the current study identified themselves as Computing teachers, all except one identified themselves as social science teachers (business or economics) implying they may struggle to see themselves, or even resist, becoming a Computing teacher.

4.12 How these beliefs influenced how the teachers prepared for, and are coping with the change?

The final research objective was to identify how respondents were responding to the curriculum change. The following section presents the findings of the research on this area. It integrates respondents' self reported responses prior to and during the change with observations on their actions during the change and initial implementation of the new curriculum developed within the department.

4.12.1 How are current ICT teachers negotiating the curriculum change?

Adrian

During his initial interview Adrian was asked how he was preparing for the curriculum change. He responded that he was not, once more quoting his pragmatism in that he suspected, or maybe hoped, that the change would not affect him.

"I've written down here ... not really so I'm not really preparing, I'm just waiting to be told what I need to do and then I need to prepare. There is a practical reason for that, the practical reason for that is that there is a good chance that over the next one, two, three years a bigger chunk of my timetable could be Economics and Business Studies at a lower level in the School, below sixth form."

A follow-up question trying to clarify why he thought the change would not impact on his teaching initiated a response identifying a weakness to his approach but reemphasising the potential waste of effort should he not need to. This response suggests that Adrian feels the curriculum change will only affect GCSE and not be felt at Key Stage 3, which is where his ICT teaching takes place.

"What would be a good idea would be if I went away and got myself tooled up to teach the subject but it wouldn't be such a good idea if I was then told you won't be teaching it, you are teaching more GCSE Economics."

4 Findings

During the regular individual meetings with Adrian that took place during the remodelling of the courses he continued to identify that he was making no preparations for the new course. His rationale for this did change as he became more aware of the fact that the curriculum changes would also affect his Key Stage 3 classes. His rationale that he may not be affected by the change was replaced by an assertion that until he was aware of exactly what the new scheme of work was there was no point in preparing; once more reiterating that he just did what he was told.

These meetings also provided a forum for him to discuss how his views regarding the purpose of IT education and the change were being altered by the process of the change. In meetings Adrian was asked either to once more reflect on the purpose of IT education or to review his original response; regardless of which approach was adopted his views remained unchanged. His views on the appropriateness of the curriculum change were equally unaltered by his experiences of the department's, and his, preparation for it.

Adrian developed a considerable number of resources for his own use during the first and second years of the new scheme of work. However, these were all related to topics that were in common with the previous curriculum and were never circulated to or shared with other department members. During the first two years of the new scheme of work Adrian followed it in terms of topics but sometimes had to modify the length of time spent on topics as the timings suggested did not always match the pace of his classes.

Barry

Barry left the department in July 2014 so gave limited self reported responses and observations during the preparation and none during the implementation of the new syllabus.

In the pre introduction interview Barry was asked if he was preparing for the new curriculum. His response stated that, other than delivering some of the new material that was introduced prior to the actual 'change over', he is making no preparations personally.

“Essentially no, I wouldn't have thought so. I mean there's a few changes to the curriculum you adapt to that with Scratch and

4 Findings

things like that, but I think that's just scratching the surface of it really because there's still quite a long way to go I would imagine.”

Barry's response implies that he feels that preparing now, October 2012, nearly two years prior to the government's official launch date for the new curriculum, September 2014, is too early. However, in his response to the direct question as to why he isn't preparing he cites a lack of time to do it and his lack of enthusiasm for the proposed changes.

“Well there's time, you know, where is their time. So I think that would probably be my number one issue but I think also because it's not, if I'm being honest if it's not an area that is particularly excites me or interests me, you know, I'm not necessarily going to prioritise a lot of time and effort into it until I need to, yeah.”

During the individual meetings with him that took place during the remodelling of the courses Barry continued to identify that he was making no preparations for the new course. His rationale for this did not change until December of 2013 when he cited the fact he would no longer be teaching at the school when the curriculum was introduced so saw no need to prepare for it. These meetings also revealed that his views regarding the purpose of IT education and the change were not being altered by the process of the change; his views remained unchanged. His views on the appropriateness of the curriculum change were equally unaltered by his experiences of the department's, and his limited, preparation for it.

Curtis

When asked what preparations he was making for the curriculum change Curtis identified that he was due to attend some formal preparing to teach Computing at a local university. He had been asked to attend by the head of ICT who was also planning to attend the training. When asked why he was prepared to commit to such professional development he responded that he felt it was a necessity if he was to be equipped to teach the new course.

4 Findings

“Because I think I will need it. I think without it I wouldn't be able to deliver the necessary skills especially at the higher levels to students to give the students the best chance to succeed really.”

During the meetings between Curtis and the researcher that took place during the preparation for and introduction of the new course Curtis lamented the fact that he had not been able to attend the proposed training and, more than once, referred back to this when reflecting on his lack of preparation for the course. Without the formal scheduled 'classes' Curtis identified that he struggled to find the time and resources needed to develop his knowledge of the new curriculum and the aspects of it he had not taught previously. In each of these meetings he identified that he was yet to engage in any preparation other than “a bit of reading around” though he expressed regret at this. It may have been the fact that Curtis had not managed to develop an appreciation of the proposed new curriculum that contributed to the situation that his views on the purpose of ICT and Computing were unchanged by the development and introduction of the new scheme of work.

Curtis did not produce any resources during the planning of the new scheme of work. During the first and second year of it being taught he developed some resources but these were not shared with the rest of the department. For the most part Curtis followed the new curriculum though he did deviate from it failing to cover work on searching and sorting algorithms in the Year 8 scheme of work.

Denise

In her initial interview Denise identified that she had been involved in informal personal development in order to try and improve her skills in certain fields. She was drawing on family members and their experiences in order to assist in this. Her response suggests that time is a constraint and that she realises that this preparation is limited.

“I am trying actually at home to get a little bit more understanding of website design because XXX has been building his own website so I've been trying to get involved in seeing how that works, time skills are not that easy but that's about all to be honest.”

4 Findings

When asked directly what was preventing her doing more to prepare she identified the external constraints of time and resources.

“Probably time, more time than anything and not necessarily having the resources at home to do that much as well I suppose.”

Denise’s ongoing meetings revealed that she failed to overcome the constraints of time and resources and didn’t manage to make any further progress in preparing for the changes. When the issue was raised she always cited a lack of time as the main reason for her lack of progress. Once more the regular reviews of her appreciation of the purpose of ICT and Computing education that took place during these meetings demonstrated that her views remained unchanged by her experiences of the introduction of the change.

Denise did not develop or share any resources during the planning or introduction of the new scheme of work. During the second year she sought out and highlighted at department meetings resources that had been used in the previous scheme of work that would still be relevant in the new version. Denise adapted the new scheme of work by adding material from previous schemes at the cost of some of the new material. The material she neglected was related to data representation and searching and sorting algorithms. The material she reintroduced was related to word processing and presentation software – both areas that she had previously specified the students now had skills in when they arrived at secondary school which was one of the reasons she had cited for the need for the curriculum to change.

Ewan

During Ewan’s initial interview he specified that he was not carrying out any preparation for the proposed change offering an unprompted justification that as it was still unclear what the change would entail he could not prepare for it. “I’m not yet because I don’t know what it is.”

Ewan’s position regarding preparing for the new course remained unchanged during his ongoing meetings. Once a new scheme of work was being developed within the department he cited that he was waiting until this was finished before commencing on any preparations and once it was available he stated that he wouldn’t need any significant preparation and would just plan his lessons from

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

week to week as he had with the previous scheme. Discussions regarding how the changes were affecting Ewan's views on the role of ICT and Computing education identified that the development and introduction of the new courses had not altered his views on either.

Ewan did not develop or share any resources during the planning or introduction of the new scheme of work instead relying on centralised resources for the new aspects of the course and employing a number of older resources he had used to teach previous courses. Ewan significantly deviated from the new schemes of work, omitting topics, modifying units so that the theoretical aspects of the Computing elements were covered and delivering ICT material that was no longer included on the scheme.

Fitz

At the time of the interview Fitz was still trying to establish what the curriculum changes were going to be so his preparation consisted of reading regarding these and the implications they would have on the formal qualifications available in the subject. His response implied that he felt these preparations were not as thorough as they could be.

“Well to be quite honest I am preparing in that I am just trying to keep on top of reading about what changes are going to be made, trying to keep on top of finding out what new courses are being released etc., and trying to speak to other members of the department that I feel that I can pull on their strengths to help with the changes when we need to make them.”

As more information came to light regarding the change Fitz's preparations expanded. He participated in both online and university led courses to learn to code, he joined the Computing at Schools network and used this to help him develop an appreciation of others' views on the change and how best to implement it, he actively sought out new certificated courses for the students, attending courses regarding these to improve his understanding further, he actively consulted with IT professionals as well as others in the department who he felt had relevant skills pertaining to the changes. These activities culminated in his developing of a new Key Stage 3 scheme of work with some supporting

4 Findings

resources. Once the course was introduced he continued to engage in such activities.

Reflections at the regular meetings during all this activity showed that his views regarding the purpose of ICT and Computing education remained unchanged and though he was skilling up and developing courses to ensure all students gained access to the new Computing curriculum he was not convinced of its suitability and value for all. His ongoing concern that some students would not be able to obtain qualifications in Computing became more developed as the GCSE and A Level courses were reviewed and updated.

During the first and second years of the new Key Stage 3 course Fitz developed and shared numerous resources and was key to the ongoing review and redevelopment of it. Despite this he often deviated from the scheme citing it was too demanding for some lower sets and did not focus on the skills they would need for an ICT GCSE which would be their likely route of study if they were to take the subject further. His deviations rarely excluded material; rather time was cut back on some topics in order to make it available for more skills practice in other areas.

Greg

At the time of his initial interview Greg was not engaging in any preparation for the proposed changes, in fact his inclination was to ignore them all together. This was partially because he felt he might not be called upon to deliver them and partially because since media discussions seemed to have died down and perceived there was no visible activity to prepare for the change within the department, or College, he was hoping that they may be dropped.

“Just crossing my fingers and hoping that I don't get to teach it. That's not strictly true but I mean obviously it's been about a year and a half ago I suppose it was really headline news but ever since certainly here it's either been brushed under the carpet a bit or maybe people's minds are changing, I'm not sure. Yeah there was a lot of you know press about it at the start whereas lately there's been hardly anything at all so I mean I would quite happily just stick with the status quo if that was an option, I don't know.”

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

Reviews of his preparation activities during the regular meetings identified that this situation did not change; even as it became apparent the curriculum changes were going to be implemented within the department and would significantly alter what he was called upon to teach. When the significance of the change was highlighted as a potential reason to complete some form of preparation he highlighted the fact that his timetable contained little ICT these days and he didn't think this would change. This along with the fact that a significant proportion of the new scheme was made up of ICT material he had delivered in the past meant he felt he would be able to get by. He felt that department wide training would have to be provided to 'skill up' all staff members and stated that his reluctance to engage with the new material meant that he would wait until he had to do something. As the new course was introduced he still did not engage in any formal development but used the resources given to direct his teaching.

Conversations about Greg's beliefs regarding the purpose of ICT and Computing education during the meetings demonstrated that his experiences of the introduction of the new scheme had failed to alter his beliefs regarding the purpose of either subject. He often specified that due to the minimal amount of ICT teaching he had he never gave its purpose any thought.

Greg adapted the new curriculum both in terms of timing and content. He delivered modules out of order and missed out some of the new computer science material. Adaptations always led to more time being spent on the ICT topics still included in the course that he had delivered previously; he did not reintroduce material that had been removed. He cited that students were likely to find the new work inaccessible and the fact that they needed more time with the ICT skills to become effective as reasons for this diversion from the scheme.

During the first year of the course Greg produced, but did not share, a number of resources related to the ICT aspects of the course. In the second year he shared some of these with the rest of the department.

Heather

During her initial interview Heather stated that she wasn't doing any preparation but then went on to specify that she had read about the changes and discussed them with others. She also demonstrates that she is reflecting on these activities

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

as she identifies that using the sources she has may mean her information is biased.

“I'm not at the moment. I haven't yet other than reading about it and what I've read up about it but from what I have read it is purely Internet/newspaper articles and talking to people about it and that could have an opinion behind it, so that would be my only worry in that am I actually getting the facts or am I getting somebody else's opinion.”

Once more the ongoing meetings identified that no further preparation was carried out prior to the introduction of the course. Heather initially identified the fact that until she knew how the scheme of work would change she could not prepare and later that she wasn't sure which year group she would be involved in teaching as the reason she had not prepared for specific new elements of the changed curriculum. Once these issues had been clarified she noted that all three lower school schemes started with material she was familiar with so there was no need to prepare any more than she had for other schemes. As the schemes were introduced Heather's preparation for the new material consisted of working through the suggested activities for her groups immediately prior to teaching the lessons.

The ongoing meetings documented that her experiences of preparing for and introducing the new schemes of work had had no impact on her beliefs regarding the purpose of teaching ICT or Computing.

Heather followed the new schemes of work and material closely not adapting it in any significant way. After two years of delivering lessons using the new schemes of work Heather was yet to develop any resources, relying entirely on those provided originally with the schemes or contributed later by other department members.

Summary

Even though the teachers in this research could identify and articulate their beliefs there was little, if any, clear correlation between these expressed beliefs and the reality of how teachers reacted to the change in terms of how they

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

contributed to its introduction or whether they adopted or adapted the new curriculum once it was introduced.

The initial interviews identified that the respondents had a variety of responses to the curriculum change from enthusiasm "... I'm very much looking forward to it and hopefully the changes that come with it with me as a teacher ... I think it will be a challenge but ... it will probably reignite a little bit of, I am looking forward to it I know that already..." Curtis; through concern "... all the staff in the department, will we all need training, will everybody be on board to take the changes on and will enough time be given to get everybody up to speed..." Fitz; to resistance "... not something I would personally be either comfortable or confident doing ..." Greg "I don't think most young people need specialised skills, but I think they all need the basic skills." Ewan. Yet these stated responses were not always reflected in the teachers' behaviour during the preparation and introduction of the new curriculum. Of the two 'enthusiasts' one did not develop or contribute any resources and one significantly adapted the new scheme of work. Of those who expressed most reluctance about the new curriculum one developed, adapted and shared a number of resources and one was one of the only two respondents who did not adapt the new curriculum once introduced.

This research has also identified occasions where teachers' stated beliefs appear to contradict other beliefs held. A number of respondents who explicitly recognised a need for the curriculum change and identified a number of benefits of such a change to students and society as a whole still, explicitly or implicitly, express a resistance to the change. For example Greg stated "I guess you know purely sort of in economic terms the IT industry is a multi-billion dollar industry and so if we could generate and produce more entrepreneurs in that particular sector than from a purely sort of economic welfare standard of living point of view then I guess that would be a very positive outcome". Yet contrast this with his response to the change "I suppose from a purely sort of selfish point of view we are happy and comfortable just to teach the skills then I would probably be happy just to leave it and I think there still is grounds for leaving, I mean I think there are a lot of kids who you know they go on to do secretarial courses whatever it might be and having those basic Microsoft Office skills you know, it is a really good qualification for them to have, a good skill for them to have." Or Adrian who observed both "...but in terms of competitiveness in the economy, industrial

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

applications, the country needs to train more people, so there is almost sort of a vocational need I think for Computing and computer science.” and “I’m being honest I think a lot of what we could be asked to teach could be actually quite stimulating for the students...” but again had a more negative personal response “I’m not sure whether it’s necessarily all completely a good idea. I think there is a need for Computing and computer science but you could lose a lot of skills if you don’t teach people basic ICT skills, so we might have lots of computer scientists who can’t word process”. Denise’s conflict is less explicitly self-identified but can be seen when contrasting her comments on the positive consequences of the curriculum change “I think it will make it, in terms of a student, I think potentially it has got the opportunity to engage them more, a bit more relevant. Yeah it’ll definitely make it more interesting” with her response as to how she is preparing for it where she states a lack of time and resources is preventing her completing any significant preparation.

Such contradiction could establish a conflict within these respondents’ teacher identity. Teacher identity has two distinct aspects: the professional and the personal. The professional aspect reflects what teachers believe to be important to the profession and their subject whereas the personal aspect reflects what they desire and consider to be important. The professional identity of the respondents discussed above recognises the benefits to students and society of the curriculum change yet the personal identity recognises the personal difficulties involved in adapting to the change.

The established teachers in this study ‘know’ that their traditional methods deliver examination performance “Yes. I think in terms of examination performance of students [the aims of IT education are achieved]” Adrian, “I do feel I achieve that [the aims of IT education] as in students leave with a GCSE or a BTEC or Applied GSCE qualification.” Fitz. They also feel that this examination performance is the main focus of the institution “... I know the nature of the beast at this school that they’ll just want results, results, results” Fitz, and that the new courses may not be accessible to students “Well it might be too difficult for some students ...” Greg.

The concerns regarding the accessibility of the new curriculum was one of the most specified and repeated rationales for leaving the curriculum unchanged.

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

The fact that the existing curriculum was successful and allowed students of lower ability to succeed and acquire qualifications came up time and again. This, apparently widely held, belief could be another significant barrier to teachers adopting the curriculum change. In this research many teachers did recognise that the new curriculum would be beneficial to society and student experiences as a whole and would potentially mean more students would take the subject to a higher level but they did not feel this was worth the trade off of potentially cutting off an accessible subject that led to certification for students of all abilities. "... but my only concern is cutting some students off from actually getting some ICT or some computer qualification whether it is ICT or Computing. My concern is that at the low end of ability ..." Curtis. "It does worry me about the lower ability students that benefit from the much, much more vocational courses. My worry is for the very weaker students, the students that perhaps are not going to benefit from that theoretical base ..." Ewan; "Well it might be too difficult for some students possibly, if you are only going to put sort of really able students in I guess that would be fine." Greg; "You may find students finding IT, computer science whatever we want to call the lessons a lot harder to begin with and a lot harder to get their heads round" Curtis.

The teachers discussed above could articulate the risks of the change in terms of student performance as they perceived them; however, others were not as explicit. "I'm not sure whether it's necessarily all completely a good idea. I think there is a need for Computing and computer science but you could lose a lot of skills if you don't teach people basic ICT skills..." Adrian; "Yeah it'll definitely make it more interesting but I do think that, you know, there is the potential to jump too far the other way as well." Denise; "...I do still think that there is a place for ICT etc., in the curriculum, whereas in the past when it all got announced that there was all this change it was everything you have been doing is a load of rubbish basically, you know certain politicians were coming out and saying everything needs to change whereas I don't think it needs to be as radical as that." Fitz. It is important to recognise though these teachers cannot clearly articulate their beliefs regarding the potential cost of the change, their beliefs regarding such will still drive their response to the curriculum change.

An individual's perception of a risk can be based on affect (emotion) or affect and analysis. These affective and rational levels to the judgement on impact of the

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

4 Findings

change was displayed by many of the respondents in this study who identified the benefits to students or wider society of the change but went on to discuss why they still didn't feel the change was a good idea based on a personal response (be that a lack of skills or a lack of interest in it). The respondents usually related their thoughts on the change in the order laid out above, the rational response (benefits) before affective response (rejection).

Teachers in this study identified concerns regarding both a lack of knowledge and skills within Computing "I know nothing about programming..." Adrian; "Well I guess it's probably just because of my lack of knowledge" Greg; and the pedagogical skills to be able to teach effectively within the discipline "...retrain all of their staff so they can actually deliver what they have been asked to do." Greg; "...it will mean that I will have to develop my teaching further, probably pick up more skills into how to offer these possibly more logically thinking minded lessons to students rather than my current ICT teaching at the moment." Curtis; "...I may need to train in order to be able to deliver Computing or computer science." Adrian.

Many of the teachers in this study were reluctant to take a proactive role in preparing for the curriculum change or curriculum and resource development and sharing.

None of the respondents in this study identified any changes in beliefs regarding the purpose of ICT or Computing education during the initial two years of the introduction of the new course.

5 Discussion

5.1 Introduction

This research set out to investigate the experience of existing ICT teachers and in particular to inquire into how teachers' beliefs were formed and how they influenced said teachers' reaction and responses to significant curriculum change. Its original purposes were to:

1. gain an understanding of existing ICT teachers' beliefs regarding the ICT curriculum prior to and during a time of significant change;
2. understand how such beliefs regarding the curriculum are formed through teachers' past experiences;
3. consider how these beliefs are impacting on how the teachers are negotiating the curriculum change.

The nature of a grounded research study is to explore, analyse and generate concepts about individuals' actions (Thornberg 2012). As it is employed to provide insight into areas that are relatively unknown (Jones & Alony 2011) the original research aims act as initial guidance that may alter focus as data is gathered and analysed and a fuller understanding of the issues emerges. This was the case during the exploration and analysis in this study these initial guiding aims became more focused on the separate but interrelated frameworks and concepts shown below. A discussion of the research findings related to these is presented in this chapter.

1. The effect of teachers' beliefs and teachers' identities on adoption of new teaching practices
2. The role of teachers' biographies in forming their teacher beliefs and teacher identity.
3. The ways in which ICT teachers' biographies differ from those of teachers of other subjects and the effect this has on their teacher beliefs and identities.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

This discussion unites the description of the beliefs and practices of a department of existing ICT teachers who are experiencing significant curriculum change with the literature on these specific areas. The chapter is divided into four main sections with one examining each of the three categories that emerged from the research: 'Enacted support of new curriculum'; 'Stated support of new curriculum'; 'Perceived personal impact of the new curriculum', and the final section discussing the relationship between these categories, presenting and explaining the grounded theory that has emerged. Figure 8 provides a metaphor illustrating how the three main categories that emerged relate.

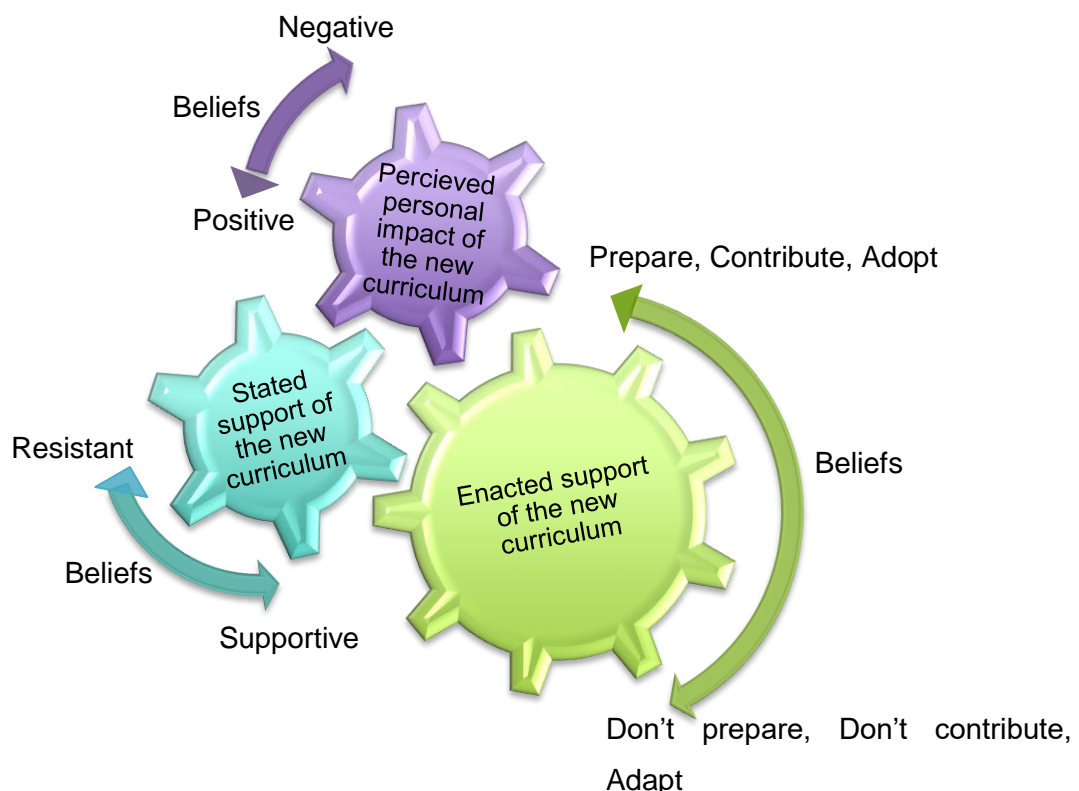


Figure 8 – Diagrammatic metaphor of the relationship between the three main emerged categories

5.2 How the grounded theory was developed from the data

The grounded theory approach adopted in this study allowed it to focus on the processes and actions implemented by ICT teachers during the curriculum change enquiring into both what happened and how the teachers interacted with the change (Thornberg 2012). In this way it allowed the research to start to consider not only what happened but to induce a substantive theory as to why

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

this may have been the case (Strauss & Corbin 1994, Neal 2009). This theory is grounded in the data collected and was developed through the whole research process as the data was collected and analysed, and proposes relationships between the three most significant sets of concepts that the analysis process exposed.

The original interviews that formed the primary data set provided the data for the initial data analysis process of open coding and through this the many individual phenomena relevant to developing an understanding of the beliefs current ICT teachers hold, including how these beliefs were formed and how they are affecting teachers' responses to the curriculum change, were labelled. Table 2 demonstrates how this coding process evolved.

The example in Table 2 shows how the coding process generated focussed and theoretical categories from the data. The initial coding engendered many codes each one representing an idea induced from the initial data. This included a group of codes relating to respondents' recognition of the need for professional development in order to help them effectively deliver the new curriculum. These codes (and data that emerged from theoretical sampling) were then compared with other codes and data to identify the major focussed codes (sub-categories): 'how the new curriculum is impacting efficacy', 'improving content knowledge', and 'developing pedagogic content knowledge' were distinguished. Through this constant comparison analysis, including the analysis of interview memoing, the relationships between these, and other related subcategories were clearly identified and understood and the theoretical category 'perceived personal impact of the new curriculum' was produced. This category captured ICT teachers' beliefs regarding how the curriculum change would personally impact on them and their teaching in terms of any changes it might necessitate.

Once the selective codes had been identified, the data and interview and case based memos were once again interrogated to make sure these codes were indeed the most significant ideas that emerged. The three main concepts: 'enacted support of new curriculum'; 'stated support of new curriculum'; and 'perceived personal impact of the new curriculum' emerged as theoretical codes. Once these theoretical codes were established the data was once more re-examined to find all insights regarding the categories. Such insights were used to

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

enrich conceptual memoing and produce diagrams; during this process a particular eye was kept for data that was not already explained (including conflicting data) to ensure such exceptional cases were integrated into the grounded theory (Sbaraini, Carter, Evans & Blinkhorn 2011). The grounded theory that has ultimately emerged from this process expresses a set of concepts that are related to one another in a cohesive way and adequately accounts for all the data collected. The three concepts and their internal relationships are shown in Table 3 and will be discussed in the subsequent three sections. How the three concepts are related to form the emerged theory is discussed in the final, conceptual narrative and emergent theory section below and a diagrammatic metaphor for the theory is shown in Figure 8.

Table 4 – The coding process

Raw data	Interview Memo	Initial code	Selective sub-category	Theoretical category
<p>Q. Can you explain why you feel that that is going to benefit the curriculum change? Or why you think why you are prepared to invest that time?</p> <p>A. Because I think I will need it. I think without it I wouldn't be able to deliver the necessary skills especially at the higher levels to students to give the students the best chance to succeed really</p>	Necessary in terms of both subject knowledge and PCK	<p>Recognising preparing for the curriculum change is essential in terms of being an effective teacher (efficacy)</p> <p>Identifying a need to develop new subject specific skills</p>	<p>How the new curriculum is impacting efficacy</p> <p>Improving content knowledge</p>	Perceived personal impact of the new curriculum
<p>Q. How do you think the curriculum change will affect you as a teacher?</p> <p>A. I think it will be a challenge but it will be I think it could, it will probably reignite a little bit of, I am looking forward to it I know that already. I think it will probably improve me as a teacher, it will mean that I will have to develop my teaching further, probably pick up more skills into how to offer these possibly more logically thinking minded lessons to students rather than my current ICT teaching at the moment. So I'm very much looking forward to it and hopefully the changes that come with it with me as a teacher.</p>	<p>Sees it as a professional development opportunity.</p> <p>Explicitly identifies a need for different and new PCK</p>	<p>Expecting a reigniting of personal interest</p> <p>Identifying a need to develop PCK</p> <p>Looking forward to the professional development it will entail</p>	<p>Being interested in the new curriculum on a personal level</p> <p>Developing pedagogic content knowledge</p> <p>Personal development opportunity</p>	

5 Discussion

Raw data	Interview Memo	Initial code	Selective sub-category	Theoretical category
<p>Q. Do you feel there will be any negatives? A. I don't necessarily foresee problems. I know that I will need a serious knowledge update and some re-skilling but I don't necessarily see that as a problem. I've always thought that would be par for the course for being an ICT teacher with technology moving on and changing anyway continuously.</p>	<p>Not a problem just necessary and part of being an ICT teacher. Very interesting as Curtis - the only one of the respondents whose ITT was ICT was expecting significant overhauls of skills and knowledge on a regular basis all through his career do those trained in other subjects share these expectations?</p>	<p>Identifying a need for new knowledge and skills Recognising the need for regular knowledge updates and re-skilling is par for the course for an ICT teacher</p>	<p>Improving content knowledge Not daunted by need for professional development</p>	

Table 5 - The main concepts induced and their internal relationships

Category	Causal sub-categories	Contextual sub-categories	Intervening sub-category
Enacted support of new curriculum	Beliefs regarding the purpose of IT education Beliefs regarding the relevance of the new curriculum Beliefs regarding the nature of the new curriculum Beliefs regarding student ability Proportion of timetable dedicated to teaching the new curriculum	Adopting new curriculum Pre introduction preparation Resource development Sharing of resources/knowledge	Personal enthusiasm for the change Time Support from the institution Guidance from external sources
Stated support of new curriculum	Beliefs regarding the nature of IT education Beliefs regarding student ability Beliefs regarding the labour market and economy Beliefs regarding the effectiveness of the existing curriculum Beliefs regarding the new curriculum Biography	Impact on society Impact on students Impact on teaching Impact on professional development	Beliefs regarding support from the school and department Content and pedagogic content knowledge Perceived risk

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

Perceived personal impact of the new curriculum	Curriculum content	Improving content knowledge	Biography
	Perception of personal content and pedagogic content knowledge	Developing pedagogic content knowledge	Accessibility of the new course
	Beliefs regarding the purpose of Computing education	New curriculum's impact on personal efficacy	Consequences of failure
		Being interested in the new curriculum on a personal level	Training and support
		Identifying self as teacher of ...	Student interest

5.3 Enacted support of the new curriculum

The enacted support of the curriculum emerged as the core category as it established how the teachers responded to the change during its planning and implementation. The teachers' enacted support was demonstrated by their engagement in a number of activities prior to and during the introduction of the new curriculum; the most significant of these were adoption or adaption of the new curriculum on its introduction, producing and sharing teaching resources for use with the new curriculum and engaging in personal preparation prior to the introduction of the new curriculum. Within the current study the teachers' behaviour during the preparation and introduction of the new curriculum demonstrated a range of responses, from enthusiastic to resistant which were reflected in their enacted support of the new curriculum. This replicates findings from previous work that recognised that, based on their beliefs teachers typically adopt a range of positions in response to a new innovation, from unabashed 'innovators' to reluctant 'laggards' (Fluck & Dowden 2013). The 'Beliefs regarding the purpose of IT education' causal sub-category reflects the major influence of ICT teachers' beliefs regarding the purpose of the subject in establishing what they feel should be involved in the course they deliver. In all cases these beliefs influenced whether and how the teachers adapted the new course, adaptations being introduced to better achieve the aims they recognise (Leat 2010). Adrian and Curtis clearly articulate their belief of the necessity to ensure students are capable users of common proprietary office applications in their consideration of the implications of the curriculum change:

"I think there is a need for Computing and computer science but you could lose a lot of skills if you don't teach people basic ICT skills" Adrian;

"... there could be an issue with students leaving school without the necessary ICT skills" Curtis

A related and equally significant causal sub-category was the teachers' 'Beliefs regarding the relevance of the new curriculum' which revealed how well they perceived the new curriculum reflected how they felt the curriculum should have been changed. The regular follow up interviews identified that experiences of the new curriculum and its implementation did not alter the teachers' beliefs on these

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

matters. This reflects Pajares' assertions that beliefs "tend to self-perpetuate, persevering even against contradictions caused by reason, time, schooling, or experience" (Pajares 1992, 324). In line with previous research, ICT teachers modified the new curriculum and its introduction so that it better reflected their beliefs (Song 2011). Participants indicated concerns regarding the relevance of the new curriculum and this influenced how they implemented the new curriculum. Ewan describes his disquiet:

"... the programming and the more theoretical background is good but most students don't need to know it but they all need to know the basic [ICT] skills."

The formative sub-categories 'Beliefs regarding the nature of the new curriculum' and 'Beliefs regarding student ability' exposed the influence of the teachers' beliefs regarding student ability and the accessibility of the new curriculum as demonstrated by Curtis, Ewan and Greg:

"My concern is that at the low end of ability ... cutting some students off from actually getting some ICT or some computer qualification" Curtis;

"My worry is for the very weaker students, the students that perhaps are not going to benefit from that theoretical core" Ewan;

"Well it might be too difficult for some students" Greg.

Many of the respondents shared the views given above and these concerns regarding the costs of the new curriculum in terms of universal student achievement acted as a constraint to their introduction of the new curriculum, especially in groups that were identified as containing students of lower ability (Howard 2013, Yang 2012).

In some instance respondents identified that the relatively small amount of Computing teaching they were (or hoped to be) involved in meant they identified the changes as not relevant to them and hence were unlikely to engage with them (Howard 2013). Though not a factor for all respondents the significance of this in terms of ICT teachers considering this exempted them from preparing for, or even thinking about the impact of, the change means that the 'Proportion of timetable dedicated to teaching the new curriculum' established itself as a further causal sub-category. Adrian concisely expresses his views on this:

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

“I'm not really preparing... the practical reason for that is that there is a good chance that over the next one, two, three years a bigger chunk of my timetable could be Economics and Business Studies.”

Intervening sub-categories established the significance of personal and resource factors. One such sub-category was the teachers' 'Personal enthusiasm for the change'. Whether this was eagerness: “I'm very much looking forward to it and hopefully the changes that come with it with me as a teacher.” Curtis; acceptance “I'm not concerned” Ewan; or reluctance “...[the] thing that I would really not like or enjoy which is the mechanics of what is inside the base unit and giving students the opportunity to program and code and that type of thing.” Greg; it had a significant intervening impact on the teachers' enacted response to the change. Judgements teachers made related to how they were going to prepare for and enact the new curriculum were made on two levels: through an affective (emotional) response and an analytic process (Howard 2013). Teachers' personal enthusiasm for the change strongly influenced their initial affective response, which took place quickly. During this affective response teachers identified if the change personally benefited them and only if this was the case did they analyse what the impact of the new curriculum would be. Hence, only those who were enthusiastic for the change made decisions on its implementation based on both affect and analysis.

The potential constraining influences on curriculum change of perceived insufficient external resource have been identified by this and many previous studies. All the respondents identified a deficit of at least one external resource as affecting their preparation for or implementation of the new curriculum. Though many resource requirements have been identified in previous research, respondents in this research identified only three specific requirements. These are reflected in the intervening sub-categories 'Time', 'Support from the institution', 'Guidance from external sources' which have all been identified in other research. Respondents recognised the perceived significance of time, both on a personal level to develop new skills (Cox, Preston & Cox 1999) and at an organisational level, support from the institution (Cox, Preston & Cox 1999, Leat 2010) and guidance from external sources (Wallace & Priestley 2011):

“Probably time, more time than anything” Denise;

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

"I don't think that certain members of the government that are making the decisions actually realise how long it actually takes for a school to put everything in place... we need to be given plenty of time to put the changes in place, communicate with staff, parents, students etc." Fitz;

"There's nothing I mean [the principal] was asking at a meeting are you looking at these new courses then, are you choosing a new course to do, there is never new courses." Ewan;

".. there aren't a great deal of courses for being put in place to see what actually is going to be out there... when I am getting in contact with the ... exam board ... all the responses is 'We have got no idea, we are waiting for the reforms to be passed by the government...' So we are in no man's land in relation to what our ICT students are actually going to do at the start of the next academic year." Fitz.

5.4 Stated support of the new curriculum

Even though the teachers in this research, in contrast to previous research (Pajares 1992), could identify and articulate their beliefs regarding the new curriculum there was little, if any, clear correlation between these expressed beliefs and the reality of how teachers reacted to the change, be this in terms of how they contributed to its introduction or whether they adopted or adapted the new curriculum once it was introduced. This situation is reflected in earlier research that identified that although teachers can explain past classroom behaviour based on their beliefs identification of teachers' beliefs does not predict behaviour (Kordaki 2013, Song 2011). Though beliefs are recognised as driving behaviour in a coherent way, responses and actions in this study demonstrate yet again that the relationship between beliefs and behaviour is complex and difficult to define.

Respondents' stated support of the new curriculum was established during the initial interviews and was revisited during the ongoing follow up interviews - individuals stated support for the change remained constant. However, stated responses were not always reflected in the teachers' behaviour during the

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

preparation and introduction of the new curriculum in this research, in line with previous publications, teachers' stated beliefs appear to contradict their behaviour (Kerem Karaagaç 2004, Hobbs 2011, Blackwell, Lauricella, Wartella, Robb & Schomburg 2013)

Both those respondents who recognised a need for the curriculum change and those who felt the curriculum should remain unchanged displayed a complex web of influences. These influences were often contradictory within and between each sub-category demonstrating that teachers' stated beliefs appear to contradict other beliefs held (Brownlee 2001, Haser & Star 2009). Adrian demonstrates one such conflict within a sub-category, 'Impact on society', when he highlights both benefits and potential problems for society of the change:

"... in terms of competitiveness in the economy, industrial applications, the country needs to train more people, so there is almost sort of a vocational need I think for Computing and computer science... but you could lose a lot of skills if you don't teach people basic ICT skills"

Ewan's reflections highlight a contradiction across sub-categories: 'Impact on students' and 'Impact on teaching', when he identifies that there are benefits for students but potential drawbacks in terms of teaching:

"I think it will make it easier for students to progress if they want to take IT further ... I think it will make teaching IT harder ... there is a lot of panic that's going to make teaching IT much, much harder"

Ewan's discussion of the increased challenge of teaching the new curriculum goes on to uncover a further incongruity within the 'Impact on teaching' sub-category in that he notes it will be harder to teach, recognising that teachers will need to deliver new topics and skills, yet does not foresee a need for formal professional development to address this.

"I don't think it will be much harder. I think it will still be accessible and I think the same teachers will still be able to teach it, they might just have to do a bit brushing up."

5 Discussion

It would be easy to assume that teachers could self-identify, or be identified as, having a 'position' in terms of whether they broadly support the curriculum change or not, and in fact at one stage of the initial interview all respondents did identify themselves as being pro or anti the change. However this tendency, and the relatively small number of contexts, obscures the true complexity that surrounds the category (Koc 2013). Each context has a multitude of aspects which can support or counter each other (Friedrichsen, Van Driel & Abell 2011, Talanquer, Novodvorsky & Tomanek 2010) and which respondents may or may not be consciously aware of (Pajares 1992); additionally this potential support/contradictory relationship is also apparent between contexts. The route of this complexity may be partially contributed to the range, scope and individualised nature of the codes in the causal sub-category; many of which are established through the respondents' personal histories. The nature of these codes means each is both unique, and uniquely multifaceted, to each respondent (Hobbs 2007, Lortie 2002). This is the consequence of respondents' personal histories acting to form their beliefs regarding the nature of IT education, the effectiveness of the existing curriculum, the capability of students, the labour market and economy (Lortie 2002).

Intervening codes covered both internal and external constraints. Once more each individual sub-category represented a variety of beliefs both within and between each respondent. All the respondents identified concerns regarding the amount of support for the new curriculum within the institution, such concerns have been identified as curtailing curriculum innovations in previous research (Leat 2010, Wallace & Priestley 2011, Lang 1998). The 'Beliefs regarding support from the school and department' sub-category recognises these. Individuals perceived there were different levels of support from individual department members as well as from individual members of senior staff and governors. Fitz in particular made frequent references to the potential limitations of department and institutional support:

"I feel as though I am relying on certain members of staff that I feel are excited by the changes, that have got a passion for it ... what is going to happen at Key Stage 4 because if it is very vague and you can do whatever you wish, then I know the nature of the beast at this school that they'll just want results, results,

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

results and the other thing for the change is the worry of will all the staff in the Department, will we all need training, will everybody be on board to take the changes on and will enough time be given to get everybody up to speed."

The 'Content and pedagogic content knowledge' sub-category addresses the respondents' significant concerns regarding their content and pedagogic content knowledge which mediate their stated support of the new curriculum. All the respondents repeatedly commented on the need to develop new knowledge in order to deliver the new curriculum. Curtis demonstrates a positive response to a need to develop his content and pedagogic content knowledge but his was the only significantly positive voice among the respondents:

"I think it will probably improve me as a teacher So I'm very much looking forward to it and hopefully the changes that come with it with me as a teacher."

Due to ICT teachers' unique biographies lacking an apprenticeship of observation, personal ICT and computer science qualifications, and formal teacher training within the subject(s) (House of Commons 2016, Mitchell 2016) they have at best partial subjective warrants regarding ICT and none for computer science meaning they feel ill equipped for the new curriculum.

Respondents expressed concern at the potential risks of the change - the 'Perceived risk' sub-category; such risks emerged in two main areas. Firstly the teachers in this study, explicitly or implicitly, identified the belief that the new curriculum would bring a risk to student success in the subject and that this would be problematic in an environment where the pressure was to achieve high examination results. A number of respondents in this, and previous, studies identified this as their main concern regarding the change and their rationale for adapting the new curriculum (Blackwell, Lauricella, Wartella, Robb & Schomburg 2013, Howard 2013, Yang 2012). Curtis and Fitz exemplify these views:

"...my ... concern is cutting some students off from actually getting some ICT or some computer qualification" Curtis;

"I do feel [with the existing curriculum] I achieve that as in students leave with a GCSE or a BTEC or Applied GCSE

5 Discussion

qualification ... I know the nature of the beast at this school that they'll just want results, results, results" Fitz.

Additionally, teachers in the study expressed personal efficacy issues which significantly influenced their strength of support for the new curriculum. As ICT teachers do not feel they have the personal efficacy to implement the new curriculum it has the prospect of returning these experienced and successful practitioners to the role of novice, a major emotional cost to a teacher (Leat 2010).

5.5 Perceived personal impact of the new curriculum

The emergent contextual sub-categories, and associated codes, within the 'Perceived personal impact of the new curriculum' category once more illustrated the complex entwined nature of the relationships between the influential factors that this study exposed. All respondents noted the curriculum change would mean their current knowledge would need updating; codes relating to needing to improve content knowledge or develop pedagogic content knowledge surfaced repeatedly from all respondents. Due to the nature of the subject keeping abreast of developments in both of these areas of knowledge caused ICT teachers concerns even before the advent of the new curriculum (Kordaki 2013). Though all the respondents noted the need to develop new skills and knowledge as a personal impact their view of the scale of the update and whether this was positive, neutral or negative varied. The quotes below from Curtis, Barry and Greg articulate some of these views.

"I know that I will need a serious knowledge update and some re-skilling but I don't necessarily see that as a problem. I've always thought that would be par for the course for being an ICT teacher with technology moving on and changing" Curtis

"... my knowledge probably is not what it needs to be if we do go down this route but on the other hand I am saying to myself well that's fine I get on with it and I'll do it and you know if it requires additional training and knowledge and skills acquisition then I will do it and get on with it." Barry

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

“... to show the students how to open up the base unit and identify the different components and so on and that's not something I would personally be neither comfortable or confident doing” Greg

The ‘New curriculum’s impact on personal efficacy’ codes emerged in two main forms, the teachers’ beliefs regarding their personal efficacy in delivering the current curriculum and their prediction of their personal efficacy in delivering the updated curriculum. Those involved in this research had positive views of their efficacy in delivering the existing curriculum hence moving to a curriculum they are unsure of their efficacy with is a considerable personal risk (Howard 2013). All respondents identified their efficacy in one of these two situations, many in both.

Though codes relating to the respondents ‘Being interested in the new curriculum on a personal level’ weren’t apparent from all interview data it emerged as a very significant personal impact to some, significantly colouring their response to the new curriculum. Some of these respondents felt the negative personal impact of having to deliver material they had no interest in:

“I’ve never neither enjoyed ... whereby I have got to show the students how to open up the base unit and identify the different components and so on” Greg;

Others felt a positive personal impact of delivering the new personally interesting material. These respondents’ personal interest in the new material was a strong influence on their initial affective response (when they identified if the change personally benefited them) hence, only those who were personally interested in the new material made decisions implementing the curriculum based on both affect and analysis (Howard 2013).

The ‘Identifying self as teacher of ...’ codes were closely entwined with the ‘Being interested in the new curriculum on a personal level’ codes. Those who recognised themselves exclusively as teachers of a subject other than ICT were more likely to express a definitive lack of personal interest in the new aspects of the curriculum. Those who recognised themselves as predominately an ICT teacher expressed a personal interest in the new material. In this way the teachers’ sense of identity is a key factor in their motivation towards and

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

commitment to the new curriculum (Day 2002, Hong 2010). Though these last two sub-categories are particularly closely affiliated it is important to note that each of these sub-categories was rarely mentioned in isolation when respondents discussed the personal impact of the change.

Codes relating to three aspects emerged as influencing ICT teachers' perceptions of how the curriculum change would personally affect them: 'Curriculum content', 'Perception of personal content and pedagogic content knowledge' and 'Beliefs regarding the purpose of IT education'. Once more these codes did not act in isolation but interwove to colour respondents' perception of the personal impact of the curriculum change. The codes relating to 'Curriculum content' and 'Perception of personal content and pedagogic content knowledge' were closely entwined and interdependent. Respondents' interpretation of the information they had about the new curriculum was based on their existing subject and pedagogic content knowledge. Equally they made judgements on the fitness of their subject and pedagogic content knowledge based on their perceptions of the contents of the new curriculum. This demonstrates the complex relationship between knowledge, experience and beliefs. The ICT teachers interpret the world through the filter of their beliefs (Funkhouser & Mouza 2013); hence it is these beliefs that helped them interpret and explain what they experienced during the introduction of the new curriculum (Pajares 1992). This resulted in them interpreting the changes 'through' their perceptions of their subject and pedagogic content knowledge (Lloyd & Albion 2009) resulting in them modifying their interpretation of the contents of the new curriculum (Collopy 2003, Song 2011). Barry and Greg's reflections demonstrate how their conception of what the new curriculum involved helped form their appreciation of how it would impact them personally:

"Computing, I probably am if I'm being honest, I probably am nervous about it because you know my knowledge probably is not what it needs to be if we do go down this route" Barry;

"I would say there will be very few who would be able to open the base unit and say that's the such and such and it does this and this is how you would program it to do X, Y and Z." Greg.

Codes relating to respondents' 'Beliefs regarding the purpose of IT education' were highly significant. Though not all respondents cited codes regarding the

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

purpose of IT education for those that did it was a major influence. These respondents primarily noted that they did not perceive a need for the change and hence it was putting extra demands on them unnecessarily; this lack of outcome efficacy (Leat 2010) resulted in a negative interpretation of the personal impacts. Greg's response illustrates this interaction:

"I think there still is grounds for leaving ... it is a really good qualification for them to have, a good skill for them to have... if I had to teach ... it then from my own point of view that would probably require a lot of training for me to do that ... I guess it is another string to your bow in that respect. But I wouldn't be sort of volunteering to do it unless I really had to."

Respondents' biographies, especially their previous teaching experience, coloured their views on a number of external variables to establish their perceptions of the likelihood and personal consequences of the change; the intervening sub-categories relate to these perceptions. Many of the respondents raised concerns regarding the accessibility of the new courses and the subsequent impact on student progress and results. The personal impact of these perceived consequences incorporated significant personal risk including them being held responsible for results in an institution that is widely recognised as placing significant worth on examination performance (Yang 2012). They also led to the risk of a loss of teacher efficacy (Howard 2013). With such significant potential negative consequences it is not surprising that all of the teachers recognised the need for significant training and support (Cox, Preston & Cox 1999) though their previous teaching experiences meant they were doubtful that this would be forthcoming.

'Student interest' unlike the other intervening sub-categories showed some disagreement. A number of respondents recognised that the new content would impact on student interest levels:

"... a lot of what we could be asked to teach could be actually quite stimulating for the students it might engage them more in the long term" Adrian;

"some students might just find it very dull, very boring ... but other students will really get into it." Curtis.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

The quotes above show those involved in the study predicted both gains and decreases in student interest levels. However, all of the other intervening sub-categories that emerged: 'Accessibility of the new course', 'Consequences of failure' and 'Training and support'; were identified by respondents as having a negative impact on them at personal level.

5.6 Conceptual narrative and emergent theory

This study was conducted to investigate the experience of existing ICT teachers during the process of curriculum change precipitated by disciplinary shift in order to identify the factors effecting said teachers' reaction and responses to the change. Rather than presenting a definitive list of factors and responses and an algorithm of which factors lead to which response the model that has emerged starts to portray the complex relationship and interactions between factors, reactions and responses that are apparent among the participants. It is hoped that this substantive model may be used by other researchers to investigate both its transferability and its generalisability.

The inductive interpretive approach and constant comparison process adopted in this grounded research has enabled the researcher to move beyond simply exposing and describing how existing ICT teachers feel about the curriculum change to start discerning how influencing factors and teachers' reactions and responses to the curriculum change interweave to steer how they are negotiating this significant change. Rather than focussing on particular responses and asking teachers why they were implementing the new curriculum in the way they were, this research has examined the teachers' thoughts on the purpose of IT education and the curriculum change and, through the ongoing interview and observation process, examined the implications of these thoughts during the planning and early introduction of the new curriculum. Employing this methodology and techniques has established both strengths and weaknesses in the research.

One strength is the researcher's position as an insider meant interviews could be carried out more regularly as a truly ongoing activity. Additionally, it made observations of how the participants were responding to the changes in their practice an ongoing day to day occurrence rather than a series of lesson

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

observations and follow up interviews. Furthermore, access to documentation and other sources of data required for primary data sources and triangulation was readily available (Munn-Giddings 2012). These access factors and the fact the researcher had an established relationship and rapport with the participants of the study led to a much richer and more complete picture of the individuals' actions and social processes than would be available to an outsider (Angrosino 2012). Such richness greatly contributed to the exposure and examination of the complex interactions that were taking place during the introduction of the new curriculum. The ongoing, iterative and implemental nature of the researcher interactions with the respondents was fundamental in identifying the contradictory nature of both the beliefs held and the subsequent actions of individual respondents. This was only possible due to the fact the researcher was embedded in the situation under study. A further strength is the constant comparison coding procedure, in particular the time invested to ensure codes faithfully represented participants' responses and gave an opportunity for the data to reveal the 'story' of participants' experiences during the curriculum change. In this way the research provided a "detailed, rigorous and systematic method of analysis" (Jones & Alony 2011, 96) leading to a "rigorous insight into areas that are relatively unknown" (Jones & Alony 2011, 96). The major challenge for any researcher trying to capture individuals' experiences, impressions and understanding concerns are trustworthiness and dependability. The strengths identified above help ensure such.

Weaknesses of the study include the sample's selection and its small size which could introduce concerns regarding transferability and generalisability. Though the sample is a convenience sample the fact it consists of a department, like all other ICT and Computing departments across the country, in the process of implementing schemes of work to reflect the curriculum change means it is a representative case (Bryman 2008). Though the sample size is small the department contains staff members illustrating a wide range of the dimensions of interest meaning it reflects maximum variation sampling (Brown, Stevens, Troiano & Schneider 2002) and hence is purposive (Coe 2012). The researcher's position as an insider also brought potential issues some may question whether they have been able to separate their own beliefs and responses to the change from the research process and demonstrate theoretical

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

sensitivity by laying aside any preconceived ideas that they may have been tempted to bring to the study. The researcher has held such issues at the forefront of their mind throughout the research process and has endeavoured to allow the data to speak for itself. The employment of member checking throughout the interview and analysis process also helped ensure this. Additionally, the researcher's insider role may have affected the way the participants responded and behaved which may introduce issues with inference validity (Coe 2012). Despite these weaknesses this thesis makes an important contribution to theory. As previously highlighted despite their uniqueness, research on ICT teachers' beliefs is sparse (Kordaki 2013), concentrating on the beliefs and conceptions held by such teachers "... without relating these to their classroom practices" (Kordaki 2013, 142) let alone considering how such beliefs were formed. The uniqueness of ICT teachers makes the transferability of research on teachers of other subjects to ICT teachers questionable. It is in this context that this research is offered to contribute some understanding to these neglected fields.

The intent of this study was to examine existing ICT teachers' responses to the curriculum change. As the 'Enacted support of the new curriculum' category established how the teachers responded to the change during its planning and implementation it was the most significant of these responses and hence this emerged as the core category. Findings from previous research have recognised that teachers typically adopt a range of positions in response to a new innovation based on their beliefs. These positions range from unabashed 'innovators' to reluctant 'laggards' (Fluck & Dowden 2013). Within the current study the teachers' behaviour during the preparation and introduction of the new curriculum identified such a range of responses, from enthusiastic to resistant and these responses are revealed by their enacted support of the new curriculum. The teachers' enacted support was demonstrated by their engagement in a number of activities prior to and during the introduction of the new curriculum; the most significant of these were adoption or adaption of the new curriculum on its introduction, producing and sharing teaching resources for use with the new curriculum and engaging in personal preparation prior to the introduction of the new curriculum. The teachers' beliefs regarding the purpose of ICT education were powerful in establishing what they felt should be involved in the course they

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

delivered and this influenced whether and how they adapted the new course. Previous research has recognised the significance of teachers' beliefs in the successful, or otherwise, adoption of interventions on a large scale, such as curriculum change (Howard, Chen & Caputi 2015, Leat 2010). Wallace & Priestley (2011) identified that, "...teachers quickly find ways to mediate the curriculum filtering 'change through their own values, which are in turn influenced by gender, social class, previous experience in the classroom, professional training and other historical and biographical factors' (Osborn et al. 1997: 57)" (cited in Wallace & Priestley 2011, 360) and that this can have a diminishing effect on curriculum reform. The teachers in this current study are no different.

A related and equally significant influence was the teachers' beliefs regarding the nature of the new curriculum. All of the teachers included in this study had established views on both what the new curriculum was and how they felt the curriculum should have been changed. The regular follow up interviews identified that experiences of the new curriculum and its implementation did not alter the teachers' beliefs on these matters and such findings are reflected in other research (Lloyd & Albion 2009). Once more many modified the new curriculum and its introduction so that it better reflected their beliefs on these issues and again such behaviour has been observed in other studies (Song 2011, Dix 2012). The current research established a lack of correspondence between the changes identified as desirable by the respondents and those introduced in the new curriculum. Such a lack of correspondence would lead teachers to modify the new curriculum as they need to identify that the new curriculum corresponds to their conceptualisation of teaching and the purpose of IT education before they adopt it (Tew 1998, Wallace & Priestley 2011). The non-consensuality of beliefs means the teachers themselves were not necessarily aware of how their beliefs were affecting their interpretation of the new curriculum and its introduction (Nespor 1987).

Teachers' beliefs have been recognised as a significant influence in the success, or otherwise, of adoption of interventions on a large scale, such as curriculum change (Howard, Chen & Caputi 2015, Leat 2010). The introduction of educational reforms, such as the new Computing curriculum, can confront beliefs that teachers hold on everything from the resources available to accommodate the change to their own effectiveness and identity as a teacher. In turn, these

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

beliefs will influence how teachers acknowledge and respond to the reform in both the short and long term and hence will determine whether it is successfully implemented or not. Wallace & Priestley (2011) identified that, "...teachers quickly find ways to mediate the curriculum filtering 'change through their own values, which are in turn influenced by gender, social class, previous experience in the classroom, professional training and other historical and biographical factors' (Osborn et al. 1997: 57)" (cited in Wallace & Priestley 2011, 360) and that this can have a diminishing effect on curriculum reform. The teachers in this current study are no different.

The teachers in this research identified and articulated their beliefs regarding the new curriculum, yet there was little, if any, clear correlation between these expressed beliefs and the reality of how teachers reacted to the change. This situation is reflected in earlier research that identified that although teachers can explain past classroom behaviour based on their beliefs identification of teachers' beliefs does not predict behaviour (Kordaki 2013, Song 2011). This contradiction is most evident when looking at the 'Stated support of the new curriculum' category where teachers' action during the introduction of the new curriculum often countered their stated position. At one end of the scale one of the most resistant in the stated support was one of the few who adopted the new curriculum without significant modification and at the other end the only enthusiastic respondent neither contributed to the new schemes development nor fully adopted it when it was introduced. This, however, is not to say that respondents' enacted support was totally independent of their stated support.

As with previous studies beliefs drove behaviour in a coherent way however, responses and actions in this study demonstrate that the relationship between beliefs and behaviour is complex and difficult to define. Respondents' beliefs influencing their stated support for the new curriculum often related to the perceived benefit of the new curriculum to others – most often society or students. Such outcome efficacy in isolation was not enough to impel their enacted support, rather it was tempered by their perceptions of how the introduction of the new curriculum would affect them personally. All the teachers expressed concerns regarding their ability to deliver the new curriculum without additional skills and knowledge and support and resources from the institution. Without such personal and teacher efficacy their outcome efficacy was not

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

enough to ensure their adoption of the new curriculum (Leat 2010). These efficacy issues, a lack of personal interest in the new material and a failure to identify themselves as a Computing teacher meant the respondents failed to develop a subjective warrant for the new discipline meaning they were reluctant to adopt the new curriculum (Lortie 2002, Casey 2012).

Figure 8 presents a diagrammatic metaphor for the integrative model of teachers' responses to the curriculum change in diagrammatic form. Teachers' enacted support of the new curriculum manifests itself through their preparation for the curriculum change, their willingness to contribute to it and their adoption of it. This enacted support is driven by a complex interrelationship of teachers' beliefs, primarily regarding the nature of IT education and student ability; their stated support of the new curriculum and their perceptions of how the curriculum change would personally affect them. It was also driven by, and to some extent drives, their 'Stated support of the new curriculum' and their 'Perceived personal impact of the new curriculum'. Teachers' stated support of the new curriculum is also determined by teachers' beliefs regarding the nature of IT education and student ability as well as those regarding the labour market and economy as well as their biographies. Teachers' perceptions of how the curriculum change would personally affect them are formed once more by beliefs regarding the nature of IT education as well as their perception of the new curriculum and of their personal content and pedagogic content knowledge. Each of these aspects has a number of intervening influences meaning that for each individual teacher there are both positive and negative forces acting on each.

This study advances the knowledge of ICT teachers, in particular how they experienced and responded to the recent curriculum change. It focuses on the beliefs, thoughts and actions of existing ICT teachers, providing rich insights into the process of the curriculum change as perceived and enacted by them. Whilst providing original insight into the factors affecting this process, it raises important questions as to the interrelationships and interdependencies of these factors and how they interact to guide ICT teachers in their enactment of the curriculum change. It is apparent that these factors both influence and are influenced by each other and that a number of further conditional and contextual factors impact on these teachers' responses to the curriculum change exemplifying the intensely complex and multifaceted nature of ICT teachers' responses to the curriculum

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5 Discussion

change. Consequently, it is clear from this research: if teachers (ICT and others) are going to be called upon to enact significant and externally imposed curriculum change, as is typical of the British (and many other) education systems at present, then how they respond to and enact such changes is an essential area for further research.

6 Concluding Thoughts

This study has sought to develop a theoretical model of the process of curriculum change precipitated by disciplinary shift as perceived by the teachers experiencing the transformation, and to identify the factors affecting this process. The study was carried out in the context of the movement from ICT to Computing, arguably the most significant disciplinary shift in the last two decades of the National Curriculum. The research was founded on the views, beliefs and experiences of existing ICT teachers as they 'lived through' the planning and implementation of the new curriculum. The research followed an inductive interpretive approach, applying qualitative methods and iterative processes of interviewing, data collection and constant comparison analysis to expose a theoretical model grounded in this data.

Whilst existing literature on teachers' experiences of curriculum change has identified the significance of teachers' beliefs and identities it is incomplete as it has yet to look specifically at ICT teachers and has rarely considered such significant and redefining changes. Furthermore, though teachers' beliefs are recognised as driving behaviour in a coherent way they are complex and difficult to define and do not predict their classroom behaviour (Kordaki 2013). Additionally, research has identified multiple occasions where teachers' stated beliefs appear to contradict their classroom behaviour (Kerem Karaagaç 2004, Hobbs 2011, Lloyd & Albion 2009, Morgan & Hansen 2008, Munby 1982, Lim & Chai 2008, Kordaki 2013, Blackwell, Lauricella, Wartella, Robb & Schomburg 2013) or even contradict other beliefs held (Brownlee 2001, Haser & Star 2009).

6.1 Reflections on the process

6.1.1 Strengths and limitations

One of the most significant strengths of this study is its grounded theory methodology. As this methodology is intended to explore, analyse and generate concepts about individuals' actions and social processes (Thornberg 2012) it was best suited to the present study due to its effectiveness in generating substantive

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

6 Concluding Thoughts

theories (Strauss & Corbin 1994) which is desirable in such a neglected area of study. Grounded theory was particularly appropriate to this research as it “is useful in providing rigorous insight into areas that are relatively unknown” (Jones & Alony 2011, 96); teachers’ beliefs in general and ICT teachers’ beliefs in particular are just such areas. This methodology provided a “detailed, rigorous and systematic method of analysis [whilst] reserving the need for the researcher to conceive preliminary hypothesis” (Jones & Alony 2011, 96).

A further strength of the grounded theory methodology was the variety of types and sources of data it permitted to be assimilated into the analysis including interviews; departmental documentation: schemes of work, lesson plans and other teaching and assessment resources; departmental minutes; observer’s field notes; previous and current curriculum advice from DfES and other relevant bodies and organisations. This made it possible to develop a full understanding of both the multifaceted issues that existed in the teachers’ experience of the curriculum change and their interactions and complex tightly woven relationships and hence develop a theoretical model of the process of curriculum change.

The grounded theory methodology was particularly fitting to explore and describe the experiences of ICT teachers living through significant curriculum change precisely because so little is known about them. The methodology developed an understanding of their lives, stories, and behaviours as well as the organizational functioning, social movements, and interactional relationships that affected them during the curriculum change (Brown, Stevens, Troiano & Schneider 2002). Grounded theory was a particular strength in this study due to both the lack of research in general on ICT teachers’ beliefs and the significant gaps in existing research on teachers’ beliefs and identities.

The researcher’s position as an insider was a further strength. The full and free access this afforded meant theoretical sampling and research, such as getting clarification of issues raised in interviews and participants’ ongoing views of the implementation of the curriculum, was more available and hence could be carried out more regularly. Additionally access to documentation and other sources of data required for primary data sources and triangulation was readily available without additional negotiation or requests. Furthermore, it made observations of how the participants were responding to the changes in their practice an ongoing

Teachers’ encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

6 Concluding Thoughts

day to day occurrence rather than a series of lesson observations and follow up interviews. Finally it embedded the researcher in the research in an almost constant basis ensuring their familiarity with both the data they were collecting and the lived experiences of the teachers involved in the study

In terms of completing the research being an insider meant the researcher did not have to familiarise themselves with, or acclimatize to, a new environment and culture. It also meant they already had an established relationship and rapport with the participants of the study. Moreover, being an insider helped participants speak freely and honestly without having to explain the previous situation or cultural impacts as they would to an outsider. However, the researcher also experienced difficulties precisely because they were a colleague going through the same process. The researcher holds their own beliefs regarding the environment, culture and curriculum change and was responding to its impact in a way that reflected these. Such beliefs and responses were not shared by others even though their day to day behaviours may look the same; hence the researcher had to separate their own beliefs and responses to the change from the research process. Though an insider to the change the researcher worked constantly and consciously to demonstrate theoretical sensitivity, laying aside any preconceived ideas that they have brought to the study and ensuring that they allowed the data to speak for itself.

The semi-structured in-depth interviews, and the ongoing nature of these presented a number of benefits in the research. They ensured opportunities for clarification, prompts and probes (Mertens 2010, Mears 2012), which were essential in obtaining a clear understanding of such a complex phenomenon. As well as affording the researcher the opportunity to follow up on significant issues, return to conversations to check understanding, review respondents' responses to the change and adopt a constant comparison thematic analysis of interview data.

Member checking was employed to ensure responses truly reflected respondents views and beliefs and gave an accurate account of what they wanted to say (Mertens 2010, Coe 2012) was an essential and beneficial aspect of the study. Respondents were given the opportunity to review their responses once they had been transcribed and were also free to add to, remove from or amend the

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

6 Concluding Thoughts

transcript of their response. Respondents were invited to participate in the analysis process, unfortunately none elected to take up this offer, had they done so this would have added additional rigour and integrity to the analysis process.

The fact the sample could be considered a convenience sample - selected because it was readily available and had few, if any, access issues; could be perceived to be a limitation. However, in this study the fact it is, like all other ICT and Computing departments across the country, in the process of implementing schemes of work to reflect the curriculum change means it is a representative case (Bryman 2008). Additionally as the department contains staff members illustrating a range of the dimensions of interest, different levels of IT education, different qualification routes, out of field teachers, second career teachers it reflects maximum variation sampling (Brown, Stevens, Troiano & Schneider 2002), hence is a purposive sample (Coe 2012).

Due to the unique nature of theories developed using the grounded theory methodology the result of this research cannot be tested for reliability and validity, rather it has its own tests for the quality of the research based on trustworthiness and rigour (Brown, Stevens, Troiano & Schneider 2002, Calman 2006). The concepts established from the research were constantly and continually interrogated to ensure the trustworthiness of the theory generated and all issues relating to trustworthiness: triangulation, dependability, transferability, and confirmability; were considered and mitigated for throughout the study. The methodology was applied with thoroughness throughout this study; all the categories emerged from, and were related through, conceptualisation of the data using constant comparison. All the categories are important to, and integrated into the core categories. The theory presented is a substantive one and will be altered when new relevant data is compared to existing data or when new contexts are explored. By its nature the grounded theory that has emerged from this research is interpretive and time and situation bound it is neither universal nor permanent (Strauss & Corbin 1994). Hence, like all grounded theories it is fluid in that it calls for each new situation to be analysed to see if the theory fits or not and as such will never be truly complete (Strauss & Corbin 1994).

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

6 Concluding Thoughts

The participants made up an entire ICT department and represented a purposive sample being both a representative case and exhibiting maximum variation. The grounded theory methodology drew on a number of sources including interviews; departmental documentation: schemes of work, lesson plans and other teaching and assessment resources; lesson observations; teachers' reflections on lessons they have delivered. Given the particular and unique characteristics of the setting, the selection of the participants is acknowledged as a limitation in that although chosen purposively, they have limited the transferability of the findings. Anyone wishing to draw comparisons with this study should consider its unique aims and culture, and the sociological and political context acting within it and the department as well as the characteristics of the students whom these department members teach.

6.1.2 Improvements

The overall aim of this research was to investigate the experience of existing ICT teachers and in particular to inquire into how teachers' beliefs are formed and how they influence said teachers' reactions and responses to significant curriculum change. This study has represented these experiences and reactions in the two years either side of the introduction of the new curriculum. However, these teachers' reactions and responses to the curriculum change are ongoing and hence one improvement would be to extend the study to investigate if and how these reactions and responses changed as the new curriculum bedded in and the teachers became more familiar with, and experienced in delivering it. Extending the study in this way would also allow the opportunity to establish if their experiences of delivering the new curriculum in the longer term led to changes in their beliefs regarding the purpose of IT education. It would also be of worth to extend the investigation to gauge the impact of teachers' divergence from the new curriculum. To gain a fuller picture of existing ICT teachers' experiences of the change the sample could have been larger and looked at teachers who made up ICT departments at other secondary schools as well as teachers delivering the new curricula at primary schools.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

6.2 Contribution to the field

This study makes three substantial and original contributions to knowledge. Firstly, by presenting existing ICT teachers' beliefs regarding IT education, and how these were formed through their biographies and how they have influenced said teachers' responses to the new curriculum this study establishes new knowledge and understanding of ICT teachers and their beliefs, which at the current time is limited to say the least. Secondly, it adds to the existing body of literature on beliefs and their impact on teachers' behaviour. Finally, it contributes through its grounded research methodology which is original in both its emphasis and context.

By identifying, examining and presenting existing ICT teachers' beliefs regarding IT education, examining how these were formed through their biographies and considering how they have influenced said teachers' responses to the new curriculum this study establishes new knowledge and understanding of ICT teachers and their beliefs, which at the current time is limited. ICT teachers are, in many ways, unique. This is likely to be reflected in both their teacher beliefs and their teacher identities and as such they, and their teacher beliefs and identities, are in need of examination. By eliciting the individual's subjective experience and views regarding ICT teaching and the curriculum the study has identified how previous educational and career experiences contributed to the development of their teachers' beliefs. Additionally it highlights how these diverse and often conflictory beliefs are affecting their introduction of the new curriculum.

The grounded theory methodology employed in this study offered a unique opportunity to consider the action and interaction of teachers' beliefs, identities and actions within the social context of the curriculum change (Strauss & Corbin 1994). By identifying patterns among established ICT teachers as they worked through the processes of, and their responses to, the curriculum change it provided the means to connect the multiple perspectives, processes and consequences of action/interaction within this specific landscape. The grounded theory that has emerged from this research provides understanding of the role of existing ICT teachers' beliefs and identities as barriers to, or facilitators of, ongoing curriculum change, identifying how they affect how the individual

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

6 Concluding Thoughts

teachers negotiate curriculum change. In this way this study extends existing work both that which identifies teachers beliefs play a significant role in how curriculum changes are implemented and that their actions do not always match their espoused theories by investigating why this the case in for ICT teachers in this particular context.

By considering how existing ICT teachers' beliefs were formed and how they influenced said teachers' reactions and responses to the significant curriculum change it has added considerable knowledge to the field of teachers' beliefs. Though it has already been established that teachers' beliefs have an impact on curriculum change and its effectiveness, work on teachers' beliefs in general is far from comprehensive and exhaustive, this is despite Pajares' (1992) clear identification that teachers' beliefs were an area in need of further study. This study has contributed significantly by identifying:

1. ICT teachers' beliefs regarding the nature of IT education and the effectiveness of alternative curricula;
2. how specific ICT teachers' beliefs are formed through their biographies;
3. how these beliefs act as barriers to, or facilitators of, curriculum change.

At this time of significant curriculum change it is important to consider the factors that may impede or encourage adoption of new ideas. It is only through considering the curriculum change through the eyes of existing ICT teachers that we will be able to introduce a curriculum that will start to address the ever increasing need for digital skills identified in Britain (House of Commons 2016, Department for Culture, Media and Sport 2016, Business in the Community 2016) and beyond.

The results of this study, however, have implications beyond just ICT teachers and the curriculum change they are living through. The conclusions of this research have consequences that reach education wide and beyond. It is valuable for teachers, and school leaders and policy makers as well as those working within the IT sector. By considering how the beliefs of those involved in the study affected their responses to the curriculum change other practitioners may better understand their own responses to such externally imposed changes. Equally school leaders and policy makers can benefit from the findings of the research to consider how they can introduce changes in a way that support those

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

6 Concluding Thoughts

who have to implement them to consider how they relate to their beliefs and how this will affect how they put the changes into place. The current trend within 'Western' education systems of centralised control makes these potential benefits of the research far reaching. Additionally, the fact that those working in the IT industry also have the same diverse and non-standardised route to their career (Valenduc et al. 2004) means the research has implications for such individuals and their professional development.

This research also contributes to its field through its grounded research methodology which is original in both its emphasis and context. The grounded theory methodology was used to establish the relationships between established ICT teachers' autobiographies, their teacher beliefs and their reactions and responses to the curriculum change. These relationships have been presented through descriptive and conceptual writing and due to this present the both the richness of the respondents accounts and the conceptual density and substantive nature of the multifaceted issues that exist and interact in the complex tightly woven relationships that were present as they experienced the curriculum change.

6.3 Future work

The timing of this study, spanning four years, two either side, of the introduction of the new Computing curriculum, makes it impossible to extend by replicating the research in other institutions. However, this research has considered a process that is a microcosm of education systems the world over. Teachers rarely, if ever, have full control over what they deliver; they are called upon to deliver syllabuses to meet examination board specifications or state or country governments' specified curricular. These syllabuses and curricular are regularly, sometimes it appears constantly, altered; the success, or otherwise, of these changes relies on how they are implemented by teachers and this is dependent on those teachers' existing beliefs about education and the subject and students they teach. England has recently seen the introduction of new A Level and GCSE curricula and is about to experience the reintroduction of grammar schools. Carrying out similar studies on teachers undergoing these, and other, significant changes, could provide greater insight into potential pitfalls and highlight which

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

6 Concluding Thoughts

teachers' beliefs are most significant in influencing whether teachers adopt or adapt them. Such research could help identify and examine teachers' beliefs regarding the purpose of qualifications and the nature of students and schools that will drive their reaction to the reforms.

Furthermore, given the significance of teachers' beliefs in facilitating significant educational change, future research could investigate the design and efficacy of initial teacher training and teacher professional development supporting such changes, examining the extent to which they attend to the seemingly powerful link between personal and professional beliefs and values and the changes being executed.

All of these investigations would not only add to the broader literature on the significance of teachers' beliefs on educational change, but would also be of importance to both teachers, school leaders and policy makers who may reconsider how they introduce and implement changes so they can draw on the undeniable power of teachers' existing beliefs. It has its limitations particularly concerning generalisability and replicability. The research was carried out within one department within one school both with particular cultures and aims; additionally it was carried out at a unique point in time that straddled the original and new curricula.

7 Appendix A – Institution informed consent agreement

Tuesday 18 September 2012

Dear XXXX

Re: Doctoral Thesis

Last term I spoke to you to get agreement in principle to carry out the research for my doctoral thesis in the Business Department here at XXX.

I now need to formalise this informal approval. To this end I have attached both an information sheet and consent form. The information sheet outlines what will be involved in the research and procedures regarding anonymity and withdrawal. The consent sheet asks a number of questions regarding your understanding of this information sheet and asks for you to formally agree to the College's participation. If you are still happy for the College to be involved please complete the consent form and return it to me.

If you have any questions or just want to discuss my thesis or research further please just let me know.

Due to my recent 'change in personal circumstances' I am keen to get the interviews carried out as soon as possible so would be grateful if you could sign and return the consent form by the end of this week, Friday 21st September.

Many thanks for your continued interest in and support of my studies.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

Institution Information Sheet

From: XXXXXXXX – Doctoral Research Study

Title of Study: What are existing ICT teachers' beliefs regarding the ICT curriculum and impending significant curriculum change?

Dear Colleague

I am currently seeking information from departmental teaching colleagues who might be willing and interested in participating in my Doctoral Study. I am investigating existing ICT teachers' beliefs; attempting to identify their beliefs regarding what ICT education is and should be, how these beliefs were developed and how they influence how we respond to ICT curriculum change.

My research is qualitative and interpretive, and will be organized around case studies. Anonymity will be maintained throughout. A pseudonym will be used for the name of the school and any other reference that might identify the school will be removed. The identity of colleagues who take part in the research will remain confidential to me, and they will be identified in my final thesis, only using a pseudonym.

As a participant in this Doctoral Study, colleagues would be required to:

- Participate in a recorded conversations expected to last about 30 – 45 minutes
- Potentially participate in shorter follow up interviews, held at either your or my request to clarify any previous responses
- Share with me feedback, testimonies, and any other materials that you judge to be of importance in forming you beliefs regarding ICT and curriculum change;
- Provide information on your own education and career.

They will also be offered the opportunity to:

- Comment on and verify conversation transcripts and interpretive material;
- Be involved in the analysis of your responses and other materials;
- Receive verbal or written feedback on the analysis of your responses and other materials;

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

7 Appendix A – Institution informed consent agreement

- Receive verbal or written feedback on the analysis of all responses and other materials;
- Receive a copy of the final study and any associated papers.

All of points 5 to nine above are optional and they are under no obligation to take them up.

Interview will be recorded using a digital Dictaphone. Recordings will then be stored digitally on private non networked devices and analysed in order to answer the research question. The analysis will focus on trends across all transcripts though quotes may be included in any write-ups. Quotes will be anonymous and have any references that might identify either the participant or the school removed.

This is not an action research project and there is therefore no expectation that colleagues will engage in any action-reflection-evaluation cycle. I aim to record and interpret their self-perceptions and experiences of ICT and curriculum change. They are welcome to participate in the interpretive process as far as their time and interest allow. Participants will be free to withdraw from the research project at any time without having to give a reason.

If I receive permission to go ahead with this research the school will:

- Receive verbal or written feedback on the analysis of all responses and other materials.
- Receive a copy of the final study and any associated papers

Both points above are optional and you are under no obligation to take them up.

This study has full Ethics Approval from my institution candidature University of Durham.

My Doctoral Supervisor is XXXXXX, email [XXXXXXX](#)

If you are prepared to give permission for this research study please complete the attached consent form and return it to me. You will be free to withdraw the school from the research project at any time without having to give a reason.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

7 Appendix A – Institution informed consent agreement

If you require any further information please contact me and I will discuss my project further with you.

With many thanks in anticipation,

XXXX

RESPONDENT CONSENT REQUEST FORM

TITLE OF PROJECT: What are existing ICT teachers' beliefs regarding the ICT curriculum and impending significant curriculum change?

The institution representative should complete the whole of this sheet himself/herself

Please cross out as necessary

Have you read the Institution Information Sheet? YES / NO

Have you had an opportunity to ask questions and to discuss the study?
YES / NO

Have you received satisfactory answers to all of your questions? YES / NO

Have you received enough information about the study? YES / NO

Have you been made aware of the fact your responses will be digitally recorded?
YES / NO

Are you aware of how such recordings will be used during and after the study?
YES / NO

Do you consent to your institution participating in the study? YES / NO

Do you understand that you are free to withdraw the institution from the study:

at any time and
without having to give a reason for withdrawing? YES / NO

Signed Date

(NAME IN BLOCK LETTERS)

.....

Approved by Durham University's Ethics Advisory Committee

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

8 Appendix B – Respondent informed consent agreement

RESPONDENT CONSENT REQUEST FORM

TITLE OF PROJECT: What are existing ICT teachers' beliefs regarding the ICT curriculum and impending significant curriculum change?

The participant should complete the whole of this sheet himself/herself

Please cross out as necessary

Have you read the Participant Information Sheet? YES / NO

Have you had an opportunity to ask questions and to discuss the study?
YES / NO

Have you received satisfactory answers to all of your questions? YES / NO

Have you received enough information about the study? YES / NO

Have you been made aware of the fact your responses will be digitally recorded?
YES / NO

Are you aware of how such recordings will be used during and after the study?
YES / NO

Do you consent to participate in the study? YES / NO

Do you understand that you are free to withdraw from the study:

at any time and
without having to give a reason for withdrawing? YES / NO

Signed Date

(NAME IN BLOCK LETTERS)

.....

Approved by Durham University's Ethics Advisory Committee

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

9 Appendix C – Consent agreement information sheet

Respondent Information Sheet

From: XXXXXXXX – Doctoral Research Study

Title Of Study: What are existing ICT teachers' beliefs regarding the ICT curriculum and impending significant curriculum change?

Dear Colleague

I am currently seeking information from academic colleagues who might be willing and interested in participating in my Doctoral Study. I am investigating existing ICT teachers' beliefs; attempting to identify their beliefs regarding what ICT education is and should be, how these beliefs were developed and how they influence how we respond to ICT curriculum change.

My research is qualitative and interpretive, and will be organized around case studies. Should you be prepared to take part in the research, your identity will remain confidential to me, and you will be identified in my final thesis, only using a pseudonym.

As a participant in this Doctoral Study, you would be required to:

1. Participate in a recorded conversations expected to last about 30 – 45 minutes
2. Potentially participate in shorter follow up interviews, held at either your or my request to clarify any previous responses
3. Share with me feedback, testimonies, and any other materials that you judge to be of importance in forming you beliefs regarding ICT and curriculum change;
4. Provide information on your own education and career.

You will also be offered to opportunity to:

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

5. Comment on and verify conversation transcripts and interpretive material;
6. Be involved in the analysis of your responses and other materials;
7. Receive verbal or written feedback on the analysis of your responses and other materials;
8. Receive verbal or written feedback on the analysis of all responses and other materials;
9. Receive a copy of the final study and any associated papers.

All of points 5 to nine above are optional and you are under no obligation to take them up.

This is not an action research project and there is therefore no expectation that you will engage in any action-reflection-evaluation cycle. I aim to record and interpret your self-perceptions and experiences of ICT and curriculum change. You are welcome to participate in the interpretive process as far as your time and interest allow.

If you are prepared to take part in this research study, you should be available to participate in the recorded conversation at some point during the first term of the 2012 – 2013 academic year.

This study has been approved by the principal at this institution and has full Ethics Approval from my institution candidature University of Durham.

My Doctoral Supervisor is XXXXXX, email [XXXXXXX](#)

If you require any further information please contact me and I will discuss my project further with you.

If you are prepared to be involved I will provide you with more information, if necessary, and a consent form.

With many thanks in anticipation,

XXXX

10 Appendix D – Pre-interview data collection sheet

Teacher Code: _____

Qualifications

GCSEs /O Levels or equivalent *record subjects only*

A Levels or equivalent *record subjects only*

Degree or equivalent – *main subjects and modules (if you can remember them!)*

Teaching certification - *main subject and modules (if you can remember them!)*

Other postgraduate study (completed or ongoing) - *main subject and modules (if you can remember them!)*

Career History

Previous employment: *employer, post title and length of time in post*

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

11 Appendix E – Research tool

How long have you been teaching?

How long have you been teaching ICT?

Do you teach any other subjects?

Do you think of yourself as an ICT teacher?

What proportion of your weekly timetable are ICT lessons?

Describe your career history prior to teaching

Describe your route to teaching ICT

What experience did you have of receiving IT teaching or training prior to teaching ICT?

Probes: taught IT at school?

 any formal or informal IT input at school, in Further or Higher Education courses, while working prior to teaching, whilst teaching?

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

11 Appendix E – Research tool

What experience did you have of receiving teaching or training prior to teaching ?

Probes: as above

What is the role of IT education?

Probes: supporting other subjects, tech skilling, understanding, life skilling

Slide from Year 7 Intro

Different at different stages?

Extension Qs:

Do you have any artefacts or anecdotes that illustrate the significance of this role?

Can you identify when/where you identified this as a significant role of IT education?

Do you feel you achieve this in your ICT teaching? Why or why not?

What is the role of ???????? education?

Probes: Different at different stages?

Extension Qs:

Do you have any artefacts or anecdotes that illustrate the significance of this role?

Can you identify when/where you identified this as a significant role of IT education?

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

11 Appendix E – Research tool

Do you feel you achieve this in your ?????????????? teaching? Why or why not?

Comparing your teaching of ICT and your teaching of ?????????????? are there any ways your understanding of them or their educational role is similar or different?

Probes: content knowledge, pedagogical content knowledge, purpose, continuity

Comparing your teaching of ICT and your teaching of ?????????????? are there any ways teaching of them is similar or different?

Probes: comfort, expertise, teaching strategies

Are you aware of the proposed curriculum change?

Artefacts as prompts: Articles from BBC News website regarding the change

Can you explain your understanding of the proposed change?

Do you think there is a difference between ICT and Computing? What do you think these differences are?

Extension Qs: Can you identify how you have come to understand the terms in this way?

Do you have any artefacts or anecdotes that illustrate your understanding?

Can you identify when/where you started to identify the terms in this way?

Do you feel one or other of these 'subjects' is more important? Why?

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

Extension Qs: Can you identify how you have come to understand the terms in this way?

Do you have any artefacts or anecdotes that illustrate your understanding?

Can you identify when/where you started to identify the terms in this way?

How do you think the change affect how IT teaching looks in the classroom?

Extension Qs: Can you explain why you think this?

Do you have any artefacts or anecdotes that illustrate your understanding?

Can you identify when/where you started to think this?

What are your thoughts regarding the proposed curriculum change?

Extension Qs: Do you believe the ICT curriculum needs changing? Why?

Can you identify how you have come to this view?

How would you like to see the ICT curriculum changes? Why?

Do you have any artefacts or anecdotes that illustrate your proposals?

Can you identify when/where you started to think this?

What benefits, if any, do you think the proposed change will bring?

Probes: In general for students, schools, society?

Specifically for this school?

Specifically for you?

11 Appendix E – Research tool

What problems, if any, do you feel teaching Computing will bring

Probes: In general for students, schools, society?

Specifically for this school?

Specifically for you?

How are you preparing for the new curriculum?

Extension Qs: Can you explain why you are doing this?

Do you have any artefacts or anecdotes that illustrate your preparation?

Can you identify when/where you started to think this?

12 Appendix F – Questions asked of the data to help identify what it is trying to say.

12 Appendix F – Questions asked of the data to help identify what it is trying to say.

Reproduced from Thornberg (2012) pp 86-87

What is this data a study of?

What category does this incident indicate?

What is actually happening in the data?

What is the participant's main concern?

What do the actions and statements in the data take for granted?

What process(es) is at issue here? How can I define it?

How does this process develop?

How does the research participant(s) act while involved in this process?

What does the research participant(s) profess to think and feel while involved in this process? What might his or her observed behaviour indicate?

When, why and how does the process change?

What are the consequences of the process?

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

13 Appendix G – Constant comparisons to be made in order to establish and refine the conceptual categories

13 Appendix G – Constant comparisons to be made in order to establish and refine the conceptual categories

Reproduced from Thornberg (2012) p 88

Comparing and grouping codes and comparing codes with emerging categories

Comparing different incidents (e.g. social situations, actions, social processes or interactions patterns)

Comparing data from the same or similar phenomenon, action or process in different situations and contexts

Comparing different people (their beliefs, situations, actions, accounts or experiences)

Comparing data from the same individuals at different points in time

Comparing specific data with the criteria for the category

Comparing categories in the analysis with other categories

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

14 Appendix H – Glaser's 'coding families' with examples.

Reproduced from Thornberg (2012) p 89

The 'six C's' - causes, contexts, contingencies, consequences, co-variance and conditions

Process family e.g. phases, stages, progressions, passages, transitions, careers, tCurtisectories, sequencings, cycling

Degree family e.g. limit, range, grades, continuum, level

Type family e.g. type, styles, classes, genre

Identity-self family e.g. self-image, self-concept, self-evaluation, identity, transformations of self

Cutting point family e.g. boundary, cutting point, turning point, breaking point, point of no return

Cultural family e.g. social norms, social values, social beliefs

The consensus family e.g. agreements, contracts, definitions of situations, conformity, non-conformity, homogeneity, heterogeneity, conflict

Paired opposite family e.g. ingroup-outgroup, in-out, manifest-latent, explicit-implicit, overt-covert, informal-formal

15 Bibliography

Abrie, A. (2010). Student Teachers' Attitudes Towards and Willingness to Teach Evolution in a Changing South African Environment. *Journal of Biological Education*, 11(3). 102 - 107. DOI 10.1080/00219266.2010.9656205

Akar, B. (2012). Teaching for Citizenship in Lebanon: Teachers Talk About The Civics Classroom. *Teaching and Teacher Education*, 28. 470 - 480. DOI 10.1016/j.tate.2011.12.002

Angrosino, M.V. (2012).Observation-Based Research. In Arthur, J., Waring, M., Coe, R. and Hedges, L.V.(Eds). *Research Methods & Methodologies in Education*. 165 -169. London: Sage.

Ashley, L. (2012).Case Study Research. In Arthur, J., Waring, M., Coe, R. and Hedges, L.V. (Eds). *Research Methods & Methodologies in Education*. 102 -107. London: Sage.

Bain, J.D and McNaught, C. (2006). How Academics Use Technology in Teaching and Learning: Understanding the Relationship Between Beliefs and Practice. *Journal of Computer Assisted Learning*, 22. 99–113. DOI: 10.1111/j.1365-2729.2006.00163.x

Bayley, P. (2012, April). IT or ICT - What should we teach our pupils to make sure they have the skills they need? *British Computer Society*. DOI: 44304.

BBC . (2013, January 29). Primary pupils 'should learn computing', says Microsoft. *BBC News*. DOI: 21250567.

BBC. (2012a, January 11). ICT teachers welcome new computing programme. *BBC News*. DOI: 16509298.

BBC. (2012b, January 11). Michael Gove: students 'turned off' by ICT lessons. *BBC News*. DOI: 16515443.

BBC. (2012c, January 13). Royal Society offers ways to overhaul ICT teaching. *BBC News*. DOI: 16515275.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

15 Bibliography

BBC. (2012d, May 23). Google funds computer teachers and Raspberry Pis in England. *BBC News*. DOI: 18182280.

BCS and the Royal Academy of Engineering.(2012). Draft ICT programme of study. *Computing at School*. DOI: 202012_0.pdf.

Beijaard, D., Meijer, P. and Verloop, N. (2004). Reconsidering research on teachers' professional identity. *Teaching and Teacher Education*, 20. 107 – 128. DOI 10.1016/j.tate.2003.07.001

Beijaard, D, Verloop, N and Vermunt, J D. (2000). Teachers' Perceptions of Professional Identity: An Exploratory Study from a Personal Knowledge Perspective. *Teaching and Teacher Education*, 16. 749 - 764. DOI: 0742051X/16/7

Blackwell, C.K., Lauricella, A.R., Wartella, E., Robb, M. and Schomburg, R. (2013). Adoption and use of technology in early education - The interplay of extrinsic barriers and teacher attitudes. *Computers & Education*, 69. 310 – 319. DOI 10.1016/j.compedu.2013.07.024

Brennan, and Resnick, M. (2012). *New frameworks for studying and assessing the development of computational thinking*. In 2012 Annual meeting of the American Education Reserach Association. Vancouver: AERA. DOI: Brennan_Resnick_AERA2012_CT

Brinkerhoff, J. (2006). Effects of a long duration professional development academy on technology skills, computer self-efficacy and technology integration beliefs and practices. *Journal of Reserach on Technology in Education*, 39(1). 23 - 43.

British Computer Society. (2012, April). The IT Gap. *British Computer Scociety*. DOI: 44451

Brittain, N. (2012, January). BETT: Gove to scrap ICT Curriculum. *Computing*.

Brown, S.C., Stevens, R.A., Troiano, P.F. and Schneider, M.K. (2012). Exploring Complex Phenomena: Grounded Theory in Student Affairs Research. *Journal of College Student Development*, 44(2). 1 - 11.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

15 Bibliography

Brownlee, J. (2001). Epistemological Beliefs in Pre-service Teacher Education Students. *Higher Education Research and Development*, 20(3). 281-291. DOI 10.1007/BF03246293

Bryman, A. (2008). *Social Research Methods* (3rd ed). Oxford: Oxford University Press.

Burns, J. (2012, January 13) School ICT to be replaced by computer science programme. *BBC News*. DOI: 16493929.

Business in the Community.(2016) *A Brave New World - Why business must ensure an inclusive Digital Revolution*. London: Business in the Community.

Calman, L. (2006). Patients' view of nurse competence. *Nurse Education Today*, 26(8). 719 - 725.

Casey, A. (2012, September 11). "Who wants to be a teacher?" *Slideshare*.

Cefai, C., Ferrario, E., Cavioni, V., Carter, A. and Grech, T. (2014). Circle time for social and emotional learning in primary school. *Pastoral Care in Education*, 32(2). 116 - 130. DOI 10.1080/02643944.2013.861506

Cellan-Jones, R. (2012, May 24). Has Google's boss harmed computer teaching? *BBC News*. DOI: 18187205.

Chakrabarti, R. (2012, January 11). School ICT to be replaced by computer science programme. *BBC News*. DOI: 16503032.

Charlesworth, A. (2011, August) Students use IT to learn but spurn IT GCSE. *Computing*.

Cochran, O.F. (1997). Pedagogical Content Knowledge: Teachers' Integration of Subject Matter, Pedagogy, Students, and Learning Environments. *Research Matters - to the Science Teacher*, no. 9702.

Coe, R. (2012). Conducting your research. J, Arthur , Waring, M, Coe, R and Hedges, L V. *Research Methods and Methodologies in Education*, 41-52. London: Sage.

Cohen, L., Manion, L. and Morrison, K. (2007). *Research Methods in Education* 6th ed). Oxon: Routledge.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

15 Bibliography

Cohen, R. and Yarden, A. (2009). Experienced Junior-High-School Teachers' PCK in Light of a Curriculum Change: "The Cell is to be Studied Longitudinally". *Research in Science Education*, 39(1). 131–155. DOI 10.1007/s11165-008-9088-7

Collopy, R. (2003). Curriculum Materials as a Professional Development Tool: How a Mathematics Textbook Affected Two Teachers' Learning. *The Elementary School Journal*, 103(3). 287 - 311. DOI: 10.1086/499727

Computing at School. (2012 March). A curriculum framework for Computer Science and Information Technology . *Computing at School*.

Computing at School Working Group. (2012). *Computer Science: A Curriculum for Schools*. Computing at School.

Cox, M., Preston, C. & Cox, K. (1999, September). *What Factors Support or Prevent Teachers from Using ICT in their Classrooms?* Paper presented at British Educational Research Association Annual Conference. Brighton. DOI: 00001304

Day, C. (2002). School reform and transitions in teacher professionalism and identity. *International Journal of Educational Research*, 37. 677 - 692. DOI 10.1016/S0883-0355(03)00065-X

Day, C., Elliott, B. and Kington, A. (2005). Reform Standards and teacher identity: Challenges of sustaining commitment. *Teachers and Teacher Education*, 21. 563 - 577.

Day, C. and Gu, Q. (2007, September). Variations in the Conditions for Teachers' Professional Learning and Development: Sustaining Commitment and Effectiveness over a Career. *Oxford Review of Education*, 33(4). 423 - 443. DOI 10.1080/03054980701450746

Day, C., Kington, A., Stobart, G. and Sammons, P. (2006). The Personal and Professional Selves of Teachers: Stable and Unstable Identities. *British Educational Research Journal*, 30(4). 601 - 616. DOI 10.1080/01411920600775316

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

15 Bibliography

Day, C., Stobart, G., Sammons, P. and Kington, A. (2006). Variations in the work and lives of teachers: relative and relational effectiveness. *Teachers and Teaching*, 12(2). 169 - 192. DOI 10.1080/13450600500467381

Department for Culture, Media and Sport. (2016). *Digital Skills for the UK Economy*. London: Department for Culture, Media and Sport.

Department for Education and Skills.(2008). *The National Strategies - Secondary The Framework for secondary ICT: overview and learning objectives*. London: Department for Education and Skills. Retrieved from DOI: 89985

Department for Education. (2012, April 26). *ICT curriculum consultation*. London: Department for Education.

Department for Education. (2013, February). *Draft Computing programmes of study for Key Stages 1 - 4*. London: Department for Education.

Department for Education. (2013, September). *Computing programme of study: Key stages 3 and 4*. London: Department for Education.

Department for Education (2014, April). *School Workforce in England: November 2013*. London: Department for Education.

Dix, S. (2012). Discursively complex identities of New Zealand teachers of writing in times of contestation and change. *Teaching and Teacher Education* 28(3). 405 - 417. DOI 10.1016/j.tate.2011.11.004

Donnelly, R. (2008). Lecturers' Self-perception of Change in Their Teaching Approaches: Reflections on a Qualitative Study. *Educational Research*, 50(3). 207 - 222. DOI 10.1080/00131880802309317

Evers, W.J.G., Brouwers, A. and Tomic, W. (2002). Burnout and Self-efficacy: A Study on Teachers' Beliefs when Implementing an Innovative Educational System in the Netherlands. *British Journal of Educational Psychology*, 72. 227 – 243. DOI 10.1348/000709902158865

Fang, Z. (1996). A review of research on teacher beliefs and practices. *Educational Research* 38, no. 1. 47 - 65. DOI 10.1080/0013188960380104

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

15 Bibliography

Flores, M. and Day, C. (2006). Contexts which shape and reshape new teachers' identities: A multi-perspective study. *Teaching and Teacher Education*, 22. 219 - 232. DOI :10.1016/j.tate.2005.09.002

Fluck, A. & Dowden, T. (2013, February). On the cusp of change: examining pre-service teachers' beliefs about ICT and envisioning the digital classroom of the future. *Journal of Computer Assisted Learning*, 29 (1). 43 - 52. DOI 10.1111/j.1365-2729.2011.00464.x

Friedrichsen, P., Van Driel, J.H. and Abell, S.K. (2011) Taking a Closer Look at Science Teaching Orientations. *Science Education*, 95. 358 - 376. DOI 10.1002/sce.20428

Fullan, M. (1993) *Change Forces: Probing the Depths of Educational Reform*. London: Falmer.

Funkhouser, B.J. and Mouza, C. (2013). Drawing on technology: An investigation of preservice teacher beliefs in the context of an introductory educational technology course. *Computers & Education*, 62. 271 – 285. DOI 10.1016/j.compedu.2012.11.005

Glaser, B. (2012). No Preconception: The Dictum. *The Grounded Theory Review*, 11(2). 3 - 8.

Glatthorn, A. , Boschee, F., Whitehead, B. and Boschee, B. (2012). *Curriculum Leadership - Strategies for Development and Implementation*. New York: Sage Inc.

Goldston, M.J and Kyzer, P. (2009). Teaching Evolution: Narratives with a View from Three Southern Biology Teachers in the USA. *Journal of Research in Science Teaching*, 46(7). 762 – 790. DOI 10.1002/tea.20289

Grover, S. and Pea, R. (2013). Computational Thinking in K–12: A Review of the State of the Field. *Educational Researcher*, 42(1). 38 - 43. DOI: 10.3102/0013189X12463051

Gu, Q. and Day, C. (2007). Teachers resilience: A Necessary Condition for Effectiveness. *Teaching and Teacher Education*, 23. 1302 - 1316. DOI 10.1016/j.tate.2006.06.006

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

15 Bibliography

Guzdial, M. (2008). Education - Paving the Way for Computational Thinking.” *Communications of the ACM*, 51(8). 25 - 27. DOI 10.1145/1378704.1378713

Hadjerrouit, S. (2009). Didactics of ICT in Secondary Education: Conceptual Issues and Practical Perspectives. *Issues in Informing Science and Information Technology*, 6. 153 - 178.

Hammond, M. (2011). Beliefs and ICT: what can we learn from experienced educators. *Technology, Pedagogy and Education*, 20(3). 289 - 300. DOI 10.1080/1475939X.2011.610930

Hammond, M. (2004). The Peculiarities of Teaching Information and Communication Technology as a Subject: A Study of Trainee and New ICT Teachers in Secondary Schools. *Technology, Pedagogy and Education*, 13(1). 29 - 42.

Hammond, M. & Mumtaz, S. (2001). How trainee teachers of IT approach teaching their subject. *Journal of Computer Assisted Learning*, 17. 166 - 176. DOI 10.1046/j.0266-4909.2001.00169.x

Haser, C. and Star, J. (2009). Change in Beliefs After First-year of Teaching: The Case of Turkish National Curriculum Context. *International Journal of Educational Development*, 29. 293 – 302. DOI 10.1016/j.ijedudev.2008.08.007

Hennessey, S., Ruthven, K. & Brindley, S. (2005). Teacher perspectives on integrating ICT into subject teaching: commitment, constraints, caution, and change. *Journal of Curriculum Studies*, 37(2). 155 - 192.

Hobbs, V. (2007). Faking it or hating it: Can reflective practice be forced? *Reflective Practice: International and Multidisciplinary Perspectives*, 8(3). 405 - 417.

Hobbs, V. (2011). The Importance of Teachers Thoughts and Beliefs. In House, S (ed) *Ingles, Complementos de Formacion Disciplinar - Theory and Practice in English Language Teaching* (147 - 157). Barcelona: Spanish Ministry of Education,.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

15 Bibliography

Hong, J. (2010). Pre-service and beginning teachers' professional identity and its relation to dropping out of the profession. *Teaching and Teacher Education*, 26. 1530 - 1543.

House of Commons. (2016). *Digital skills crisis - Second Report of Session 2016–17*. London: House of Commons.

Howard, S.K. (2013). Risk-aversion: understanding teachers' resistance to technology integration. *Technology, Pedagogy and Education*, 22(3). 357 - 372. DOI 10.1080/1475939X.2013.802995

Howard, S.K., Chan, A and Caputi, P. (2015). More than beliefs: Subject areas and teachers' integration of laptops in secondary teaching. *British Journal of Educational Technology*, 46(2). 360 – 369. DOI 10.1111/bjet.12139

Jegede, P. (2009). Age and ICT-Related Behaviours of Higher Education Teachers in Nigeria. *Issues in Informing Science and Information Technology*, 6. 771 - 777.

Jones, M.T. and Eick, C.J. (2007). Implementing Inquiry Kit Curriculum: Obstacles, Adaptations, and Practical Knowledge Development in Two Middle School Science Teachers. *Science Education*, 91(3). 492 - 513. DOI 10.1002/sce.20197

Jones, M. and Alony, I. (2011). Guiding the Use of Grounded Theory in Doctoral Studies - An Example from the Australian Film Industry. *International Journal of Doctoral Studies*, 6. 95 - 114.

Kagan, D.M. (1992). Implication of Research on Teacher Belief. *Educational Psychologist*, 27(1). 65 - 90. DOI 10.1207/s15326985ep2701_6

Kerem Karaagaç, M. and Threlfall, J. (2004). The tension Between Teacher Beliefs and Teaching Practice: The Impact of the Work Setting. *Conference of the International Group for the Psychology of Mathematics Education*, 3. 137 - 144. Group for the Psychology of Mathematics Education.

Khoh, L., Ling, L., Ch'ng, A. and Chuan, G. (2013). Student Teachers' Reasons for Choosing Teaching as a Career. *Redesigning Pedagogy International*

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

15 Bibliography

Conference. Singapore: National Institute of Education Singapore. DOI: 10.1.1.517.1667

Kirchhoff, A. and Lawrenz, F. (2011). The Use of Grounded Theory to Investigate the Role of Teacher Education on STEM Teachers' Career Paths in High-Need Schools. *Journal of Teacher Education*, 62(3). 246 – 259. DOI 10.1177/0022487110397840

Kırkgoz, Y. (2008). A Case Study of Teachers' Implementation of Curriculum Innovation in English Language Teaching in Turkish Primary Education. *Teaching and Teacher Education*, 24. 1859 – 1875. DOI 10.1016/j.tate.2008.02.007

Kobie, N. (2013, January 30). Computing to become UK's "fourth science". *PCPro*. DOI: 379615

Koc, M. (2013). Student teachers' conceptions of technology: A metaphor analysis. *Computers & Education*, 68. 1 - 8. DOI 10.1016/j.compedu.2013.04.024

Kordaki, M. (2013). High school computing teachers' beliefs and practices: A case study. *Computers & Education*, 68. 141 - 152. DOI 10.1016/j.compedu.2013.04.020

Lang, P. (1998). Getting Round to Clarity: What Do We Mean by Circle Time. *Pastoral Care in Education: An International Journal of Personal, Social and Emotional Development*, 16(3). 3 - 10.

Lasky, S. (2005). A sociocultural approach to understanding teacher identity, agency and professional vulnerability in a context of secondary school reform. *Teaching and Teacher Education*, 21. 899 - 916. DOI 10.1016/j.tate.2005.06.003

Leat, D. (2010). Rolling the Stone Uphill: Teacher development and the implementation of Thinking Skills programmes. *Oxford Review of Education*, 25(3). 387 - 403. DOI 10.1080/030549899104053

Lee, O., Luykx, A., Buxton, C. and Shaver, A. (2007). The Challenge of Altering Elementary School Teachers' Beliefs and Practices Regarding Linguistic and Cultural Diversity in Science Instruction. *Journal of Research in Science Teaching*, 44(9). 1269 – 1291. DOI 10.1002/tea.20198

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

15 Bibliography

- Levin, T. and Nevo, Y. (2009). Exploring Teachers' Views on Learning and Teaching in The Context of a Trans-disciplinary Curriculum. *Journal of Curriculum Studies*, 41(4). 439 – 465. DOI 10.1080/00220270802210453
- Lim, C.P. and Chai, C.S. (2008). Teachers' Pedagogical Beliefs and Their Planning and Conduct of Computer-mediated Classroom Lessons. *British Journal of Educational Technology*, 39(5). 807 – 828. DOI 10.1111/j.1467-8535.2007.00774.x
- Lloyd, M. and Albion, P. (2009). Altered Geometry: A New Angle on Teachers Technophobia. *Journal of Technology and Teacher Education*, 17(1). 65 - 84.
- Lortie, D. (2002). *Schoolteacher - A Sociological Study*. 2nd Edition. Chicago: University of Chicago Press.
- Mangubhai, F. (2007). The Moral and Ethical Dimensions of Language Teaching. *Australian Journal of Education*, 51(2). 178 – 189.
- McDougall, J. (2010). A Crisis of Professional Identity: How Primary Teachers are Coming to Terms with Changing Views of Literacy. *Teaching and Teacher Education*, 26. 679 – 687.
- Mears, C. (2012). In-Depth Interviews. In Arthur, J., Waring, M., Coe, R. and Hedges, L.V. (Eds), *Research Methods and Methodologies in Education*, 170 - 175. London: Sage.
- Mertens, D. (2010). *Research and Evaluation in Education and Psychology*. London: Sage.
- Mitchell, B. (2016, January 18). How much are computing teachers struggling with the new curriculum? *BCS Academy of Computing*.
- Morgan, P. and Hansen, V. (2008). The relationship between PE biographies and PE teaching practices of classroom teachers. *Sport, Education and Society*, 13(4). 373 - 391. DOI 10.1080/13573320802444994
- Morse, B. (2012, September 12). Why critical thinking is overlooked by schools and shunned by students. *The Guardian Teacher Network*.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

15 Bibliography

- Moseley, D., Higgins, S., Bramald, R., Hardman, F., Miller, J., Mroz, M., ... Bramald, S. (1999). *Ways forward with ICT: Effective Pedagogy using Information and Communications Technology for Literacy and Numeracy in Primary Schools*. Newcastle: Newcastle University.
- Mumtaz, S. (2000). Factors Affecting Teachers' Use of Information and Communications Technology: a review of the literature. *Journal of Information Technology for Teacher Education*, 9(3). 319 - 338.
- Munby, H. (1982). The Place of Teachers' Beliefs in Research on Teacher Thinking and Decision Making, and an Alternative Methodology. *Instructional Science*, 11. 201 - 225.
- Munn-Giddings, C. (2012). Action Research. In Arthur, J., Waring, M., Coe, R. and Hedges, L.V. *Research Methods & Methodologies in Education*, 71 - 74. London: Sage.
- Nargund-Joshi, N., Rogers, M.A.P. and Akerson, V.L. (2011). Exploring Indian Secondary Teachers' Orientations and Practice for Teaching Science in an Era of Reform. *Journal of Research in Science Teaching*, 48(6). 624 - 647. DOI 10.1002/tea.20429
- National Advisory Committee on Creative and Cultural Education. (1999). *Creative and Cultural Education Creativity, Culture and Education*.
- Naughton, J. (2012, March 31). Why all our kids should be taught how to code. *The Guardian*. Retrieved from .
- Neal, L. (2009). Researching Coaching: some dilemmas of a novice grounded theorist. *International Journal of Evidence Based Coaching and Mentoring*, Special Issue No. 3. 1 - 10.
- Nespor, J. (1987). The role of beliefs in the practice of teaching. *Journal of Curriculum Studies*, 19(4). 317 - 328. DOI 10.1080/0022027870190403
- Ni, L. & Guzdial, M. (2012). Who Am I?: understanding high school computer science teachers' professional identity. *SIGCSE'12 Proceedings of the 43rd ACM technical symposium on Computer Science Education*. New York: ACM,. 499 - 504.
- Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing*

15 Bibliography

- Nielsen, D.C., Barry, A.L. and Staab, P.T. (2008). Teachers' Reflections of Professional Change During a Literacy-reform Initiative. *Teaching and Teacher Education*, 24. 1288 – 1303. DOI 10.1016/j.tate.2007.01.015
- Obara, S. and Sloan, M. (2009). Classroom Experiences with New Curriculum Materials During the Implementation of Performance Standards in Mathematics: A Case Study of Teacher Coping with Change. *International Journal of Science and Mathematics Education*, 8. 34 - 37. DOI 10.1007/s10763-009-9176-9
- Office for Standards in Education. (2011). *ICT in schools 2008–11*. Manchester: Ofstead.
- Opfer, V.D., Pedder, D.G. and Lavicza, Z. (2011). The role of teachers' orientation to learning in professional development and change: A national study of teachers in England. *Teaching and Teacher Education*, 27. 443 - 453. DOI 10.1016/j.tate.2010.09.014
- Pajares, F. (1992). Teachers' Beliefs and Educational Research: Cleaning Up a Messy Concept. *Review of Educational Research*, 62(3). 307 - 332. DOI 10.3102/00346543062003307
- Papaioannou, P. and Charalambous, K. (2011). Principals' Attitudes towards ICT and Their Perceptions about the Factors That Facilitate or Inhibit ICT Integration in Primary Schools of Cyprus. *Journal of Information Technology Education*, 10. 349 - 369.
- Pinnegar, S., Mangelson, J., Reed, M. and Groves, S. (2011). Exploring preservice teachers' metaphor plotlines. *Teaching and Teacher Education*, 27. 639 - 47. DOI 10.1016/j.tate.2010.11.002
- Polettini, A. (2000). Mathematics teaching life histories in the study of teachers' perceptions of change. *Teaching and Teacher Education*, 16. 765 - 783. DOI 10.1016/S0742-051X(00)00024-X
- Ramnarain, U. and Schuster, D. (2014). The Pedagogical Orientations of South African Physical Sciences Teachers Towards Inquiry or Direct Instructional Approaches. *Research Science Education*, 44. 627 – 650.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

15 Bibliography

Reio, T. (2005). Emotions as a lens to explore teacher identity and change: A commentary. *Teaching and Teacher Education*, 21. 985 - 993. DOI 10.1016/j.tate.2005.06.008

Rinke, C.R. (2008) Understanding teachers' careers: Linking professional life to professional path. *Educational Research Review*, 3. 1 – 13. DOI 10.1016/j.edurev.2007.10.001

Rinke, C.R., Mawhinney, L. and Park, G. (2014). The apprenticeship of observation in career contexts: a typology for the role of modeling in teachers' career paths. *Teachers and Teaching: Theory and Practice*, 20(1). 92 – 107. DOI 10.1080/13540602.2013.848517

Robinson, M. and McMillan, W. (2006). Who teaches the teachers? Identity, discourse and policy in teacher education. *Teaching and Teacher Education*, 22. 327 – 336. DOI 10.1016/j.tate.2005.11.003

Robson, J. (2002). The voices of vocational teachers in the UK: Their perceptions of the nature and status of the further education teacher's professional knowledge. *Australian and New Zealand Journal of Vocational Education Research*, 10(2). 95 - 113.

Rogers, M.A.P., Cross, D.I., Gresalfi, M.S., Trauth-Nare, A.E. and Buck, G.A. (2011). First year implementation of a project based learning approach: The need for addressing teachers' orientations in an era of reform. *International Journal of Science and Mathematics Education*, 9. 893 - 917. DOI 10.1007/s10763-010-9248-x

Rousseau, C.K. (2004). Shared Beliefs, Conflict, and a Retreat from Reform: The Story of a Professional Community of High School Mathematics Teachers. *Teaching and Teacher Education*, 20.783 – 796. DOI 10.1016/j.tate.2004.09.005

Sahota, D. (2011, January 11). ICT curriculum is damaging perception of IT, says IET. *Computing*.

Sammons, P, Day, C, Kington, A, Gu, Q, Stobart, G and Smees, R. (2007). Exploring Variations in Teachers' Work, Lives and Their Effects on Pupils: Key Findings from a Longitudinal Mixed-Method Study. *British Education Journal*, 33(5). 681 - 701. DOI: 10.1080/01411920701582264

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

15 Bibliography

- Santoli, S. (2009). Why We Teach: Autobiographies of Traditionally and Alternatively Certified Pre-Service Social Studies Teachers. *The Qualitative Report*, 14(3). 478 - 488.
- Sbaraini, A., Carter, S.M., Evans, R.W., and Blinkhorn, A. (2011). How to do a grounded theory study: a worked example of a study of dental practices. *BMC Medical research Methodology*, 11(128). DOI 10.1186/1471-2288-11-128.
- Scott, G. (1999). *Change Matters*. St Fitzs: Allen & Unwin.
- Shah, S. (2011), December). Ofsted report: ICT teaching in the UK is 'inadequate'. *Computing*.
- Shapiro, S. (2010). Revisiting the teachers' lounge: Reflections on emotional experience and teacher identity. *Teaching and Teacher Education*, 26. 616 – 621. DOI 10.1016/j.tate.2009.09.009
- Silverman, D. (2010). *Doing Qualitative Research* (3rd ed). London: Sage.
- Song, Y. and Looi, C. (2011). Linking teacher beliefs, practices and student inquiry-based learning in a CSCL environment: A tale of two teachers. *Computer Supported Learning*, 7(1) 129 - 152..
- Southerland, S.A, Gess-Newsome, J and Johnston, A. (2003). Portraying Science in the Classroom: The Manifestation of Scientists' Beliefs in Classroom Practice. *Journal of Research in Science Teaching*, 40(7). 669 – 691. DOI 10.1002/tea.10104
- Stephenson, C., Gal-Ezer, J, Haberman, B and Verno, A. (2005). *The new educational imperative: Improving computer science education*. Final task force report. ACM/CSTA Curriculum Improvement Task Force.
- Stipek, J., Givvin, K.B., Salmon, J.M. and MacGyvers, V.L. (2001). Teachers' Beliefs and Practices Related to Mathematics Instruction. *Teaching and Teacher Education*, 17(2). 213 - 226. DOI 10.1016/S0742-051X(00)00052-4
- Strauss, A. and Corbin, J. (1994). Grounded Theory Methodology An Overview. In Denzin N. and Lincoln, Y. (Eds), *Handbook in Qualitative Research*, 273 - 285. London: Sage.
- Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing*

15 Bibliography

Talanquer, V., Novodvorsky, I. and Tomanek, D. (2010). Factors Influencing Entering Teacher Candidates' Preferences for Instructional Activities: A glimpse into their orientations towards teaching. *International Journal of Science Education*, 30(10). 1389 - 1406. DOI 10.1080/09500690903019572

Tedder, M. (2012). Biographical Research Methods. In Arthur, J., Waring, M., Coe, R. and Hedges, L.V. (Eds). *Research Methods and Methodologies in Education*. 322 - 329. London: Sage.

Tew, M. (1998). Circle Time: A Much-neglected Resource in Secondary Schools. *Pastoral Care in Education*, 16(3). 18 - 27.

The Royal Society. (2012). *Shut down or restart? The way forward for computing in UK schools*. London: The Royal Society.

Thomas, L. and Beauchamp, C. (2011). Understanding new teachers' professional identities through metaphor. *Teaching and Teacher Education*, 27. 762 - 769. DOI 10.1016/j.tate.2010.12.007

Thornberg, R. "Grounded Theory." In Arthur, J., Waring, M., Coe, R. and Hedges, L.V. *Research Methods and Methodologies in Education*, 85 - 93. London: Sage, 2012.

Timostsuk, I. and Ugaste, A. (2010). Student teachers' professional identity. *Teaching and Teacher Education*, 26. 1563 - 1570. DOI 10.1016/j.tate.2010.06.008

Twining, P., Raffaghelli, J., Albion, P. and Knezek, D. (2013). Moving education into the digital age: the contribution of teachers' professional development. *Journal of Computer Assisted Learning*, 29. 426 - 437. DOI 10.1111/jcal.12031

Vähäsantanen, K. and Eteläpelto, A. (2011). Vocational Teachers' Pathways in the Course of a Curriculum Reform. *Journal of Curriculum Studies*, 43(3). 291 - 312. DOI 10.1080/00220272.2011.557839

Valenduc, G., Vendramin, P., Guffens, C., Ponzellini, A.M., Lezano, A., D'Ouille, L., Collet, I., Wagner, I., Birbaumer, A., Tolar, M. and Webster J. (2004). *Widening Women's Work in Information and Communication Technology:*

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

15 Bibliography

Professional tCurtisectories and biographies. Namur (Belgium): Fondation Travail – Université ASBL.

Van Eekelen, I.M., Vermuntb, J.D. and Boshuizenc, H.P.A. (2006). Exploring Teachers' Will to Learn. *Teaching and Teacher Education*, 22. 408 – 423. DOI 10.1016/j.tate.2005.12.001

Vartuli, S. (1999). How Early Childhood Teacher Beliefs Vary Across Grade Level. *Early Childhood Research Quarterly*, 14(4). 489 - 514. DOI 10.1016/S0885-2006(99)00026-5

Vaughan, R. (2014, February 26). 'Rising tide of panic' among teachers expected to teach computing curriculum, expert says. *TES News*.

Veen, K. and Lasky, S. (2005). Emotions as a lense to explore teacher identity and change: Different theoretical approaches. *Teaching and Teacher Education*, 21. 895 - 898.

Veen, W. (1993). How Teachers Use Computers in Instructional Practice - Four Case Studies in Dutch Secondary School. *Computers in Education*, 21(1/2). 1 - 8.

Wakefield, J. (2012, July 2). How schools will boot up a new ICT curriculum. *BBC News*. DOI: 18687248.

Wallace, C.S. and Priestley, M. (2011). Teacher Beliefs and the Mediation of Curriculum Innovation in Scotland: A Socio-cultural Perspective on Professional Development and Change. *Journal of Curriculum Studies*, 43(3). 357 - 381. DOI 10.1080/00220272.2011.563447

Webb, M. and Cox, M. (2004). A Review of Pedagogy Related to Information and Communications Technology. *Technology, Pedagogy and Education*, 13(3). 235 - 286.

Wing, J. , (2006). Viewpoint: Computational thinking. *Communications of the ACM*, 49(3). 33 - 35. DOI 10.1145/1118178.1118215

Wing, J. (2008). Computatioal thinking and thinking about computing. *Philosophical Transactions of the Royal Society*, 366. 3717 - 3725.

Teachers' encounters with major disciplinary and curriculum change: a theoretical framework in the context of ICT and computing

15 Bibliography

Yang, H. (2012). ICT in English schools: transforming education? *Technology, Pedagogy and Education*, 21(1). 101 - 118. DOI 10.1080/1475939X.2012.659886

Zeitler, N.A. (2013, June 18). Computer Scientists in Short Supply. *SAP News Center*.

Zhang, D., Wang, Q., Losinski, M. and Katsiyannis, A. (2014). An Examination of Preservice Teachers' Intentions to Pursue Careers in Special Education. *Journal of Teacher Education*, 65(2). 156 - 171. DOI 10.1177/0022487113510743