CHANGING PERCEPTIONS OF ICT AT KS3: A CRITICAL INVESTIGATION
USING ACTIVITY THEORY

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STATEMENT:
This research was undertaken under the auspices of the University of Wales:
Trinity Saint David and was submitted in partial fulfilment for the award of a
Degree of PhD by Research in the Faculty of Education and Communities of
the University of Wales, Trinity Saint David.

March 2015

Abstract

This study examined the pedagogy of ICT and the aim of the research was to explore teachers' perceptions of ICT capability and whether their practice in the classroom matched their personal constructs. This is particularly pertinent given the current environment of curriculum change in Wales.

Cultural Historical Activity Theory (CHAT) was used as an analytical framework within this study. The use of this tool has enabled different dimensions within the case studies to be recognised and discussed. The use of the activity settings over time has allowed a fourth dimension to be added to the analysis and to examine how the teachers in the case study have managed their recognition of the emergent contradictions. The use of the activity setting to analyse similar settings from different viewpoints has prompted the use of CHAT as a tool to model likely contradictions which may emerge from the introduction of any new curriculum. The use of CHAT in an educational setting in this way has built on the use of Activity Theory to analyse the workplace activity in highlighting change and participant's reaction to that change.

Two continuums emerged, one concerning how ICT capability was perceived in terms of skills used, with the metacognitive skills at one end and the tools of specific software applications at the other. The other continuum was concerned with the pedagogy of ICT. It emerged that the schools employed different pedagogical strategies which resulted in the use of different pedagogical tools by the teachers within the study. The pedagogical continuum ranged from a mechanistic rigid pedagogy to one of facilitation with pupils creating opportunities for knowledge construction.

These variations have implications for the pedagogy of any new computing curriculum which may be introduced and the need for continued professional development to enable effective teaching of that new curriculum.

Acknowledgements

This PhD has been a road of discovery, with peaks and troughs along the way, however, it has not been a journey that has been solitary and it is only appropriate to thank those who have contributed to the study and made this research possible.

Firstly I would like to thank my friends and family particularly my husband Jon and my son Stevie, for their forbearance, support and understanding.

I would also like to thank my case study teachers who freely gave of their time and knowledge, and without whom none of this would have been possible.

I would like to acknowledge my faculty and particularly The South West Wales Centre of Education in supporting my quest for a doctorate.

Lastly thanks to my director of studies, Dr Howard Tanner and my supervisor Dr Steve Kennewell for their academic and moral support. They have always made time to see me and to support me in my studies. They have allowed me the room to develop my knowledge whilst at the same time testing my assumptions and supporting my suppositions.

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Chapter One – Introduction

The statutory curriculum for Information Communication Technology (ICT) and Computing in the UK has evolved over a relatively short period, during which there has been a process of devolution in Government, with Wales being given power to manage affairs in a number of fields including Education. This has resulted in changes in the curriculum between England and Wales, resulting in slightly different specifications within each country.   Personal experience of teaching ICT within England where the National Strategy for ICT resulted in a defined and prescribed understanding of the National Curriculum for ICT in England which contrasted with the situation observed within Wales. In England the guidance issued in the form of the National Strategy for ICT was considered to be compulsory in nature whilst in Wales there was an ethos of greater freedom allowed within the teaching of the ICT curriculum. The experience of observing the teaching of ICT in Wales at KS3 suggested that the ICT curriculum and the pedagogy associated with the subject varied widely between schools in Wales. This study examines the pedagogy of ICT with a particular focus on teacher's perceptions of ICT capability and whether their practice in the classroom matched their personal constructs. This is particularly pertinent given the current environment of curriculum change in Wales. In order to study this phenomenon the following research objectives were devised:

1. To investigate teachers' constructs of ICT capability at KS3 in Wales;
2. To investigate the relationship between individual teachers' personal constructs of ICT capability and their classroom practice;
3. To identify changes in individual teachers' perceptions during a period of curriculum review;
4. To investigate how individual teachers' changing perceptions are mediated by their environment.

Historical perspective

The 1988 Education Reform Act (ERA) heralded changes within education which, together with changes in social security, housing and health altered post-war social policy. The act modernised education and in doing so reshaped the values and

objectives, resulting in the establishment of the ground rules for education in the 1990's and the introduction of the National Curriculum (Jones, 2003).

Many of the qualifications available were, like CLAIT a computer literacy qualification, an extension of the typing, shorthand and book-keeping courses designed for secretaries of the pre-computer age. Computers were considered for the specialist few with the schools having limited numbers of either BBC Micro's or Commodore PET's.

In working papers by HM Inspectorate as early as 1977 there is recognition of the need for Information Technology, both within the Mathematics and the Technology subject areas. In the supplement to Curriculum 11-16 (HMI, 1977), the Mathematical paragraph refers to the need for "communicating, problem solving" specifying that the communicating refers to the process of "transmitting information and interpreting information conveyed by table, diagrams and models"(ibid). This bears a very close resemblance to the current National Curriculum for ICT (ACCAC, 2008a), where the strands outlined for the teaching of ICT in Wales at Key Stage 3 (KS3) are finding and analysing information, and also creating and communicating information. Within the supplementary paper (HMI, 1977), and in particular the proposed curriculum for Technology, there is recognition of the role of technology within our society and further of the likely impact of technology in society and culture in the future. Whilst Information Technology is not yet mentioned, given that the report was compiled in 1977, prior to the introduction of the first computers into some schools in the late 1970's, in hindsight it is possible to equate these statements of need to the introduction of Information Technology into the curriculum in 1990. In a review and investigation of the then new technologies and their impact on learning (De Corte, 1990) there was recognition that information technologies also have an impact on a cross curricular basis by facilitating and augmenting various teaching strategies.

1985 saw the publication of a Curriculum Matters Series (DES, 1985), which proposed how the curriculum should be formed and delivered. In this document it was outlined that there was a need for pupils to experience the following areas within their study, "aesthetic and creative; human and social; linguistic and literary; mathematical; moral; scientific; spiritual and technological" (DES, 1985 p17-35).The document emphasises

that these areas should not be taught in isolation but used as a planning process within the design of each discrete subject matter. These appear to be the forerunners of the common requirements that exist in the curriculum today. In this document there is no specific mention of Information Technology; however, when examining those areas of technology which should be taught across the curriculum there is distinct reference to "the collection, coding, storage and manipulation of data" when discussing aspects of control (ibid). It was not until 1989 that the curriculum matters series published material directly related to Information Technology (IT), where IT is defined as "the technology associated with the handling of Information" (DES, 1989, p. iv) the documentation recognises that IT is embedded in everyday life and society, linked economically and politically. Further there is discussion of its capability and the development thereof. It is within this publication that the phrase ICT capability is coined.

ICT Curriculum Timeline

Year	Event (above)	Event (below)
1977		Recognition of the need for IT within the subjects of Mathematics & Technology
1988	Education Reform Act	Introduction of the National curriculum Information Technology is part of Technology
1989		Information Technology is recognised
2002		ICT in Wales differs form the subject as taught in England
2008		Control moves from the ICT curriculum in Wales to D&T
2012	ICT in England is disolved from the National curriculum	
2013		Steering group for Wales publish its curriculum review an recommendations for change to computing
2014	Computing replaces ICT as curriculum subject in England	

Figure 1 - Timeline for the evolution of the ICT and computing curriculum within England and Wales

Developing ICT Capability

The teaching of ICT at KS3 has undergone changes since its introduction into the National Curriculum. In the 1995 National Curriculum the distinction was made between Information Technology and Design and Technology, this separation gave an emphasis to Information Technology as being a discrete subject. Since that time the

subject has grown with increasing importance within the curricula of England and Wales. In the accompanying orders ICT capability was characterised as being an ability to effectively use IT tools and various information sources in order to analyse, process and present that information. A further aspect stated that it also involved the modelling, measurement and control of external events, involving

- o using information sources and IT tools to solve problems;
- o using IT tools and information sources, such as computer systems and software packages, to support learning in a variety of contexts;
- o understanding the implications of IT for working life and society

(Crawford, 1998)

Previous research carried out in schools across Wales (Kennewell et al. 2000) concluded from observational data that ICT capability can be recognised as having five components. These are described as

1) The basic routines used in operation of ICT and include characteristics such as the use of a mouse or the left / right click action of the mouse.

2) The use of fundamental techniques, where the user carries out operations such as formatting of a page

3) Concepts key to applications e.g. the saving of files; developing presentations searching for information.

4) Processes such as reporting, and

5) The conceptualisation and justification of using particular applications for specific tasks; the use of the higher order skills as characterised in Bloom's Taxonomy (1956).

These characteristics do not develop in a linear form or indeed as a cyclic model, but develop concurrently and ultimately through the teaching of increasingly challenging tasks.

The National Strategy for literacy and numeracy was introduced at KS3 in 2001 and whilst it took the form of guidance it was aimed to build on the achievements of the KS2 strategies introduced in 1998 and 1999 respectively (Department for Education, 2011). This strategy has broadened from 2004 in England to include Science, Information and Communication Technology and Modern Foreign Languages (ACCAC, 2004a).

In 2002 the frameworks for teaching ICT in England were described as

- o Finding things out
- o Developing ideas and making things happen
- o Exchanging and sharing information
- o Reviewing, modifying and evaluating work as it progresses

(DfES, 2002)

It was at this point that the education system in Wales became devolved from England and the National Curriculum in the two countries started to separate and evolve in a different format. Indeed between 2003 and 2007 in England there was a National Strategy for the development of ICT as subject within secondary schools in England which did not exist in Wales. This National Strategy laid out a rigid and prescribed format for the teaching of Information and Communication Technology, complete with schemes of work, lesson plans and resources dictating which aspects should be taught and when. Whilst this was labelled as guidance, in practice in many English schools and local Education authorities this strategy was deemed as being compulsory. This strategy was rolled out to all schools with advisors visiting and advising schools on its implementation. The result was an influence on the teachers' perceptions of what was meant by ICT capability and how it should be taught which did not occur in Wales, where the National Curriculum Orders (NCO) continued to be vague and allowed individual interpretation of both the term and how it should be developed. In Wales this was deemed as respecting teachers' professionalism, in allowing them to use their judgement as to how the subject was to be taught.

Since then there have been working groups set up both in England and Wales and the framework for the teaching of ICT in Wales currently states that together with teaching ICT across the curriculum, ICT should be taught in the following strands

- o Communicating and Handling Information
- o Modelling

(ACCAC, 2008a)

Within England the National Strategy requires that there are discrete lessons for the teaching of ICT in Wales, however, the lack of reference within Estyn's thematic reports to teaching ICT as a discrete subject (ESTYN, 2007) tends to imply that this subject should be developed as a cross curricular tool rather than as a discrete subject. The continued reference by Estyn to the development of ICT Capability using a cross curricular model may give rise to an element of confusion over the way the subject is taught. In some schools where the status of the subject is low, development of ICT

capability may be on a cross curricular basis rather than as a discrete subject. This would result in a lack of parity and further add to the variation in defining the subject amongst teachers.

Unlike other subjects such as mathematics, the guidelines for the teaching of ICT in Wales have been vague allowing for educators to interpret the teaching requirements of the subject. Level descriptors are open and this has brought about a variance in perception of the requirements at each stage.

In the writings of ICT practitioners such as Kennewell et al. (2003) and research carried out by ACCAC & NAACE (2004b), the route to the development of ICT capability is described as being a network of building blocks, which include the mastery of basic skills or techniques, routines, processes and conventions culminating with conceptualisation and the higher order skills. However there are no clear guidelines as to what ICT capability is. The Qualifications and Curriculum Authority in England suggests

> "Pupils develop ICT capability by mastering technical skills, and understanding when to use them. ICT capability involves pupils finding, developing and communicating information safely and responsibly. Pupils learn how to use their skills purposefully to solve problems"

(QCA, 2008)

This refers to the curriculum for ICT but does not necessarily define ICT capability or the way in which ICT capability is achieved.

Through the large body of research (Webb & Cox, 2004) carried out since the introduction of ICT to the curriculum, it is now well understood that it is beneficial to the pedagogical process. It is not the presence of ICT capability but the perception of what that capability is that is under question, together with an understanding of how most effectively that ICT capability can be taught.

The next step in the evolution of the subject came about with the publication of a report by the Royal Society (2012), proposing a change to the curriculum. The proposals were for the introduction of aspects of computer science including the use of algorithms, logic and abstraction and the ability to use coding to generate

computational solutions to problems. This, together with pressure from industry and in the political arena, resulted in the Minister for Education in England announcing the immediate withdrawal of the National Curriculum for ICT pending a complete review (Gove, 2012). This has resulted in a new curriculum in England for the teaching of Computing, which came into being for the academic year 2014-2015. This program of study includes aspects of computer science previously mentioned, together with the use of two programming languages in the design of solutions to problems.

However, in Wales the National Curriculum for ICT (ACCAC, 2008a) has continued to be a statutory requirement, whilst a review of the subject was carried out. This review was published in the autumn of 2013 (Arthur, et al., 2013) but as yet has not been implemented. These proposals include a number of recommendations which include a rebranding of the subject to computing and the inclusion of computer science from Foundation Phase. It emphasises the need for skills such as creative problem solving to be an obvious part of the curriculum and describes Digital Literacy as being key to the new subject. The recommendations also make some key definitions defining the re-branded subject 'Computing' as being "The broad subject area; roughly equivalent to what is called ICT in schools and IT in industry, as the term is generally used" and digital literacy as "The general ability to use computers. This will be written in lower case to emphasize that it is a set of skills rather than a subject in its own right." (Arthur, et al., 2013, p. 10). The implication of these definitions can be construed as meaning that the new curriculum subject of Computing in Wales will continue to include aspects of the present curriculum referred to as ICT with aspects of Computer Science as proposed in Recommendation 1, "A new subject named Computing should be created to replace Information and Communications Technology (ICT) from Foundation Phase onwards. This new subject will disaggregate into two main areas: Computer Science (CS); and Information Technology (IT)" (Arthur, et al., 2013, p. 13). The recommendation also advocates the production of a new digital literacy framework. This digital literacy framework appears to closely resemble the previous cross curricular ICT, and as it includes the ability to use technology to create as well as consume, then it equates to ICT capability in creating solutions in the support of other subjects as well as problem solving. A further recommendation within this report is that the subject should become a fourth science and be afforded the same status within the national curriculum that a science deserves.

Although it appears that the National Curriculum in Wales continues to evolve along a different path to that of the curriculum in England, teachers in Wales are very conscious of the changes taking place in England. The implications of the changes in curriculum, which have taken place in England, appear to be having an impact in Wales, particularly in relation to teachers' perceptions of what ICT capability is and more importantly perhaps in what they think it should be.

This study evaluates those perceptions and explores how the teacher's personal constructs of ICT capability within this changing environment relate to their practice within their classrooms in the teaching of this subject. In this field, the study is moderately distinctive in the United Kingdom, as there have been few studies of this nature focusing on ICT capability. Whilst there has been research into the methods used in the teaching of many other subjects, little has been carried out into the teaching of ICT, or the perceptions of ICT capability. This in itself has brought about major challenges, first in the literature review where there have been few specific academic studies to discuss, and second this has meant that there are areas of the topic, such as assessment, which have had to remain outside the boundaries of this research.

Lastly, this subject has required the use of an analytical tool which would enable the rigorous study of both perception, classroom practice, the surrounding culture and political environment which impacts on that perception and practice. In order to carry out analysis it seemed appropriate to use Cultural Historical Activity Theory (CHAT) as this would allow the analysis of the socio-cultural and political environment in which these changes are taking place in relation to the ethos of the school and the perceptions and practice of the teacher. This also added an element of originality to the study in that whilst there is literature concerning the use of CHAT as a tool in analysing activities in workplaces, there is limited literature actually applying the tool to classroom practice. This study aims to extend the use of CHAT in pedagogical settings.

The following chapters outline the relevant literature available to support the study including evaluating literature discussing the nature of the formation of knowledge. Another key theme which runs through the literature review is that of Shulman and his Model of Pedagogical Reasoning (Shulman, 1987) and the use of pedagogical content knowledge in the effective teaching of ICT capability. There is a chapter evaluating the use of Cultural Historical Activity Theory (CHAT) and in particular the use of activity settings in the evaluation of changing practices. The discussion recognised the relationship between the emergent contradictions and how those contradictions are resolved particularly with links to expansive learning. The methodology chapter discusses the ways in which the research was carried out, the use of case studies, links between qualitative and quantitative research, and how the chosen methodology situated within a socio-cultural epistemology sought to answer the research objectives. Having established what the research aims to achieve and how it aims to achieve it there are three chapters devoted to the various findings which emerged from the different analysis, that of the case studies, specifically with the use of CHAT; the cross case analysis and finally quantitative analysis which emerged from a cross-Wales questionnaire.

The final chapter consists of the conclusions, implications, recommendations limitations of the study and the areas for future study.

Chapter Two - Literature Review

In the following chapter a number of topics, which are integral to the research, will be critically reviewed. In order to be able to answer the research objectives it will be important to gain particular understanding of a variety of issues. The main focus of this research is to investigate ICT capability, to gain an understanding of how teachers perceive ICT capability and how they teach and develop it within the classroom.

At present the curriculum subject is situated in a period of change. Within England there is a strong body of persuasion being built for the inclusion of aspects of computer science into the subject, together with a name change in order to add significance to this change. (The Royal Society, 2012, Gove, 2012). This change in the curriculum in England may have an impact on the perceptions of the teachers here and to this end part of the focus of this study is to evaluate how the environment and any change in that environment may impact on the teachers' perceptions.

The issues which this literature review is going to concentrate on include the National Curriculum in Wales for Information and Communication Technology, particularly in relation to the development of ICT capability. It will note and discuss the differences which exist between, firstly the National Curriculum in England and secondly the curriculum orders for other subjects within Wales. In order to gain an understanding into the development of ICT capability, the formation of curriculum, and the relationship between that curriculum and the construction of knowledge will also be discussed. There is also a relationship between effective teaching and the pedagogy of the subject and Shulman's (Shulman, 1987) Model of Pedagogical Reasoning will be investigated in order to understand different models of development of ICT capability. For example, the concept of the knowledge of the pupils, and a use of pedagogical content knowledge relates to the use of specialist ICT teachers with a model of development though specialist lessons, in contrast to using non specialist teachers or developing ICT capability in a cross curricular fashion as a pedagogic strategy.

Curriculum and Knowledge

Two of the key objectives of this study are to examine the relationship of the teachers personal constructs of ICT capability and the elements of classroom practice, and to

clarify the characteristics of ICT capability as represented by the National Curriculum at KS3. In order that this may take place it is important to understand the curriculum in question and the way in which the development of knowledge impacts upon curriculum planning.

Information Technology (IT), the fore runner of ICT, was initially situated in the order for Technology when the national curriculum were first introduced in 1990 (Curriculum Council for Wales, 1990). The document splits the Technology Curriculum into two distinct areas, that of Design and Technology capability and that of Information Technology Capability. The document goes on to stipulate that IT capability is a "cross curriculum competence" (Curriculum Council for Wales, 1990), that it can enhance the learning process and as such should be integral to learning activities, and discusses the need to incorporate Information Technology into all schemes of work. It is very clearly stated that whilst Design and Technology is a discrete subject in its own right, this is not the case for IT, but that this is inherently cross – curricula in nature. As the use of information technology in society and in the economy grew throughout the next decade, due to the availability of more user-friendly hardware and interfaces enabling routine use of applications such as Microsoft Office and Microsoft Windows there was a need to build a greater understanding within the curriculum. Information Technology (IT) and later Information and Communication Technology (ICT) grew into a subject in its own right becoming part of the national curriculum in both England and Wales in 1999, with ICT capability being linked to the discrete subject of ICT. (DfEE, 1999) According to Kelly (2010) the curriculum can be defined in a variety of ways. Kelly refers to the 'educational curriculum' as being used for the multitude of programmes and varieties of processes that make up teaching and the educational system. He further explains that there are numerous types of curriculum all of which will need discussion in order to arise at a definition for the purposes of this research. In the following sections entitled Curriculum Analysis, there is a critical review of how different authors views of the curriculum and the role of the various aspects of curriculum design in the constructions and acquisition of knowledge. This process will start with an analysis of the curriculum as it currently stands, highlighting and discussing the difference which exist between England and Wales and further comparing the National Curriculum in Wales for Information and Communication

Technology (ICT) and other National Curriculum, for example the National curriculum for Mathematics. This section will also discuss the formation pf the present curriculum in Wales.

Curriculum Analysis

The 2008 NCO for Wales states that

> "At Key Stage 3, learners should be given opportunities to build on the skills, knowledge and understanding acquired at Key Stage 2. They develop a growing awareness of the relevance and plausibility of information and begin to identify and question bias in sources. They should be taught to become increasingly independent in their use of safe and suitable information sources, both ICT and non-ICT; to use a range of ICT skills and resources to find, analyse, communicate, present and share information, while becoming more aware of the need to check the accuracy of their work; to consider the advantages and limitations of using ICT in their activities across a range of subjects thus becoming increasingly aware of the social, ethical, moral and economic effects of ICT in the wider society."
> (DCELLS, 2008:p10)

The above extract from the 2008 NCO in Wales states the expectations of the Welsh Assembly Government for the teaching of Information and Communication Technology (ICT) within KS3. In order to understand the purpose of this curriculum and how it can be achieved, it is necessary to consider how it came about.

With changes to the curriculum in the 1970s and the prospect of the introduction of the National Curriculum in the 1980s, together with an increase in research and professional discussion about the curriculum, leading to possible basis for agreement (HMI, 1985) was sought. The publication details broad aims for future curricula. These aims have remained within the curricula since that time and are an adjunct to subject specific curriculum. These are as follows

- "to help to develop lively, enquiring minds, the ability to question and argue rationally and to apply themselves tasks, and physical skills;
- to help pupils to acquire knowledge and skills relevant to adopt life unemployment and a fast changing world;
- to help pupils use language and number effectively;
- to instil respect for religious and moral values, and tolerance of other races, religions and way of life;
- to help pupils to understand the world in which they live, and the interdependence of individuals, groups and nations;
- to help pupils to appreciate human achievements and aspirations."
(DES, 1985)

The extract from the subject specific curriculum of 2008 links closely to the points from the 1985 HMI document; the ability of pupils to be able to argue and apply themselves to tasks comes about from a growing awareness of the subject, ICT its relevance in the wider society, and in the case of ICT the need to use appropriate software to bring about dissemination of information. To bring this about is to facilitate pupils growing ICT capability. A definition of ICT capability has evolved and is cited as being a hierarchy of "routines, techniques, key concepts, processes and higher order skills" (Kennewell, et al., 2003, p. 7) indicating use of a curriculum that incorporates the higher-order skills, and not just the basic tools and routines needed to merely operate the software. This hierarchy links the initial stages of routines, techniques and even key concepts with low order or even tools-based elements such as opening an application, using formatting tools, understanding difference between databases and spreadsheets respectively. However, processes which require conscious thought and the use of higher order skills in the recognition of the appropriate use of the software application together with the ability to use reflection and evaluation in connection to the use of ICT can be linked to the inclusion of metacognitive skills in ICT capability (ibid).   Furthermore, Kennewell discusses the place ICT has in the secondary curriculum and highlights particular themes inherent to ICT, these themes include "knowledge and skills" associated with ICT hardware and software; tools for business, cross curricular skills for the use in other subjects. (Kennewell et al., 2003). He suggests that ICT should also include experience in using ICT tools in order to support learning in other subjects; and knowledge about the place of ICT in the wider context, for example ethical and responsible use. This is supported by Bloom's Taxonomy of Knowledge (Bloom et al., 1956). In this taxonomy Bloom proposes a hierarchy of knowledge of six distinct stages spanning from 'Knowledge', where the pupil recalls or recognises information and ideas through to 'Evaluation' where the pupil is able to appraise, assess and critique ideas and concepts against known criteria. Kennewell's analysis corresponds quite closely to Bloom's Taxonomy of Knowledge with tools and routines representing to basic knowledge and higher order skills involving analysis, synthesis and evaluation. It is not sufficient to be able to perform tasks or recall basic knowledge, but the requirement is to be able to evaluate and justify the applications required to solve particular problems. With this use of the higher order skills, either using the model proposed by Bloom (Ibid) or that of Kennewell et al., (2000) in his

breakdown of ICT capability, comes the ability to be independent, accurate, and use ICT appropriately. A further requirement of both the 1985 and 2008 documents is an understanding of the subject's place in the wider world and its role from the social, moral, ethical and economic viewpoint. The descriptors are concerned with handling and analysing data, communication and aspects such as health and safety including internet safety. The lack of definite descriptors within the ICT curriculum enables the programme of study to accommodate technological change.

These curriculum documents neither specify what is to be taught or how it is to be taught, either through discrete lessons or on a cross curricula basis, they merely contain broad aims for the curriculum as a whole and for the subject itself. Indeed the 1988 Education Reform Act, (HMSO, 1998) clearly stated that the government would be unable to dictate teaching methods, however it is worth noting that when investigating the National Curriculum documents for subjects other than ICT, for example for Mathematics there are specifications concerning what the pupils should be taught and the order in which they should be taught. Further, in today's society, there has been increased availability of ICT tools to a majority of pupils. Whilst there is still a gap between those with access to computers within the home and those without access, with the advent of Web2.0 technology, the popularity of social networking sites, and accessibility via mobile phones this gap is becoming decreased. With greater access there is greater interaction with technology by the pupils in everyday life. And perhaps it is this lack of specificity within the programme of study which allows for the inclusion of technological improvement without requiring a complete re-write of the curriculum with each technological advance.

Nature and philosophy of Curriculum planning.

The following paragraphs discuss the nature of the curriculum and its need for clear definition especially when planning and enabling the teaching of the subject. They also discuss the argument for and against clear and specific curriculum objectives. When analysing curriculum it is necessary, according to Hirst (1969), to establish clear objectives, and not to establish curriculum on the basis of a list of subjects to be taught, topics within those subjects, knowledge applicable to said subjects, and a way

which this can be achieved. Both the HMI document in 1985 and the NCO of 2008 outline broad objectives for the general curricula and the subject specific curriculum of ICT, allowing schools to interpret the topics and applicable knowledge, and indeed the method of achievement. In Hirst's (1969) deliberations concerning the philosophy of the curriculum he believes that it is not about the questioning of facts and moral judgements the curricula might make, but more about questioning the fundamental basis of our understanding. He further believes it is less about those investigations that may be initiated in the teaching of the curriculum, but more importantly should be about what we wish the pupils to achieve, what is the knowledge we wish them to gain, and finally what is meant by motivating and capturing their interest.

O'Hear (1993) reviewed the process of curriculum planning five years after the National Curriculum had been introduced to the United Kingdom. His feeling was that given the opportunity a curriculum with clear aims and values, which linked to our society, could be produced. O'Hear (1993) proposed a curriculum consisting of content or subject matter, the wider curriculum, structured progression a system for assessment and recording. O'Hear examines areas of knowledge and understanding described as personal, social, and scientific and technological. It was recommended that all subject matter be mapped, and associated with one of these three headings. The problem with this form of association in the 21st-century, is that it does not allow for the advances in technology that have occurred since the original article was written, in so far as these advances are not just driven by scientific need but also by social and leisure based impetus. Together with areas of knowledge and understanding, the curriculum was also broken up into the experience of The Arts, and Areas of Technological Competencies. With regard to The Arts it was proposed that all the arts were included, and practical competencies were designated as communication and numeracy, physical movement and health and safety, social interaction, and planning and organisation. With the advent of ICT, the knowledge and understanding associated would bridge both the areas of The Arts and areas of Technological Competencies.

Within the ICT National Curriculum 2008, there is also an inclusion into key skills across the curriculum, meaning that ICT is also required to support learning in other

curriculum subjects. ICT is a unique subject, in that it can be seen as a discrete subject, and also as a tool for learning and everyday life. The increased use of ICT in society, for communication and especially with the increased popularity of the use of mobile texting and social network sites has an impact on the liberal society of which O'Hear speaks, in that there is a danger for users of this technology to publish what they think at that snapshot in time with little thought for consequence or repercussion. With the advent of 'cyber-bullying' (Campbell, 2005) there is a threat to the moral aspects of such a curriculum and the need for curriculum aims and objectives to address this are required.

Within the current curriculum the role of ICT as a discrete subject and a tool to support learning is recognised and throughout the National Curriculum there is a requirement that ICT be used to enhance learning (ESTYN, 2007). This suggests that some of the responsibility for the teaching of ICT capability may be allocated to non-ICT specialists in their inclusion of ICT on a cross – curricular basis within their own subject area. As such the development of ICT capability may be constrained by the requirements of the cross curriculum subject in that the aims and objectives and concepts of the non-specialists teacher's specialist subject in which ICT capability is being taught is likely to take precedence over the concepts associated with ICT capability. There then becomes a danger that ICT capability becomes reduced to a tool used only in the support of learning in other subjects rather than remaining a subject in its own right. White (1993) suggested that these cross-curriculum aspects were 'bolt-ons', because the original National Curriculum of 1988 was designed around ten foundation subjects that on their own did not adequately cover some important aspects of education. White (1993) further suggests that there is no great value in a National Curriculum per se, but the value lies in the type of National Curriculum that is created, going further to explain that it can be one of indoctrination or repression whereby the pupil is denied the ability to question. He proposes a curriculum in line with a liberal democratic society, where pupils are given the tools to flourish in a society with western political beliefs of equality, freedom, self-worth and self-determination are fostered. Whilst his writings, together with those of O'Hear (1993), Woodhead (1993), Hirst (1993) and Lawton (1993) are all directly assessing the National Curriculum as it was introduced in 1988, there are still relevancies for the curriculum as it stands today. He felt that the

curriculum appeared to be a strong basis on which to build an education system for the acquisition of knowledge, however he also felt that this strength was superficial, that its defined core subjects and the obligatory and detailed demands of those subjects could lead to a lack of flexibility. There was a need for more work to be carried out in order to establish, not only the central aims and particularly the values, but also the ways in which these aims could be realised or achieved. The Welsh National Curriculum for ICT published in 2008, like the National Curriculum of 1988 which White was assessing; has aims and objectives that are broad and not rigid. Should the ICT curriculum become more rigid, there is the danger that teachers with differing degrees of ICT capability may interpret the requirements in more restrictive ways and with differing emphasis. This may result in the subject becoming inhibited and limit the capability of the pupils undertaking the curriculum. The 'statements of attainment' that White admonishes may ultimately result in incoherent standards of education in this subject   and result in denying differing sets or groups of pupils the ability to explore emerging technology. This limitation would possibly restrict White's goal of preparing pupils for a place in a modern society. Woodhead (1993) in his assessment not only of the National Curriculum of 1988, but also of the research of O'Hear and White, disagrees. When reviewing the National Curriculum, whether this be the curriculum of 1988 or that of 2008, a subject-based curriculum indicates the current understanding is organised in terms of distinct areas of knowledge (Woodhead, 1993).

In Hirst's (1983) characterisation of educational theory concerned with justifying action for a range of practical activities he differentiates between domains of practical theory and domains concerned simply with theoretical knowledge. The theoretical knowledge he sees as explanation and the practical theory he sees simply as practice. Hirst (1983: p3) feels this is "hypothesis or logically interconnected set of hypotheses that have been confirmed by observation. Giving standards by which we can assess the theory". Whilst Hirst (1983) agrees that the theory of education is explanation he also feels that beliefs and values should also be taken into account, which will link to the society and beliefs of the day. So that as society grows and culture changes this is reflected in the changes of that part of the curriculum. Hirst (1983) also suggests that curriculum design and analysis is reliant upon society as a whole, this can be particularly true for

information communication technology in that over the last twenty years the increase in its presence both as a single subject and as a tool for other subjects within education. The software applications that it utilises are closely related to the way in which information communication technology is used in the world of business and society as a whole.

He believes that that if curriculum planning and therefore curriculum change is undertaken rationally then there must be sound supporting evidence about the way in which learning takes place and the accumulation of knowledge together with evidence of the requirement for specialist knowledge within our society. With the growth in technology in society, the need for ICT capability permeates through that society on a cultural, economic and social level. From a curriculum design standpoint using Hirst's beliefs as a benchmark, then not only is there a need for ICT to be a prominent part of the curriculum, but also the teaching of it must generate a specialist knowledge which can support that societal growth. To this end the development of the ICT curriculum since its conception has attempted to do just that.

Hirst (1974) defines philosophy as being a particular use of higher-order skills in the form of metacognition. Being mainly analytical and with the goal of understanding concepts used in lower order knowledge and awareness he sees it as a "second order area of knowledge" examining our understanding and awareness of the development of a subject specific metacognition. Linking this definition of philosophy to the curriculum he believes that it is not about examining particular foci of our curriculum but about providing general knowledge and questioning the nature of things that we wish the pupils to achieve and how we wish to motivate them within their secondary school experience. In his definition of the curriculum he justifies it as being a programme of tasks designed in such a way that specific aims objectives are achieved and learning takes place. These tasks or activities being carried out by both the teacher and pupil in a learning environment, by the pupil so that learning takes place and by the teacher in order that that learning is connected to the curriculum.

One of the main differences particularly when talking about information technology is that education today has greater influence from the world as a whole, learning does

indeed take place outside of the learning environments defined by the classroom, and to an extent away from the teachers input to ensure that learning is in line with the curriculum. In line with this there is also an argument that the planning of curriculum is not as rigid as has been previously laid out, that the curriculum that we have is a result not only of planning but also of social attitude and influence (Hirst, 1993; Woodhead, 1993; O'Hear, 1993; White, 1993).

Hirst's domains of knowledge

When considering the curriculum planning and the expected impact of that curriculum upon learning it is also important to consider how that learning and development of knowledge takes place.

Hirst (1974) suggested that these domains of knowledge may be that of mathematics and physical sciences, knowledge of persons, literature and fine arts, morals, religion and philosophy. There may be crossovers in concepts integral to the different forms of knowledge and also overlaps in reasoning. Good example of this may be that of ethical judgements versus scientific judgements in that both require different logic and different forms of justification. This implies that experience and learning builds in the different domains then development is almost web like as each sub element of knowledge other builds and impacts upon each other. If this concept is then linked to the notion of ICT capability particularly that definition as laid out by Kennewell et al., (2003a) where ICT capability is made up of basic skill or technique, routine, facts, conventions, key concepts, processes and higher-order skills, and particularly in the way in which they developed there is a similarity. ICT capability is not developed through progression from one element to another but more as a complex net with each elements of capability impacting and helping to develop another element.

Hirst's work impacted and changed ways of thinking in the 1970s about curriculum theory and theory of education. Since this time there has been the technological revolution with the advent of ICT in the information technology permeating everyday life. If Hirst's theory about distinct disciplines or forms of knowledge were applied today it is feasible that there would be the addition of information communication technology. ICT capability as the common concepts and experience present in everyday life with his use not just as part of the business world, but web 2.0 click

technologies such as blogs and wikis and social networking sites so frequently permeated with pupils of all ages. The use of mobile phones and texting in particular uses a language, developing exponentially with every generation for increased communication. In education, information communication technology or ICT is taught both as a subject in its own right and as a tool to aid learning in other subjects. As such the testing of ICT capability uses none of the testing criteria which Hirst (1974) has used to form disciplines of knowledge. Given this had he been characterising knowledge in this way with today's technology it is possible that the further discipline that of information technology or merely technology would also be categorised.

Curriculum design and Epistemic Ascent

Whilst it can be recognised that the work of Hirst, (1974,1969,1983) highlighted a liberal education within the curriculum this has been challenged with the idea of Powerful Knowledge (Young, 1971).

Young explains that the understanding of knowledge should be situated in a sociological perspective, emphasizing that knowledge and particularly the curriculum and design of the curriculum is a social construct. If knowledge is socially constructed and indeed an expression of power then the curriculum of what is taught, how that knowledge is taught and to whom, must also hold an element of power. This being the case the introduction of the national curriculum and particularly the formation of the ICT curriculum should mirror the needs and requirements of the social arena at the time that the curriculum was conceived (Young, 1971 , 2013a). With the growth of the technological society and the widespread use of that information technology within society, particularly western society there is indeed an argument that the curriculum is in need of further development in order to fulfil the need of society.

Young (2010a) proposes that in defining knowledge it was also important to distinguish between knowledge and experience. Whilst Young supports the notion of a subject-based curriculum, he differentiates this from the more traditional understanding of such a curriculum by discussing concepts of knowledge and the assumptions that are made about the relationships learners develop with that knowledge. Young (2010b) further argues that his knowledge-based curriculum acknowledges the different

relationships that the learners may have with knowledge and thus the different forms of pedagogy, which may be required, to bring about successful learning.

He proposes that there may well be problems, which arise from an instrumentalist approach to the curriculum and that these problems relate to a 'blurring' of the differences which should exist between curriculum and pedagogy (Young 2010b). This idea of development and exploration of concepts differentiates from the traditionalist definition of a subject based curriculum in that the content becomes important as a vehicle for exploration and development of understanding, rather than a series of facts which may be learnt without the exploration of their relevance.

It was stated earlier that Young also believed that a lack of distinction has developed between the curriculum content and the pedagogy associated with it, noting that it is the recognition of the difference between the curriculum and pedagogy which allows us to differentiate between the 'school knowledge' or the conceptual knowledge acquired through the curriculum and 'every day knowledge', or in other words experience. Experience can be used in the pedagogical approach used to develop the students' conceptual knowledge by situating the abstract concepts in a concrete experience that they can refer to. However it is also important that the pupil is able to distinguish between the conceptual knowledge and the experience. Young's (2010b) final argument for a subject based curriculum is that with such a curriculum it is possible to recognise that each subject has a specialist knowledge base and in the acquisition of that knowledge, pupils start to join that 'community of specialists'. As those pupils develop journeying through the education system they themselves will become specialist within that chosen field.

The inference is that with specialist knowledge, that knowledge offers areas for enquiry and in order to understand this you need to have a conceptual knowledge of the specialist area of knowledge. It is this form of knowledge which Young describes as 'Powerful Knowledge'. Young further defines Powerful Knowledge as being specialised in both how it is created and communicated, and in its focus and boundaries with other disciplines. From the point of view of this study it could be argued that Information Communication Technology as a subject with its own concepts and

theoretical knowledge is Powerful Knowledge, however when used as a tool for other disciplines in a mechanistic way devoid of the use of higher order skills then it becomes generalised and as such can no longer be associated with Powerful Knowledge. It is further defined as being different from the experiences which pupils bring to school, this again supports the idea that ICT when associated with higher order metacognitive skills has Powerful Knowledge, however when limited to how the pupils may use ICT externally through social networking gaming or merely browsing the net, that is devoid of conceptual application then it becomes merely a tool and not Powerful Knowledge. Young impresses that Powerful Knowledge is not just related to the STEM subjects, that of science, technology, engineering and mathematics, though he does acknowledge that those subject areas exhibit Powerful Knowledge "least ambiguously" (Young, 2013b, p. 108).

In contrast Winch discusses the need for three kinds of knowledge and their relevance within curriculum design; these he proposes are knowledge by acquaintance, know-how and propositional knowledge (Winch, 2013). Whilst subjects are generally defined by their propositional knowledge rather than practical knowledge, there is support for Hirst in his supposition that conceptual structure also utilises practice and procedure in the formation of knowledge. He argues that the art of good curriculum design requires the management of the different types of knowledge in such a way that the needs of both subject and learner are met (Winch, 2013).

Knowledge by Acquaintance is defined as that knowledge which is gained through the use of the senses. It is a knowledge that includes qualities and characteristics of the subject which could not be attained in any other way. By acquaintance is important in that it includes characteristics which cannot be understood in any other way than through the senses. In Winch's definition of this type of knowledge he refers to be able to hear, see, smell or taste and object and the knowledge by acquaintance refers to the results of using the senses to understand the object. There is further acknowledgement that it is a challenge for the curriculum designer to be able to include this form of knowledge easily within the result curriculum. A further form of knowledge described is as 'knowledge that' or KT (Winch, 2013, p. 129), and goes on to distinguish between 'knowledge that' and 'knowledge how'. A distinction is made that

there is a difference between what can be referred to as 'knowledge that' and a 'true belief that', stating that the focus is whether or not some propositions are understood independently of the subject matter and further whether 'knowledge how'is really part of'knowledge that'. This relates the ability for individuals to understand and articulate implications and inferences from the context and concepts inherent to the subject matter. There is further distinction that 'knowledge how' has a relationship with both knowledge by acquaintance and the'knowledge that'previously described, in that knowing how to do something will require elements of the other two knowledges in order to succeed. Winch (2013) goes on to state that the important part concerning 'knowledge how' is that it is critical to our definition of subject expertise. Furthermore there was a claim that subject expertise involves not just that 'knowledge how', but also that this in part is related to the relationships between the propositions of that subject and that these relationships need to be made in order to understand the concept that subject. There's further argument that together with these forms of knowledge there is a need to understand and embrace the language of subject and to express concepts involved.

Hirst (1993) made attempts in organising areas of knowledge or types of knowledge according to a variety of domains, where knowledge existed as broad areas rather than distinct subjects. Like Winch, Hirst affords a degree of importance to propositional knowledge (Hirst 1993, Winch 2013), for Hirst this equated to a number of dimensions or domains of knowledge, some of which it could be argued have a relationship with belief systems rather than the pure domains knowledge (Winch 2013). However, Winch notes that the relevant aspect of the classification is about the relationship between the propositional knowledge discussed earlier and practical knowledge required in the exploration of any conceptual aspect within the subject matter. Similarly to Young (2010) acknowledgement of the relationships between various elements of knowledge highlights the need to distinguish between the knowledge subject and the experience of that subject.

When these ideas and definitions knowledge are related to curriculum design then the objective must be to introduce the learner not only to the concepts inherent in the subject, but also in a manner that allows that allows for the learner to progress within

that subject. This he refers to as 'epistemic ascent' The implication is that for this progression to take place the subject concepts need to be presented in such a way the learner is able to sort organise and conceptually map those concepts in order to generate knowledge (Winch 2013). This then will allow the learner to move within subject from novice to expert.

The curriculum and the acquisition of knowledge

Given this distinction between the formation of knowledge and particularly Powerful Knowledge, when returning to the question of whether The National Curriculum KS3, adequately represents the development of ICT capability, it is important to establish the context of curriculum, what should be taught, and how this should be taught. Within curriculum studies, this is not a new debate; indeed the argument about context and content within the curriculum is present in every subject. More recently a similar debate has emerged in England regarding the inclusion of computer science and in particular the use of 'coding' with ICT, creating a new subject of Computing.

> *"Democratic debate about what should be taught is perhaps one of the characteristics of free society"*
> (Moon, 2010, p. 155)

For the much the latter half of the 20th century, curriculum decision-making in the UK was largely decentralised with many of the decisions about content and context made by head teachers in particular. In 1988, the government introduced a national curriculum, this resulted in the government and politicians regarding what and to whom the subject should be taught. Since that time there have been a number of reviews of the national curriculum, and with the devolvement of education in Wales, variation between Welsh and English curriculum has arisen. Related to the context and content of the national curriculum knowledge and the types of knowledge are also crucial to the ultimate goals of learning. Bereiter and Scardamalia (Moon, 2010), classify different categories of knowledge as:

- formal knowledge;
- procedural knowledge;
- informal knowledge;
- impressionistic knowledge;
- self-regulatory knowledge.

The first two categories that are formal and procedural knowledge are concerned largely with knowing what something is, and knowing how to use a process based on it. Informal knowledge represents the techniques concerned with unquantifiable actions such as problem solving, sometimes referred to as tacit knowledge. Impressionistic knowledge refers to background knowledge of for example experience, cultural preferences, which can exert influence is on the teaching and learning process.

When deliberating about the development of ICT capability, to some extent it is worth considering evaluating the social norms brought about by the technological revolution. Specifically, Information Communication Technology is not a subject which exists only in the classroom. It is a subject which surrounds every one of us every day of our lives. With the advent of social networking and web technology students interact with information technology and develop ICT capability in their social and leisure time using laptops, personal computers and mobile phone technology. The gaming industry is developed in such a way that many pupils have greater technology available to them at home for leisure than is available in many schools (McClarty, et al., 2012). It was also noted that in many schools teachers are trying to educate the future workforce on outdated technology (McClarty, et al., 2012). In this definition impressionistic knowledge and informal knowledge, gained independently through interaction and exploration of such applications as social media games and Web 2.0 technology, must be considered an important factor and possibly one that should be utilised more within the curriculum. Whilst the last category, that of self-regulatory knowledge refers to that knowledge one has about oneself, for example, perception of one's strengths and weaknesses. Moon (2010) asserts that a well-designed curriculum looks at appropriate relationships and balance between these different forms of knowledge.

The question of knowledge and teachers' knowledge at a subject or content level, pedagogical level and at a curriculum level leads to an examination of the curriculum. In order to be able to effectively teach the subject content within that curriculum there must be a relationship between that curriculum and the teacher's knowledge. The teacher must also be able to perceive a way to bring about the required learning. Within the 2008 NCO, there is a requirement that the pupils be given opportunities to build on the experience of ICT that they gained in KS2, and the same time to become

more independent in their learning whilst using this knowledge gained to assist in learning other subjects. The KS3 ICT curriculum is vague in its nature when compared to the curriculum of other core subjects. This has its advantages, in that it allows for the pace of development of ICT applications and uses, it also enables teachers in the subject to interpret how best to teach the skills required. However, this has the propensity to lead to a possible difference in teachers' perceptions of ICT capability. These differences in perception may lead to a differences in how ICT capability is taught, or at the very least to differences in emphasis for certain aspects of the curriculum. However to understand it fully, and for the purposes of the research to be able to examine teachers understanding and knowledge of that curriculum, it is important to understand the requirements at a curriculum level.

Theories of Cognitive Development

The following discussion focuses on different theories of cognitive development, particularly constructivist and socio- constructivist theories which will have an impact of the types of pedagogical strategy chosen for the development of ICT capability. Piaget's theory of cognitive development (Child, 2001) consists of three dimensions. The first aspect is connected to a genetic theory that the higher processes, or higher-order skills, can be seen to evolve from biological processes linked to the development of an individual's neurological system. A further dimension of Piaget's theory is that of maturation. Piaget believed that the processes or higher-order skills involved in the formation of concept followed a pattern, and that this pattern showed clearly defined the stages. The final dimension was a hierarchical one, in that the proposed stages had to be experienced in a given order before the next stage of development would be possible. Within this theory there are links between conceptual growth and an active adaptation to the environment by the learner, who is organising the experience into personal knowledge in order for learning to take place (Child, 2001).

For the purpose of this research the stage that is of interest is that of the Formal Operations, concerned. Smith (1986) defines this as being a collective of a number of ways of thinking including deductive thinking and reversible thinking as examples. All these ways of thinking or conceptualisation are examples of higher order skills and the development of this form of knowledge within the curriculum is imperative for the

development of ICT capability. The perceptions within the literature on ICT capability advocate the inclusion of these higher order deductive skills.

Similarly over many years Vygotsky and his socio constructivist views on the acquisition and construction of knowledge have been examined by many educationalists (Penuel & Wertsch, 1995; Rowlands, 2003; Hofstetter & Schneuwly, 2009) and to his supporters offers a compelling argument for how collaboration and interaction between pupils and either adults or more adept peers can aid the formation of and acquisition of knowledge and bring about learning through the Zone of Proximal Development (ZPD). Seminal to the ZPD is the concept that pupils' learning can be moved from their present level to a level that they are as yet incapable of through scaffolding. It is the use of this scaffolding which closes the learning gap between the pupil's present knowledge and the knowledge the teacher wishes the pupil to attain. One form of this scaffolding is described as being the means by which an adult or 'expert' in the field assists some one less expert in attaining their goal. Scaffolding can be further defined as being a process whereby the adult or 'expert' controls those aspects of the task or goal which are currently outside the pupil's knowledge or expertise (Wood, et al., 1976). This orchestration of the learning allows the pupil to concentrate on the aspects of goal within their capabilities independently, whilst having support or a 'scaffold' for those aspects of which they are unsure. As the pupil becomes more expert this scaffolding can be withdrawn until they are successfully achieveing their goal independently (Wood, et al., 1976).

His theory advocates the use of support for the learner in the form of scaffolding and the use of physical tools and psychological signs particularly the use of language and discourse. The use of these tools and signs are advocated within a social environment to develop higher order skills. There also appears to be an assumption that these higher order processes are found through "socio-communicative interactions which are themselves shaped and mediated by semiotic, linguistic and discursive mechanisms" (Tappan, 1998, p. 22).

Tappan (1998) goes on to claim that Vygotsky's approach can be associated with three fundamental assumptions, one of which is, that higher mental function and its

development is supported by the use of words, discussion and language and that those higher mental functions originate within social interactions. There is an argument that the use of speech is as important in the transformation process as the action of learning itself; that for children, particularly those in early childhood, the speech and action are both equally part of the psychological function which enables problem solving. This being the case the verbalisation of any problem is key to the solving of the problem and subsequent learning. It is useful to note that these elements and the use of Vygotsky's approach are often used as a pedagogical approach in the teaching of ICT.

Perceptions of ICT Capability

ICT capability and the development of ICT have been cited as elemental in the teaching and development of ICT as a subject within the curriculum at KS3. To be able to understand the role of ICT capability within the national curriculum it is vital to understand what ICT capability refers to. In reviewing literature it has become apparent that ICT capability has a variety of definitions and as such perceptions of ICT may differ. There are a number of different terminologies relating to Information and communication technology, Webb (2002) noted that in both England and Wales the term ICT includes the study of and use of computers and any technologies associated with communication and information systems. Whereas in other countries differing terminologies of IT and informatics are used, for example in America, Creighton et al., (2006) refers to the evolution from 'computer literacy to information literacy', where computer literacy is concerned with not only the ability to use a computer but also the ability to understand how that computer works and communicate with that computer. However, when discussing the nature of 'Information Literacy' he highlights a subtle change, citing the move towards the access of information as being the underlying reason for the change in terminology. Information literacy, Creighton et al., claims, is about the ability to interact and analyse the information retrieved and selected rather than the mechanics of the computer. Nevertheless, it may be suggested that in order to be information literate, the individual has to be able to effectively work with and communicate with the technology involved to achieve this. Moore (2005) refers to the movement from the terminology of 'ICT Literacy' to 'ICT Capability', Whilst he

discusses the nature of ICT capability, stressing the need for technical and metacognitive skills, he essentially states that the movement of ICT literacy to ICT capability is little more than a change in terminology, with the underlying definitions of both terms remaining the same. Kennewell and colleagues state that

> 'Information and communications technology refers to the set of tools used to process and communicate information; to be 'ICT capable' is to be competent in controlling the situations in which those tools are applied.'

(Kennewell, et al., 2000, p1)

Here Kennewell refers to the use of higher order skills citing competency in controlling situations. According to this statement ICT capability is the use of those skills involved in deciding which tools to use and how to use them to bring about the optimum solution. This is supported by DCSF (2002), which states that a child who has developed ICT capability should have the ability and confidence to use ICT; and the equipment and software with purpose to support their work. Further they should be able to identify situations where the use of ICT would be relevant. To enable this students' should be able to reflect and comment on the use of ICT; and recognise that ICT affects the way in which people live and work (Gaskell, 2003)

Gaskell (2003) suggested that there should be less focus on specific applications and more focus on the generic features of the application taught; to aid the relationship between transferable skills and conceptual knowledge the teaching should focus to an extent upon the enabling of the students to carry out a degree of independent learning. This will have an impact on the method of approach to the teaching of ICT capability and will be dependent on not only the teachers' knowledge of the subject but also but the perception of the characteristics of ICT capability. The nature of ICT capability as being important on a cross curriculum basis will have an impact in that those teachers teaching ICT who are not ICT specialists will need guidance from those teachers who are. There is a possibility that with the development of ICT capability by those teachers other than specialist ICT teachers the aspects of ICT capability which are best developed will be those aspects with direct relevance to their own specialist subject. Furthermore, the development of ICT capability may also be dependent on those aspects of ICT in which the non- specialist ICT teacher is both comfortable and confident. However, if ICT Capability is to be developed in this way it is important that

all the strands are developed, and that that development be equal in status to the non ICT specialist teacher's subject. Markauskaite (2007) in her study of trainee teacher's ICT literacy refers to this as being a 'blended' concept, which includes technical ability to use ICT as a tool, together with cognitive abilities of problem solving and information processing. Markauskaite goes on to state

 ''ICT literacy is using digital technology, communication tools, and/or networks to access, manage, integrate, evaluate and create in order to function in a knowledge society''
Markauskaite (2007, p123)

In essence this is very similar to Kennewell's "set of tools" (2000) (as discussed previously in the chapter) and conceptualization of the need and use of varying applications to answer specific needs.

Further Wood & Webb (2002), also notes that ICT compromises three distinct parts all of which go to the development of ICT capability these parts are ICT as a subject, where the student develops a knowledge of Information Communication Technology and the five key componants as laid out by Kennewell et al., (2003); ICT as a tool where the student uses those skills as a facilitator for learning. Here the student may be using ICT as a tool in other curriculum subjects, such as spreadsheets and graphs to tabulate findings in science projects, the use of word-processing to write assisgnments or databases to collate information from fieldtrips.

The curriculum and the national strategy at both a local, national and international level will also have an impact on the definition and perception of what ICT capability purports to be. It is within the NCO where the Department of Education and Skills and in the case of Wales the Welsh Assembly outlines the prescribed details of what should be included in the teaching of ICT at KS3.

The teaching of ICT at KS3 has undergone changes since its introduction into the National Curriculum. In the 1995 National Curriculum the distinction was made between Information Technology and Design and Technology, this separation gave an emphasis to Information Technology as being a discrete subject. Since that time the subject has grown with increasing importance within the curriculum. In the

accompanying orders ICT capability was characterised as being an ability to effectively use IT tools and various information sources in order to analyse, process and present that information. A further aspect stated that it also involved the modelling, measurement and control of external events, involving:

- o using information sources and IT tools to solve problems;
- o using IT tools and information sources, such as computer systems and software packages, to support learning in a variety of contexts;
- o understanding the implications of IT for working life and society.

(Crawford, 1998 [online])

Since then there have been working groups set up both in England and Wales (ACCAC) and the framework for the teaching of ICT in Wales currently states that ICT should be taught in the following strands, Create and Communicate Information and find and analyse information (DCELLS, 2008) further stating that schools should choose material that will: "provide a meaningful, relevant and motivating curriculum for their learners and meet the specific needs of their learners and further their all-round development. " (DCELLS, 2008). Whilst at the same time maintaining the statuse of ICT as a key skill acrsoss the curriculum, furthermore investigation of the curriculum for KS3 also emphasisses the importance of thinking skills in association with ICT further supporting a definition of ICT capability as incorporating metacognitive elements.

To enable this teachers will need to have an in depth understanding of the elements of ICT capability and unlike many of the other subject specific NCO like numeracy and literacy the guidelines for the teaching of ICT in Wales have been vague allowing for the teachers to interpret the teaching requirements of the subject. Level descriptors are open and this has brought about a variance in perception of the requirements at each stage. To this end it is important to establish whether ICT teachers' view of what should be taught as part of the curriculum affects the perception of ICT capability.

It has been recognised that the degree to which the teaching of ICT Capability can be successfully achieved in the classroom is related to the ICT capability of the individual teachers (Lankshear, 2010). Further influences on ICT capability will be the degree to which the individual is exposed to ICT in environments external to the classroom (Kennewell, 2003a).

Wood & Webb (2002) suggest that the generic nature and lack of specificity in the subject has meant that the curriculum has lasted well; it has also meant that many teachers are unsure in their perceptions of ICT capability. If therefore there is a variation in the understanding of what ICT capability is then it is also true that there is likely to be a variance in the teaching of IT at KS3 this will also have a correlation to achievement at this level and pupils perception of their learning. The primary aim of this research is to investigate IT teachers understanding and perception of the meaning of "ICT Capability" and how this reflects in their teaching practices at KS3.

This is particularly pertinent as the curriculum for 2008 further allows for interpretation of the requirements at KS3 with both the program of study and the attainment targets not exactly defined. When compared to the curriculum for mathematics (ACCAC, 2008b) for example, ICT as has been outlined has limited and relatively undefined strands, whereas mathematics has six clearly defined strands, which detail not only what is required to be taught, but also the order and nature that that teaching should take.

 The result of this is that with core curriculum subjects such as mathematics the interpretation of the curriculum requirements must be more rigid and there is less discretion to teach the subject as the teacher perceives to be appropriate as is the case with ICT. It is worth noting at this point however, that the descriptors for ICT require pupils to 'have opportunities', whilst the mathematics descriptors require pupils to be 'taught'. This may imply that the policymakers at the time regarded ICT curriculum as having a lesser status than Mathematics in the use of this terminology or definition.

Brosnan (2000), highlights the difference in perceptions within the classroom regarding ICT capability, where one teacher described the acquisition of skills as being the ability to utilise programmes such as spreadsheets and databases. The aims of the National Curriculum are to enable students to acquire a capability that will assist in successfully operating in an increasingly technological age, and to further assist the development of independent learning. Crawford (Crawford, 1998) researched student teachers' perceptions of ICT capability and found that the most popular response was

the belief that ICT capability was about the understanding and use of basic hardware and software, together with the management of files and discs. There was also a response, though to a lesser degree, that ICT capability involved an ability to use ICT to improve the individual's personal effectiveness. The researcher believes that the ability to use ICT appropriately in this way, and to be able improve one's own personal effectiveness, should be integral to the acquisition of ICT capability

However, in additional to the NCO there is also an expectation that ICT be developed as part of the key skills across the curriculum, meaning that ICT is also required to support learning in other curriculum subjects. ICT is a unique subject, in that it can be seen as a discrete subject, and also as a tool for learning and everyday life. This inclusion is providing a dilemma in that some schools are interpreting this to mean that ICT provision can be supplied on a cross curriculum basis only. This can be evidenced by a number of both Ofsted and Estyn reports where the emphasis tends to be on the delivery of ICT in a cross curricular framework, rather than as a discrete model (Ofsted, 2005; Estyn, 2003; Estyn, 2007). This can imply that much of the teaching of ICT capability may become the responsibility of non-ICT specialists, or even if being taught by ICT specialists may be constrained by the requirements of the cross curriculum subject.

Teaching of ICT Capability

The curriculum orders published between the start of the National Curriculum in 1990 and the present day, refer to the 'delivery' of ICT capability. This is referring to the teaching of ICT Capability, however, the term 'delivery can be used in a number of ways and for the purposes of this study some clarification of terminology used is necessary. According to the Oxford English Dictionary, delivery is defined as to 'state or present in a formal manner' whilst to teach is defined as 'to impart knowledge'; 'to give instruction'; 'to cause to learn by example or experience' and 'to advocate as a practice or principle'. When considered as part of the development of ICT capability the IT educator, 'imparts knowledge' if they are to develop the higher order skills associated with ICT capability, and 'gives instruction' when demonstrating the use of the skills techniques and routines associated with generic or individual applications of

software. The ultimate goal is to 'cause to learn' and the ability to plan and differentiate which particular application for a given purpose can be allied to advocating as a practice or principle. This last definition can also be linked to what Shulman (1987) described as 'general pedagogical knowledge' the aspect of a teacher's tools which allows for the conditions within the classroom; the management of the students and tasks to be optimal for learning to take place. It is for this reason that for the purposes of this research, that while the NCO may refer to 'delivery' when discussing elements of ICT capability this document will use teaching as the terminology of choice.

A further point to examine is whether the development of ICT capability is brought about by over emphasis of the development of the tools which form a part of the capability as established earlier. Gaskell (2003) looks into the emphasis of the teaching of the 'how's' within ICT. This is a tools based technique and often the students may be unable to grasp the transferability of the routines they are practising, either to other applications or to be able to utilise these skills and techniques in subjects other than ICT. This being the case tool based teaching on its own will not develop ICT capability.

Influences affecting the development of ICT Capability

When examining the development and teaching of ICT capability, an issue worth exploring is any influences which may act upon that development. In today's technological age where technology exists in the fabric of society ICT is unlikely to be developed in purely the isolation of the ICT class.

> "If children's ICT capability is to develop rapidly in the early years of schooling so as to aid learning from activities across the curriculum, it is clearly sensible for approaches to the use of ICT in school and home to be coordinated as far as possible" (Kennewell, 2003, p. 82).

> "Learning of specific subject matter is expected to take place through goal directed activity in which there is a gap between the learning objectives and the student's current knowledge. The 'learning gap' is bridged through cognitive effort" (Kennewell, 2003, p. 2)

It is therefore the responsibility of the educator to design tasks related to the learning objectives to assist the learners in achieving this goal and this task will be directly related to the competances of the educator. This may be by the design and setting of differentiated tasks that will have a 'learning gap' appropriate to the learning

objectives and ability of the learners. This will rely on the specific subject knowledge of the teacher and their perceptions of what is required to develop ICT capability. Kennewell et al., (2000) also believes that learning may not be brought about by the simple process of accessing information but that successful learning also requires a reflective stage.

Other influences may act as constraints on the development of ICT capability including those negative in nature

- Learners may develop expertise at home with software unfamiliar to or unavailable in schools
- Applications used at home may be more current than those available at school e.g. the differences and capabilities available in Microsoft Office 2007 as apposed to those available in earlier versions.
- School Networks may crash making computers unavailable
- Teachers may not allow the pupils access to software they themselves are underconfident with.

There are also positive constraints (Kennewell, 2003a) in which structure for learning is supplied such as

- Focusing the use of the internet to particular web sites, usually of an educational nature
- Restricting time spent on enhancing the work
- Ensuring all learners have the same access to computers and that that access is regular and productive.

When discussing development of ICT and the teaching of ICT as a discrete subject or even as a tool to support learning in other subjects there is a need to measure the degree to which ICT capability is achieved. The assessment process by which ICT is measured like the curriculum orders are vague and open to ICT specialist teachers perceptions and definitions. The implication of this is that the standards of ICT capability are open to interpretation like the curriculum itself. However, evaluation and research of the assessment methods fall outside the scope of the study.

Pedagogical reasoning

Given that the development of ICT capability in the pupils is directly linked to the ICT capability of the teacher (Lankshear, 2010), the implications are that the understanding or perceptions of ICT capability may be varied and that the teaching of that ICT capability varied also. In order to ensure that ICT capability is effectively taught within a curriculum which has been seen to be vague in its definition, there is a need for the teacher to have a clear perception of what is required in the development of that capability. When investigating how teachers brought about learning in the classroom and the different teaching processes and strategy used to do this, Shulman (1987) designed a model discussing the processes observed in teaching and classroom practice (Table 1). In the course of his investigation Shulman observed and interviewed a number of teachers, examining their best practice, with common practices emerging the following model evolved. The model is not a mechanistic process but rather an underlying concept that drives best practice of the pedagogy. The research was a result of investigation into reform of the initial teacher training; this was based on a number of questions:

> 'What are the sources of the knowledge base for teaching? In what terms can these sources be conceptualised? What are the processes of pedagogical reasoning and action? And what are the implications for teaching policy and educational reform?'
> (Shulman, 1987, p1)

A Model of Pedagogical Reasoning and Action	
Comprehension	*Of purposes, subject matter structures, ideas within and outside the discipline*
Transformation • Preparation • Representation • Selection • Adaptation and Tailoring to Student Characteristics	 *Critical interpretation of texts, structuring and segmentation, development of a curriculum repertoire and, clarification of purpose.* *Used of representational repertoire which includes analogies, metaphors, examples, demonstrations, explanations and so forth.* *Choice from among an instructional repertoire which includes modes of teaching, organising, managing and arranging.* *Consideration of conception, preconceptions, misconceptions and difficulties, language culture and motivation, social class, gender, age, ability, aptitude, interests, self-concepts, and attention*
Instruction	*Management, presentations, interactions, group work, discipline, humour, questioning and other aspects of active teaching, discovery, or enquiry instruction, and the observable forms of classroom teaching*
Evaluation	• *Checking for student understanding during interactive teaching* • *Testing student understanding at the end of the lesson or units* • *Evaluating one's own performance, and adjusting for experiences*
Reflection	*Reviewing, reconstructing, re-enacting and critically analysing one's own and the class's performance and grounding explanations in evidence*
New Comprehension	• *Of purposes, subject matter, students, teaching, and self* • *Consolidation of new understandings, and learning from experience.*

Table 1 Shulman's Model of Pedagogical Reasoning and Action (1987)

In the majority of curriculum subjects within KS3 the teaching is carried out by specialist subject teachers. With ICT this teaching may be carried out by non-specialists teaching ICT as a discrete subject or with ICT being taught as a cross- curriculum key skill. If ICT is being taught in some capacity by a non-specialist ICT teacher then there are a number of key points within this model that will have specific relevance. The comprehension of purpose and ideas within and outside ICT may be limited to the teachers own experience or sphere of understanding which may mean the perceptions of the teaching and development of ICT capability may be constrained. This will also constrain other elements of the model. Shulman (1987) in his foundations for teaching

reform highlighted the need for expertise not only of the management of the classroom, but also the management of ideas which arise in the classroom discourse. This discourse is key to the exploration of ICT as a transferable tool in the development of ICT capability, in that the ideas for purpose and the justification of the use of ICT tools in the best context for the situation, develops the use of the higher order skills needed for ICT capability to truly exist. He goes on to highlight the need for flexibility in this approach, and referring back to his model of pedagogical reasoning and action, any lack of comprehension of the subject matter will make this flexibility limited and indeed impact on the transformation and instructional elements of said model. Shulman attempts to define the 'knowledge base' and how this links to pedagogy, this is seen not just as discrete entities but also as a combination of the two bringing about an element coined as 'Pedagogical Content Knowledge' .

In his review of literature at the time Shulman felt that when discourse was centred on what was considered as the general principles of effective teaching there were features in his view 'critical features' that were largely ignored. These included aspects such as

'The subject matter being taught, the classroom context, the physical and psychological characteristics of the students or the accomplishments of purposes not readily assessed on standardised tests'

(Shulman, 1987, p6)

If these aspects are ignored in the teaching of ICT is it the tools and skills of ICT to enable the accomplishment of the set task that is being taught or is it the concept behind the use of those tasks which are being taught. If the knowledge of the teacher has developed from the use of ICT with little understanding and application of the underlying concepts, then it maybe that it is likely to have a tools based focus, however with teaching from specialist subject teachers it would be expected that the content or subject knowledge of the teacher would be greater and the teaching would be focused on the concepts underlying the use of the skills to a greater extent. This again backs up the findings of Webb (2002) where it was found that there was an over concentration on the teaching of how ICT tools were practised and not why these tools were used to accomplish certain tasks to the optimum effect. If this is related to ICT capability as identified by Kennewell et al., (2000), a non-specialist teacher whose

knowledge is based on their experience of using ICT, then will be more likely to develop the lower order aspects of ICT capability, such as basic routines and fundamental techniques. However, in order to differentiate between that experience and subject knowledge, the teacher would require a specialist knowledge in order to develop the higher order skills associated with the conceptualisation and justification of the use of those applications to bring about a given purpose or to solve a particular problem.

In Shulman's model he starts by examining the Teacher's knowledge as a basis for understanding and analysing the pedagogical process. This is because teaching is about initiating learning and for learning to take place the teacher has to communicate knowledge to the student in such a way that understanding and comprehension can take place. Shulman refers to this as 'transforming'. This may result in the student obtaining new skills and understanding of subject matter, but is not just the possession of that understanding and those skills it is a process of change, with a change in thinking evaluation and values. Teaching will start with the teachers understanding of what needs to be learnt, and ends with new comprehension both for the student and the teacher.

This has been explored further by Wilson et al., (1987), who highlight the need for not only a specialised understanding of the subject but an ability to recognise and generate alternative ways of examining the subject matter. In discussing successful teaching of any subject, there is emphasis on the need for a personal knowledge of the subject together with an additional requirement of knowledge of how to enable pupils in the classroom to gain knowledge within the subject as well. This form of knowledge is termed pedagogical content knowledge (PCK) and this knowledge is likely to be particular to different subject matter. Teachers of ICT are likely to use different pedagogical techniques in order to bring about the construction of knowledge or understanding by their pupils, than for example those teaching mathematics or indeed one of the humanities subjects.

The development of this pedagogical content knowledge has links to the way in which teachers plan to teach any particular aspect of their subject and the activities they use

to enable the contextual, and conceptual understanding to be constructed within the lesson. This knowledge is influenced by the way in which teachers think about their practice. Wilson et al., (1987) suggested that teachers think and acquire knowledge about the way they view their subject and their practice. They also build a knowledge base about their pupils and their curriculum and the teachers use this knowledge, continually making decisions about their teaching within the lessons.

Within the study two models are proposed to further the understanding and evaluation of successful teaching processes whereby successful teachers draw upon a large knowledge base which comprises of various types of knowledge. In analysing the teachers' knowledge base Shulman generated a number of categories to evaluate the knowledge base, these were as follows: Content Knowledge; General Pedagogical Knowledge; Curriculum Knowledge; Pedagogical Content Knowledge; Knowledge of learners and their characteristics; Knowledge of educational contexts and Knowledge of educational aims.

As can be seen in Figure 2 below.

Knowledge of subject	Knowledge of curriculum
Pedagogical content knowledge	Knowledge of learners
	Knowledge of educational aims
Knowledge of other content	General pedagogical knowledge
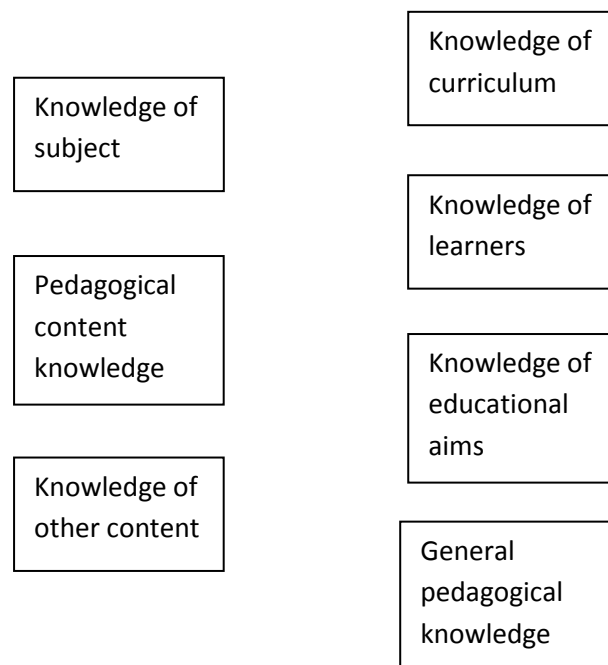
Figure 2 - Components of professional knowledge base Wilson et al., (1987)

This model emphasises that successful teachers' use a different knowledge within their professional knowledge base, for example, their content knowledge, their personal constructs of their subject; their understandings of the structures of that knowledge

and the way in which those structures are organised. Moreover, they use their knowledge of general pedagogical principles in the construction of knowledge, bringing about variations to match the needs of the learners employing their knowledge of the learner, whilst underpinning all this with their knowledge of the curriculum, what need to be taught and the knowledge of the educational aims. This suggests that for the successful development of ICT all these knowledge will need to come into play. Couple this with the model of pedagogical reasoning discussed earlier and there is a transformation of the knowledge outlined into the practice within the classroom.

This work has been built on in light of the impact of digital technology on learning and pedagogical reasoning (Starkey, 2010) where in a networked world with the ability to access up to date information instantly and the ability to interact an collaborate with the information though web 2.0 technology there is an additional impact from creativity and greater affordances for pupils to make connections with that information. Indeed it has been proposed that when examining the impact of using digital technology in teaching then a further category should be added to the professional knowledge base of technological pedagogical content knowledge (Mishra & Koehler, 2008) which has particular relevance when discussing not only the use of digital technologies as a pedagogical technique used in support of learning, but particularly when discussing the teaching of information communication technology. Starkey's study of emergent teachers and their use of technology to support their practice (2010) found that with more digitally aware teachers, there was a greater tendency to access web based or digital resources within their pedagogical toolkit rather than the more traditional resources such as texts as had previously been highlighted by Shulman (1987), whilst perhaps this is not surprising, it does emphasise that the professional knowledge base (Shulman, 1987) is indeed changing. This will again have particular relevance when examining the practice within a digital technological teaching environment such as within ICT lessons.

In summary, there have been a number of key findings, which have emerged from the review of literature, regarding ICT capability and its definition. The literature analysed has shown that it is considered to be more than just a tool, used to support other

subjects, but with the use of higher order metacognitive skills and concepts, (ACCAC, 2000, 2008a; Brosnan, 2000; Kennewell, et al., 2003a). Furthermore, it is important to note the distinction between knowledge and experience (Young 1013b) and the different aspects of knowledge required to bring about Epistemic Ascent (Winch 2013) and ICT capability.

Given that the National Curriulum Orders for ICT acknowledge the need for a conceptual basis to the subject, and not just a basis for the support of learning in other subjects then it can be argued that there is indeed a relatonship between the development of ICT capability and 'Powerful Knowledge'. However, if the perception of ICT is no more than a mechanistic cross-curricular tool, then there would be no relationship to knowledge but merely an experience of its use. Similarly, the notion of 'Epistemic Ascent' and the management of the various knowledges defined (Winch2013) implies that in order to establish any relationship to to the ICT curriculum there is a need to understand the relationship between the three forms of knowledge outlined and the overiding perception of ICT capability.

Winch (2013) acknowledges that the relationship between and 'Knowledge by Acquaintance' is often difficult for any curriculum designer to recognise however in the case of ICT capability this can be linked to creative use, and some of the more ethereal concepts, such as the understanding of 'Audience' and 'Purpose' which drive the subject. The aspect of 'Propositional Knowledge', 'Knowledge That' and their relationship with 'Knowledge How' together with the relationship to expertise links to a progression of knowledge within the subject. It is the recognition of the journey from learner to expert and the development of expertise which allows for the formation of subject knowledge. If this underlying differentiation between propositional knowledge, knowledge by acquaintance and 'knowledge that' is linked to Shulman (1987) and his evaluation of what is needed to teach any subject effectively. It may be surmised that if a teacher's level of content knowledge is limited to that of experience or 'Know How' then it is unlikely they will themselves possess the level of knowledge required to develop ICT capability effectively. This in turn may imply that the non-specialist teacher may not have the 'propositional knowledge' required to move the learner for novice to expert.

Further literature which is likely to become fundamental to this study is that of Shulman (1987) and his suppositions of the knowledges which are essential to effective teaching. The study is to investigate not only the perceptions of ICT capability but the practices used to develop that capability. In order to apply 'Pedagogical Reasoning' to ICT capability and the development of knowledge then it is important to acknowledge possible links between the perceptions of the subject and the 'Transformation' phase in effective teaching, particularly the recognition and consideration of conceptions, preconceptions and misconceptions.

Chapter Three - Activity Theory

Activity theory is a form of research and theorising which is based upon work carried out by the cultural historical school of Russian psychology (Engeström, et al., 1999; Engeström, 2007; Kaptelinin, 2005). Over the years this method of research and analysis has been refined by contemporary researchers and theorists, particularly the Helsinki school of activity theory, and specifically Engeström. It is the work of Engeström (2001) which would be examined in order to establish a possible analytical framework for this study. Cultural Historical Activity Theory or CHAT, allows the researcher to pay particular attention not only to the specific object of activity under research, which for the purposes of this study is the development of ICT capability, but also links in with the Vygotskian focus of 'Mediation and discourse' (Daniels, et al., 2010; Nardi, 1996; Roschelle, 1998). Activity theory is a developing resource, which maintains the core principles of Vygotsky and Leon'tev, but at the same time has the flexibility to adapt to any given activity within the workplace (Roth & Lee, 2007; Daniels, et al., 2010; Engeström, et al., 1999; Kaptelinin, 2005).

Thus use of CHAT within educational research has become increasingly popular over the last thirty years (Roth & Lee, 2007) some of the reasons for this increased popularity may be that in their experience the use of CHAT leads to changes in the representation or practice of what is educationally relevant. This being the case, the use of CHAT becomes increasingly relevant in studies such as this where the focus is change in understanding of the nature of ICT capability and particularly on the activity of developing that capability.

CHAT 'explicitly incorporates the mediation of activities with society, expanding this with application to information communication technology, which has grown exponentially to the extent that it is ingrained into everyday society, and indeed its continued growth and use not just as an educational topic but as a societal norm necessitates that any study of its development has not only the ability to incorporate and analyse change within the study, but also to be able to link to society in general. The very nature of the use, availability and growth of ICT and the capability to use it

effectively, denotes that the development of that capability cannot be confined to a classroom (Roth & Lee, 2007).

Whilst Vygotsky developed the first generation of activity theory, (Daniels, et al., 2010; Engeström, et al., 1999; Roth & Lee, 2007) in the examination of human labour activity it was his student Leon'tev (Roth & Lee, 2007) who made and clarified the link between the human labour activity and cognition. It is this second generation activity theory which is used in education research, having a much broader application for use within the classroom.

There is some evidence that some researchers have adopted CHAT purely because it is a theory of praxis (Roth & Lee, 2007). It should also be noted that within activity theory, praxis is defined as being moments of real human activity that occur only once as opposed to multiple events which would denote the practising of an action or activity. When examining the development of ICT capability, it is often the repetition of the action that transforms one element of ICT capability, which initially needs conscious thought, into a more automatic response (Kennewell et al., 2003). Therefore, when using activity theory to analyse the development of ICT capability within the classroom environs, it will be important to distinguish that activity which is developing new skills or elements of ICT capability and occurring only once within the setting, that is praxis and those actions which are repetitive and designed for consolidation. Roth and Lee (2007) discuss CHAT in terms of its links to dialectics which is a philosophy rooted in Russian psychology and which proposes that the opposing viewpoints or contradictions become the starting point for reflection and contemplation. This belief or approach to determining reality suggests that ideas arise as products and as a result of reflections of physical or quantifiable situations. Roth and Lee (2007) further believe that it is this area that has been least understood within western applications of CHAT, this may be due to the nature and formation of the theory, in that the origins of the theory are within both the Russian psychology and Marxist movements whose cultural belief systems were diametrically in opposition to western philosophy at that time. This study is proposing to evaluate and analyse the perceptions of educators in the development of ICT and to examine their personal constructs in teaching the subject. The cultural and belief systems are going to have a strong influence. This paradigm is also likely to differ culturally because western

society has enjoyed a freedom of growth, and because the education systems are less dictatorial or explicit than in the communist societies of Vygotsky's and Leont'ev's era. The authors use the analogy of threads, strands and fibres as a metaphor to describe the relationships within CHAT and the need to recognise that the interpretation of one aspect of the model is entirely dependent on the interpretation of the inter-relating objects of the said model. It is also important to stress that the use of the activity triangle, as well as dialectics in the analysis of the activity should be on a heuristic basis (Engeström, et al., 1999; Roth & Lee, 2007).

The proposition of activity theory is that human activity consists of much more than mere action, but is a socially-situated phenomenon. It is a theory or framework that examines practice, but situates that practice within an environment, which also examines the process and the purpose of that practice (Daniels, et al., 2010). In doing this it accounts, or attempts to account for, the complexity of real-time activity, investigating factors that influence the activity such as the beliefs and perceptions of those central to the activity. Activity theory has mostly been developed through the psychology of play, particularly when trying to research language acquisition and cognition when studying child development and learning (Engeström, et al., 1999). Engeström et al., (1999) further believes that activity theory has much to contribute to research as it allows for complexity, especially when attempting analysing the micro, meso and macro environs in which the activity exists. Webb (2010) examines models used in the analysis of pedagogical practice, and amongst others cites the use of activity theory and in particular Engeström's triangle. Webb (2010) discusses the point that our increasing understanding of cognition and meta-cognition has led to the need for researchers to develop more complex models of analysis, involving aspects of influence such as the environment in which learning is to take place. There is a need to recognise multiple dimensions of influence that may impact upon practice of the teacher, from a personal perspective, school perspective, and national perspective. These dimensions of influence and their impact on education and individual teachers are likely to bring about change, indeed they may be viewed as activators of change, and it is when attempting to analyse these influences and the change that is being brought about by them that activity theory and in particular Engeström's (2001) third-generation of activity theory becomes a relevant model for this research.

Activity settings

Prior to examining how this research can use that flexibility and discourse to examine the pedagogy of ICT capability and the activity of its development within the classroom at KS3, it would be opportune to examine Engeström's model of activity theory and how this may be applied.

In describing the use of the activity triangle (Engeström, 2000; Gorodetsky & Barak, 2009; Kaptelinin, 2005) point out that in any activity there are a number of smaller actions that lead to further actions, all of which can be applied as discrete activities, and all of these sub-activities can have a different dominance or foci within the activity triangle. If this were to be analogised within ICT and its development using the production of a leaflet with ICT as an example, then there is the over-riding activity of the leaflet production with the conceptual contexts of audience and purpose linked to that production, within that there are a number of other 'actions' taking place, such as selection of the most appropriate software, creative design of the leaflet to best suit audience and purpose, these actions can be further subdivided into 'operations' involving the appropriate selection and use of tools within the particular software chosen for the overall task. These different activities or small actions are played out according to rote, or as Engeström describes it according to a script. The point is made that when using activity theory it is important to distinguish between transient short term goal-directed action, such as the interaction between a pupil and the computer in the insertion of an image to an electronic poster and the longer term durable object-orientated activity, such as the completion of the whole electronic poster. In relation to this Engeström points out that the central unit of analysis is the collective activity system and its networks, linking to other activity systems. These sub actions are often relatively indistinct but become relevant as part of the whole. When referencing this to education in general and to the development of ICT capability within the classroom in particular, the object within the object orientated activity would be the pupils' learning, and without the pupils and the need for their learning there is no activity.

Engeström (1981; 2007) also discusses variances within the settings and describes these as being deviations within the scripts of the setting, coining them as disturbances or contradictions.   These contradictions are not merely problems or clashes but are

tensions which may exist historically and have built up over time, for example changes within the ICT policy within a school, or subtle changes in pedagogy with the advancement of technology. According to Hu and Webb, (2009) these contradictions can exist on two levels, level 1, which is a contradiction within an element, for example this may be a tension of teachers' subject knowledge or of their own levels ICT capability which is likely to be situated in the mediating artefacts elements within the activity triangle. The other Level of contradiction identified was those that exist between elements, for example this may exist between the subject and community where there is a conflict between the teachers' perceptions and belief systems and the culture which exists within the organisation. When evaluating activity settings, especially when examining two different activity settings there are always one or more contradictions emerging (Murphy & Rodriguez-Manzanares, 2008a). As explained previously, these are differences, or as Murphy and Rodriguez define them as 'problems, ruptures disturbances and conflicts' which alter the balance or equilibrium of the activity triangle, indeed may even be a form of resistance to the ultimate achievement of that activity (Lim & Hang, 2003). There are a number of authors (Engeström, 2000a; Lim, 2002; Artemeva & Freedman, 2001; Turner & McEwen, 2004; Turner & Turner, 2001) recognise a multi-layered form of contradiction in that rather than existing on two planes as described by Hu and Webb (2009) there are four differing types of contradiction ranging from Primary Contradictions through to Quaternary Contradictions. Primary contradictions relate to the first level of contradiction as described by Hu and Webb (2009), where there is a disruption between one element of the activity triangle, an example within this study may exist within the subject or individuals in groups in the form of the differences in ICT capability of the various teachers involved in the activity. Similarly Engeström's (Turner & McEwen, 2004) secondary contradictions can relate to the second level contradictions (Hu & Webb, 2009) which have been defined as disturbances within the same activity triangle but between two different elements, i.e. between the rules and the tools in that the attitude to ICT capability may be that it is being taught as a skill based subject, but in reality the schemes of work - the tools favour a tools based approach. At this point the comparison between the two sets of authors ceases, tertiary contradictions are described as being those changes or disturbances which exist between one activity setting and a previous activity setting. It is the contradiction,

in whichever form it may take which will highlight a need for change and the adjustment to this contradiction will bring about the transformation which is essentially the point of this form of analysis, therefore it is the disturbance between the initial activity setting which was the instigator for change and the transformed activity setting after the change has taken place. An example of this may be a change in curriculum which demands a change in pedagogy to bring about new learning. The object of both activity settings is the learning taking place, however with the introduction of new curriculum; the way in which that learning is developed may need to change. By comparing the two activity settings, before and after that change in method is required a disturbance or contradiction between the two will be demonstrated. Finally there exists the Quaternary contradiction, which is described as being a contradiction between two concurrent activities. This may between the working practices of two teachers within the same school. This multi-layered definition of contradictions implies a flow and relationship between one or more activity settings, the relationship between concurrent activities and the growth between one activity setting and the transformed practice. For the purposes of this study, where activity settings are being used to analyse the practice of teacher within related but individual case studies, there could be a challenge in recognising where one activity starts and ends, there will need to be strict boundaries established with the analytical framework to expedite the formation of meaning from any findings. With this in mind each of the activity settings will need to associate closely within its own contextual setting in order to differentiate one to the other (Uden, 2007; Nardi, 1996). Lim and Hang (2003) discuss this obstacle and recognise that activities within the classroom and the external activities influencing the classroom cannot be examined in isolation. Acknowledging that the 'higher levels of activity considerations' would include influencing establishments such as the Department of Education and Skills (Wales), and the Department of Education (England), this would also include the influence and culture of the School. These influences by the nature of what they are going to exist in a hierarchical fashion. Lim and Hang state that by evaluating not only the activity setting within the classroom but also within the influencing environment, then it is possible to gain a perspective on the sociocultural context of the situation under analysis (Figure 3). When this hierarchy is seen in the analysis of dynamic activity settings where transformation and change is present, especially in the light of

analysing tertiary contradictions leading to new activity settings, which themselves exhibit contradictions with their predecessors, it should be possible to develop an understanding of the historical change and development within that situation.
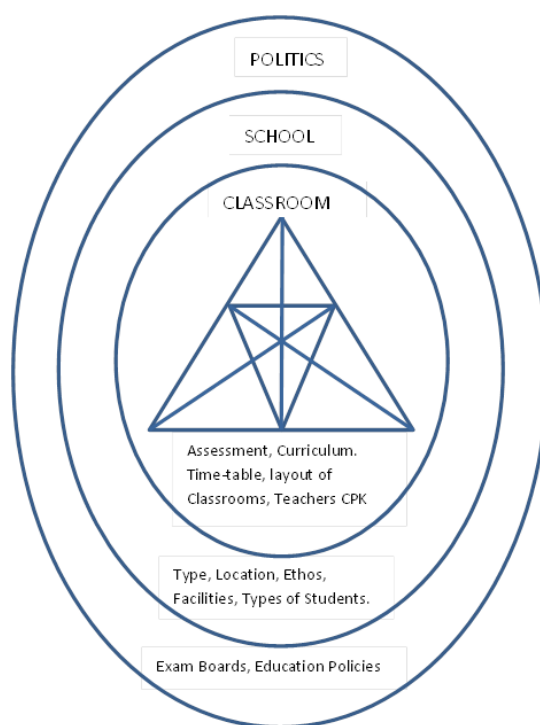

Figure 3 -Adaptation of Activity Systems with broader sociocultural context of the classrooms (Lim & Hang, 2003)

Lim (2002) explains the triangle in the following manner, that the classical triangle can be split into mediated and unmediated function and references the definitions of Vygotsky, whereby the elementary or 'unmediated' functioning, is apparent at the base of the triangle whereas the higher level or mediated functioning is apparent at the top of the triangle. However he also recognises that this simplistic analogy does not account for the dynamic nature of activities and their analysis. However the addition of the elements of rules, community and division of labour (as seen in figure 4) assist in greater analysis and by comparing across time the dynamic notion of formation and transformation can become apparent within the tertiary and quaternary contradictions.

For the purpose of the analysis it is these levels of contradiction which need to be established and examined. If sense can be made of these tensions then this is the aspect which will highlight the sense making purpose of the activity triangle and any potential for change (Engeström, 2001). These are described as demonstrating 'developmentally significant systemic contradictions and change potentials within the activity' (Engeström, 2000b, p. 963). In this case the objects of analysis within the system are the pupils and their motive in the use of ICT and their participation within the lesson environment and the learning or development of ICT capability, and it is these elements within the system which give the activity system coherence and a stable structure, any contradiction in the relationship within the system will result in an unstable system. On a macro level these contradictions and disturbances may be aspects such as a lack of funding for appropriate time or equipment for that learning to take place from one school to another resulting in a change in ethos or relative importance given to ICT as a discrete subject. From another perspective, disturbances within the system may be due to specific learning needs and a subsequent lack of appropriate planning or differentiation. For example the use of independent learning and pupil's controlling their own pace in the development of ICT capability may be appropriate for able and talented children, however within the same culture and environment should this strategy to be used with pupils requiring greater support then the teaching would not necessarily be as effective and the learning may be limited. On a micro level the personal constructs of the teacher is likely to influence the level of import given to any of the different elements that that teacher perceives to be of importance in the development of ICT capability. Linking back to the previous analogy of the use of ICT in the production of a leaflet, one teacher may perceive the prime importance in the development of ICT capability lies at a tools based level and that it is the use of software that defines ICT capability; in this example there is likely to be a greater importance given to the activity subset that develops the use of the applications tools. A contradiction to this would be a teacher who believes that the key aspect of ICT capability in this example is that of the higher order skills and the understanding of the contexts of audience and purpose, where the teacher is likely to attach greater importance to the activity subset concerned with this aspect of teaching. These disturbances and contradictions can be established by analysing the needs of the pupils, together with the school policies regarding the time allocated for

the activity systems and the environment or culture within which those activity systems are designed to operate. It is the identification of these disturbances within the systems, which allow researchers to identify any inappropriate application of the activity and any improvements, or remedies that can be made to the activity. By direct analysis of working practices or activities whether they be within the classroom or elsewhere it can be possible to identify areas of need within the activity. Using activity theory to identify relationships within the learning process and possibly to instigate change will also require some mechanism to model change and ultimately reapply the activity system to establish the merit of the redesigned activity.

The activity theory analysis has limitations in that, whilst it can identify areas of need (Engeström, 2000b), its role is in the identification process but not in the modelling process required to establish a new, appropriately working activity. In order to undertake this, a form of reflective practice, learning cycle or indeed basic systems analysis would be needed. In this case a solution to the need identified in the activity theory could be modelled and then further analysed using the activity triangle once again to establish whether further adjustments are needed. Furthermore, because within CHAT and in particular the activity triangle (see Figure 4), (Engeström, 2000b; Engeström, 2001; Roth & Lee, 2007; Daniels, et al., 2010) there is a dependency on relationships and networks within related activity systems, any change and alteration of an aspect of one system, whether it be part of the tools, rules, roles, individuals, or outcomes are likely to affect another part of the system or systems. Whether this ultimate change is positive or a further contradiction or disturbance will be dependent on the nature of the change taking place.
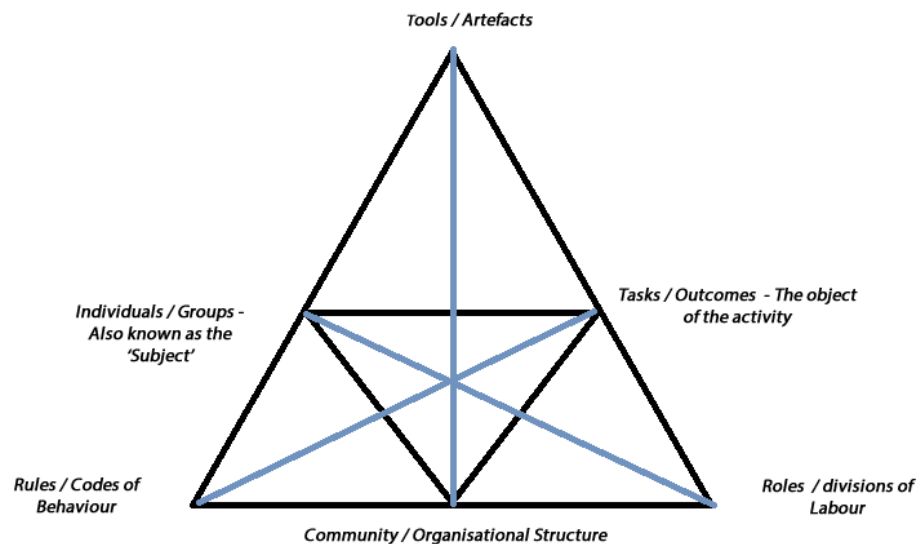
Figure 4 Activity Triangle adapted from Engeström (1999)

Jonassen and Rohrer-Murphy (1999) argue that when there is a need to analyse the needs of the classroom or learning environment then a powerful tool for this is Activity theory and in particularly the activity system, using the activity triangle. In describing the activity system they state that the primary focus for analysis is the object leading to the goal, with a secondary focus on the tools or operations that bring about that outcome. The application of this to this study leads to the following:

Individuals and groups

The individuals and groups also known as the subject in more traditional activity theory triangles, (Murphy & Rodriguez-Manzanares, 2008b), and they describe this element as being 'the individual or group whose viewpoint is adopted'. As such this will include the teacher, any support staff who may be involved and the pupils themselves. The observer can also be included in this subset, because the triangle above is used to analyse the relationships and influences that each of the subsets may have on each other and ultimately on the effects of the activity itself, whilst the observer may wish to be as anonymous and unobtrusive as possible, they are an addition to the activity setting and as such there is the propensity for an alteration in the dynamics of the activity setting. For example, the addition of a new person to the classroom may result in a change in behaviour of the pupils, especially where

behaviour management may be an issue. Further, key aspects will include the beliefs and perceptions of the teachers but also those of the pupils, with their attitude to learning playing a key role.

Tasks and Outcomes

These are likely to dominate the activity setting when used in a classroom based setting (Kennewell, 2010) as the main purpose for the classroom is the pursuance of learning and attainment of knowledge and from a purely simplistic view, these are likely to be one and the same. However, on a slightly different dimension, the process of learning is a process of change and as such these tasks should emulate what those changes are and how they relate to the pedagogy of the subject. However learning should not be confused with the pupil's ability to complete a task as this is a different kind of action (Kennewell, 2010) and should be recognised as such to make the research meaningful. Many researchers (Engeström, 1981; Hu & Webb, 2009; Jonassen & Rohrer - Murphy, 1999; Murphy & Rodriguez-Manzanares, 2008b) refer to this element of the activity triangle as the Object, Murphy and Rodriguez-Manzanares refer to this as the 'raw material' or 'problem space'. It is the object which is transformed by the other elements or mediating factors of the activity triangle to produce the activity. Traditional this is portrayed pictorially within a circle, denoting the pressures and influences of all the other factors upon it. It is at this point where there is the recognition of the opportunity for change on the resultant outcome. It is worth noting that there is a difference between the goal of the action and the object of the activity. Furthermore, the goal of the action and the object of the activity are likely to alter depending on the perspective of the triangle. This perspective will be set by the individual and group, or the 'subject' of the activity. If the subject is the ICT teacher, then the goal of the action will be related to the task set for the learners, whilst the object of the activity in these instances will be the learning taking place as a result of that task. However if the perspective taken has the pupil as the subject of the activity triangle, then the goal of the action and the object of the activity are likely to be the same, that of the tsk set for the pupils to complete.

Tools and Artefacts

In a learning environment within the classroom, tools and artefacts are likely to include, not only the curriculum, but the method in which this is achieved, for example the plans and schemes put into place to facilitate the teaching of ICT at KS3. It is also likely to include the software and hardware used to support the teaching together with the strategies used to bring about the learning process. These tools can not only be external tools, such as the national curriculum, but also may be symbolic and include the language and take part in the transformation process of the object into an outcome (Murphy & Rodriguez-Manzanares, 2008b), due to the technical nature of this subject and the study of the development of ICT capability language and the conceptual understanding of it within the subject is likely to play an important role.

Community and Organisational structures

This relates to the community within the class, school or indeed on a national level depending upon whether this model is being used to evaluate on a micro, meso or macro level. The focus of the research, in this case is the teachers' perception of ICT capability and how teachers relate to its development. One of the strong influences here is likely to be the culture that exists within the department or organisation concerning.

Divisions of labour

Simplistically this implies how the outcome is brought about, where in a manufacturing environment, for example, this would be who participates and what their level of participation is in the making of the product. In education the product is the learning, in this case the development of ICT capability, as this is the ultimate object at least for the teacher, if not for the pupils. As such, the interpretation would be the strategies involved in bringing about that goal, which would include any individuals such as the teacher and any support assistants together with the pupils themselves. This is not just about the division and participation in the tasks of the activity setting, but also and importantly the division of power within the activity settings community. This can include the senior management team within a school and in term the government policies which drive the organisation and process of the learning activity.

Rules and codes of behaviour

These may include the attitude of all the participants to ICT and how this links to the culture of the organisation, for example where is ICT perceived as a tool to assist learning on a cross curricular basis or where it is afforded a higher level of status within the curriculum of the school. This may also apply to examining how pedagogy relates to ICT and in turn how the use of ICT within the classroom relates to the pedagogical content knowledge as defined by Shulman (1987). However, when modelling this with the pupils as individuals as opposed to the teachers, the dynamics of the perception are likely to change and the perceptions or culture of the pupils are likely to link the position of ICT in a societal role and the rules that apply to it in that setting.

Engeström (2001) formulated five key principles which govern the use of activity settings and the subsequent analysis. The first principle is that the primary unit of analysis within activity theory is the activity setting itself; the second is that the principle of multi-voicedness, where there are multiple perspectives, interests and traditions which have been built historically within the activity setting and in itself can show the very contradictions which bring about the transformation and innovative change. Thirdly there is a principle of 'historicity', whereby the formation or history of the activity setting helps the analysts to understand the contradictions as well as the potential for change. This is because as the activity setting evolves its origins are inherent within it. The fourth principle is concerned with the contradictions themselves and states that these are the tensions which can if recognised result in transformation. Finally there is the principle of expansive learning, as previously stated, possible limitations of the activity theory analysis is that whilst contradictions can be recognised these contradictions need to be acknowledged in order that change in practice can take place. It is the reconceptualization of both object and motive which results in the expansive transformations, where change in the process is initiated and a new activity setting emerges (Murphy & Rodriguez-Manzanares, 2008b). As such when related to learning there is an implication that for the goal to be achieved, which from the point of the teacher at least will be that of learning then there has to be a transformation within the setting needs to take place, this means that there will be a contradiction of one level or another within the setting, if that contradiction is of a cognitive nature within the subject, then there are two

pedagogical assumptions which may be considered. Firstly is there a bridging of cognitive gaps from existing knowledge to new knowledge with help from others, which is socio-constructivist in nature, or does the contradiction result in acknowledgement by the individual learner, in which case accommodation and assimilation of the new knowledge and skills may be taking place which is Piagetian in nature and the contradiction is resolved, or is the contradiction ignored in which no learning, or change in cognitive state will be established.

Contradictions within activity systems, whether they are at a level where they are within an element, or whether they are at a higher level, and exist between elements of the activity setting emerge as disturbances, which Capper and Williams describe as being visible manifestations of the contradiction (Capper & Williams , 2004). Whilst it is widely acknowledged (Engeström, 2000b; Daniels, et al., 2010; Kaptelinin, 2005; Murphy & Rodriguez-Manzanares, 2008b) that these contradictions, or disturbances are important due to their potential to bring about change it has also been acknowledged (Murphy & Rodriguez-Manzanares, 2008b) that the transformation or change does not always occur despite the presence of contradiction. There is a need for that contradiction to be recognised by the subject of the activity and this recognition of a contradiction can have one of two outcomes. Where the contradiction is recognised as being valid then change of practice or learning can progress. Conversely if that contradiction is not recognised as being valid and ignored then change of practice and learning will not take place. This appears to be dependent on whether those contradictions are 'acknowledged or resolved' (Murphy & Rodriguez-Manzanares, 2008b), furthermore Murphy and Rodriguez-Manzanares also claim that in order that these contradictions bring about the required transformation is dependent on the resolution not occurring at an individual level, but at the social level of the community. Another reason for contradictions not leading to change may be that they may not easily be recognised, and that this would lead to an inability to discuss the contradiction amongst the community and hence an inability to recognise the need for the resultant change, (Capper & Williams , 2004).

Expansive Learning

Learning takes place within a subject when an action or series of actions brings about a permanent change in perception, cognition or behaviour. Engeström (2001) (Engeström, et al., 1996; Virkkunen & Kuutti, 2000) argues that this traditional definition of learning presupposes that there is a definite aspect to be learnt that has been identified by the teacher and that it is the skill of the teacher that brings about the change in attitude, cognition or behaviour. However, his claim is that in the workplace learning can take place without there being a definite aspect of learning identified prior to the activity, but that it is possible for this object of learning to evolve during the process. This theory of Expansive Learning is particularly interesting when applied to technology and specifically the creative and innovative aspects of ICT capability. This theory of the learning object evolving as part of the activity setting not only makes allowances for differences in pupils creativity but also gives credence to methods of exploration as a learning strategy within the development of ICT capability. There is a recommendation that an analysis of expansive learning be linked to the activity setting in such a way as to map the four questions outlined with the activity system as the main foci, but also with multi-voicedness, allowing for differences in opinion and perceptions within the learning. This is important when trying to identify the development of ICT capability, as it allows for the introduction of variety within the creative and innovative aspects of that capability. A third focus is that of historicity, this aspect identifies that the activity system itself may have developed over a period of time, undergoing slight changes with each cycle, as a consequence of tertiary contradictions again this is applicable within a classroom setting, and in particular the curriculum or scheme of work, which will be part of the tools analysed, as these will have evolved and adjusted over time. And finally the contradictions can be linked to the expansive learning cycle, which are described as having a series of stages similar to a system life cycle, where by the need for change is questioned or identified, there is an analysis of the need or historical purpose, a new model is designed and implemented, post implementation reflection of the model takes place and the cycle repeats itself or there is consolidation of the model depending on the outcome of the reflection. There are a number of different types of transformations taking place as a result of disruptions within the activity setting (Engeström, 2009; Engeström &

Sannino, 2010; Virkkunen & Kuutti, 2000) and these range from destructive and regressive to expansive. In expansive transformations the subject recognise the contradictions and modifies the activity in order to accommodate the contradiction, this may involve complete or partial redesign.

Learning theories relate learning outcomes in terms of changes in knowledge and skills or changes in behaviour, expansive learning depicts the outcomes as expanded objects, and new work practices which will include changes in thinking and cognition and changes in discourse (Engeström & Kerosuo, 2007). As such learning can be defined as having two key dimensions, the first being the known or existing knowledge which competes against the emerging nature of the object together with the new activity generated after the conceptualisation of any recognised contradictions. And the second dimension which consists of the manipulation of existing knowledge which in itself competes with the exploration of new knowledge. These two contrasting dimensions can be joined to form matrix which supports four different types of learning within the workplace (Engeström, 2004; Hill, et al., 2007)
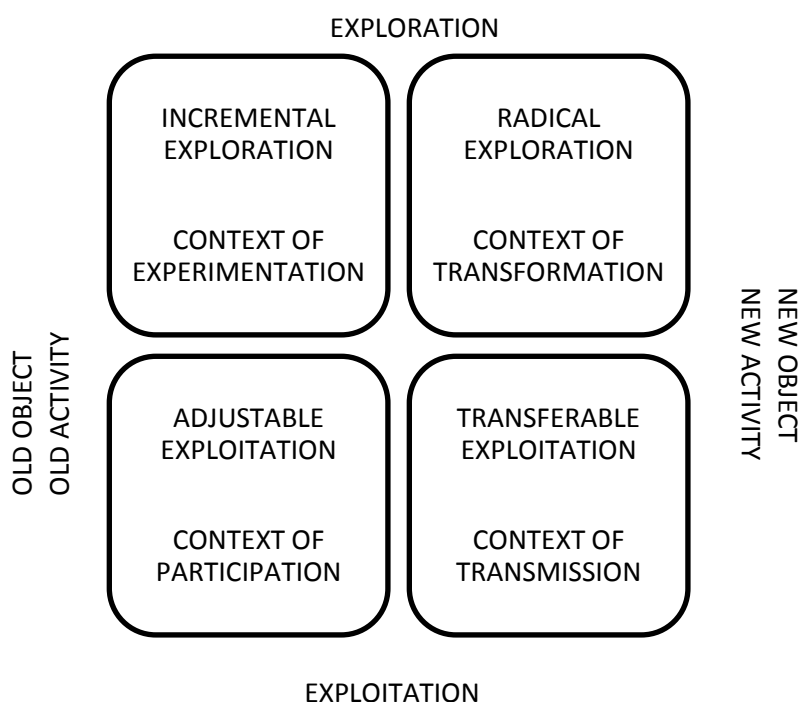
Figure 5 Four Types of Learning (Engeström, 2004)

Transferable Exploitation is the use of existing knowledge to enable the participants within the activity setting to adapt and deal with a new object and activity. In terms of developing ICT capability, it may be the transference of skills learnt within a suite of

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software from one application to another in order to achieve the desired outcome, an example of this may be the use of formatting skills transferred from Microsoft Word to Microsoft Excel in order to improve the appearance of a model.

Adjustable Exploitation is the gradual acquisition of existing knowledge in order to achieve the desired outcomes. This is the application of existing knowledge to existing problems. In terms of ICT capability it can be akin to the gradual formation of a routine (Kennewell, et al., 2003a) from a basic skill by repetitive use, that state where the student ceases to have to think about the action they are taking within the software application.

The region within the matrix of 'Incremental Exploration' is where new knowledge is brought about by the participants in the activity experimenting within that activity. From the point of view of developing ICT Capability, this may be the case where there is limited support for the students within the activity setting. The pupils would need the success criteria associated with the task, however the ways in which they accomplished this success would be the pupils' responsibility, and it is entirely likely that they would experiment with the tools available in the software to achieve success according to their rules, and understanding of the task.

Radical exploration exists where there is no pre-existing knowledge from which to explore. It is about defining new knowledge for new activity, in the case of this study it would be connected with the use of the high order skills where students have a goal or outcome, but no rules about what to use or how to achieve this. They would need to use metacognition in order to define for themselves both the success criteria and the means by which they can achieve this. It is the least understood of the forms of learning and according to Engeström (2004) the most exciting form of learning out of the four types defined here. It is what Expansive learning is focused upon, the generation of new knowledge for a new activity. (Engestrom, 2004) (Engeström & Sannino, 2010).

Models for exploring Pedagogy

In a review of a variety of models used to explore both ICT and its impact on teaching and pedagogy within ICT Webb (2010) points out that there is a need to understand the basis of teachers planning, both from the point of view of their processes and of their knowledge when planning the use of ICT in teaching. She explains this as being the way in which teachers perceive the use of ICT to enhance learning and this will also apply to the teachers plan and perceived use of ICT capability and its position within the ICT curriculum at KS3. In this instance the key point is the effect of ICT capability on learning, but not on the development of ICT capability and for this reason there are a number of adaptations to the model which may need to be made. With a curriculum subject such as ICT and its reliance and dependency both on technological development and social use and with that, the speed with which the subject has the capacity for change it is important that if the subject is to maintain its relevance as a curricular subject then change occurs within the classroom. Other literature (Engeström, 2001; Kaptelinin, 2005) is more specific stating that in order to successfully use activity theory in a classroom as opposed to a manufacturing environment it is important to acknowledge who the subjects of learning are and how they are situated within the system, what the motivation for the learning is and the relationship between the learning outcomes and the content or tasks enabling that learning, and those key actions or processes of learning. Furthermore by using these key questions within the activity theory model it is suggested that it is possible not only to identify but also examine expansive learning.

Webb (2010) describes a framework for examining the perception and pedagogical practices relating to IT use. Using affordances for learning based on the work by Gibson (Greeno, 1994) and later adapted by Greeno (Greeno, 1998) it offers a method of thinking about the conditions required within the environment to promote learning. The hypothesis is that in order to recreate or conceptualise those affordances for learning we must first establish what processes or perceptions have brought about those conditions, which will include teachers' perceptions of the pedagogy involved, the planning and the teaching itself. The aspect of the teachers' beliefs, values and knowledge can be equated to the relationship between the community of the

classroom or school and the individuals within activity triangle described earlier. However, this also links to aspects of Shulman's theory of Pedagogical Content Knowledge (Shulman, 1987), especially where the development of ICT capability may be the responsibility of non-specialist subject teachers. An exploration of aspects of ICT and pedagogy linking relationships between different forms of ICT and the teachers perceptions of ICT, Webb and Cox (2004) examine the relationships between pedagogical and subject knowledge and try to define the ICT capability of the teacher developing ICT capability. These relationships will define aspects of the 'community'; the 'divisions' of labour' and the 'tools or artefacts' apexes of the activity triangle. Using Shulmans model of pedagogical reasoning, (Shulman, 1987) it is the content and pedagogical knowledge which brings about the transformation in learning. Whilst this will influence how teachers plan and develop schemes of work in order to develop ICT capability, it does little to explain the behaviours and actions of the teachers or indeed the perceptions of what ICT is and how the development of that capability can take place. This may be especially true, when a scheme of work is developed by one teacher for example the head of department, but taught by another teacher within the department. However, Webb and Cox (Webb & Cox, 2004; Webb, 2002) propose that the purpose of Shulman's model is to examine the reasoning taking place when the teachers plan and that it is this knowledge to which he refers. It is with this reasoning that the use of lesson plans as a process, can be given its own entity within the subsequent model instead of incorporated into the tools and artefacts with other entities such as resources as is the case in the activity triangle. One aspect, which appears to be in contradiction within this model is that whilst there is a link between the teachers knowledge, their pedagogical knowledge and the development of the lesson plans, there is no link between those lesson plans, or any planned learning outcomes to the student's knowledge base, belief or values. It clearly indicates a relationship between that knowledge and student's behaviour on any affordance which may be present within the system, however for learning to take place, especially if aligning with Vygotsky's (1978) view of constructivist learning and his zone of proximal development (Vygotsky, 1978) and Bruner's (1960) view of scaffolding, there must be a relationship between the students' prior learning and any planning for new learning outcomes taking place within the system.
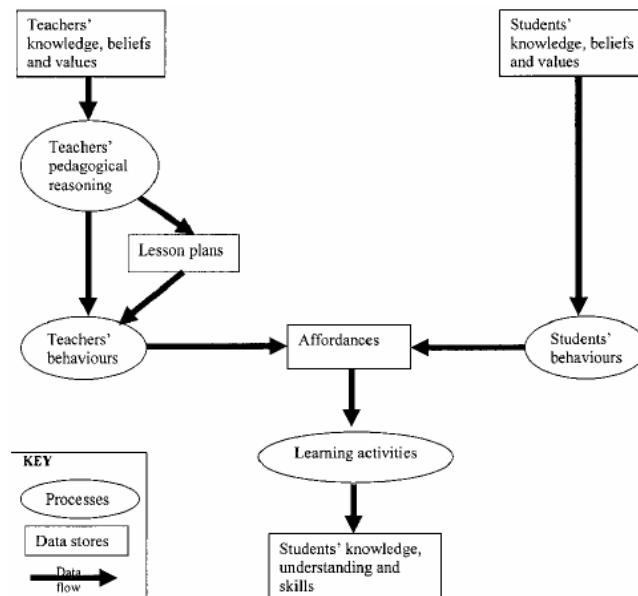
Figure 6 - Framework for pedagogical practices for IT use (Webb & Cox, 2004)

Webb and Cox argue that each process has levels of complexity that are not readily identified within the model, and suggest that the process linked to pedagogical reasoning really consists of a cycle of sub-processes, one of which being a cycle of transformation. This is a further link to activity theory and Engeström's activity triangle (Engeström, 1981) where transformation takes place. In Engeström's triangle, however it is the recognition of the disturbance or contradiction, whether this be primary, secondary, tertiary or quaternary in nature which brings about a representation of the need for change and it is this need which ultimately results in transformation taking place. Webb and Cox (2004) propose that transformation takes place in a constantly cyclical fashion, taking place within planning, teaching and evaluation and is initiated by the interaction with students. This interaction allows teachers to deliberate those affordances which best assist the students learning. Whilst one strand relates to the teacher and their activity within the classroom, the parallel line examines the student's activity within the classroom, concentrating on the student's knowledge beliefs and values, their behaviour and the affordances and learning activities put in place by the teacher and resulting in the students' knowledge understanding and skills. With students' knowledge present at start of the framework and at the end, it is supposed that it is the transformation of knowledge after the interaction of affordances and learning activities which are the object of the evaluation or analysis. Webb and Cox

(2004) acknowledge that this framework depicts the pedagogical process at a moment in time and is a 'snapshot' of the activity as is the unit of analysis in CHAT (Daniels, et al., 2010). A further point worth noting is that this framework was used in evaluating the impact of the use of ICT on the pedagogies in use within the classroom, but has not been used in examining the development of ICT capability as a knowledge, this is however also true for the use of CHAT. In a further study (Webb, 2005) students' pedagogical reasoning as a process has been inserted as a mirror to the teachers' pedagogical reasoning present in the original. This process would allow for the existing ICT cognition of the students and the way in which they use and adopt ICT to further their study (Webb, 2010).

Educational Activity settings

Kennewell (2010) examines methods for analysing the impact of IT on both the activity and the learning that that the educator wishes to take place. He acknowledges that whilst the use of classical activity theory does highlight any change taking place within the activity taking place, it does not necessarily highlight these changes within a classroom setting, and that this may need a more detailed approach in studying the impact on the learning (Kennewell, et al., 2008). The need for a model to analyse changes in student learning was recognised (Kennewell, 2003b) and a model involving the qualitative interpretations of actions or interactions involving ICT within a pedagogical setting was proposed (Kennewell, 2003b). It was suggested that the model be based upon the analysis of any affordances or constraints observed within the classroom, and went on to further state that these affordances (or potential for action), within the setting and the constraints (the structure allowing that action to take place), should not be considered in isolation but should also take into account the abilities and skills of the student or students undertaking learning. However, if this is hypothesis is examined in conjunction with the model proposed by Webb and Cox (Webb, 2010), then the pedagogical and subject knowledge and the reasoning used by the teacher in the design and implementation of those affordances will also have an impact on the proposed learning. The analysis of this form of interaction is already in existence within the proposed use of the activity triangle in the form of the inter-relationship which is portrayed between the various elements of the triangle. Similarly

to Webb and Cox (2004), Webb (2005), (2002), Kennewell (2001) evaluated the use of ICT as an aid to teaching and learning involving the use of affordances and constraints, again as in the previous models it should be noted that the focus of investigation is the use of ICT, not the development of ICT skills.

Kennewell (2011) acknowledges the factors having the potential to impact upon any pedagogical setting citing amongst them variables such as "the teacher, students, classroom organisation, resources, subject / classroom culture, and norms", most of these variables will link to and indeed can be used within the elements of the activity setting for analysis. As such it is implied that it is not enough to just analyse the activity, but also to analyse the environment in which that activity is set, however when applying the activity triangle according to Engeström (Avis, 2009; Artemeva & Freedman, 2001; Engestrom, et al., 1999), much of this can be evaluated through rules and codes of behaviour, for example the use of seating plans and the generation of an atmosphere for learning, aspects concerning the level of light, temperature or indeed the time of day of the lesson whilst indeed may have an impact on the learning and thus the activity are outside the scope of Engeström's triangle. Kennewell also asserts that any evaluating or analytical framework needs to consider the aims of the teacher involved and thus any affordances they may design and any constraints present in order to support those affordances. In this instance the affordances and constraints are linked to didactical activity, which is explained as being "any goal-directed actions in relation to tasks which have been designed to bring about learning" (Kennewell, 2001, p. 105). Once again there is an analogy to the object or goal as exists within the activity triangle. However, whilst activity theory talks about transformation, and change brought about by contradictions or disturbances within the setting, Kennewell (2010) explicitly refers to learning and the learning environment. There is an affirmation that in order for any goals or outcomes to be achieved, the students must build on their own existing skills and there is a requirement of a cognitive effort to bring new learning. It is this new learning which is the goal of the teacher in this setting.

Not only is this in line with Vygotsky and his Zone of Proximal development (Vygotsky, 1978) but also there are striking similarities between this form of constructivism and

the change that takes place as a result of tertiary contradictions as described earlier (Engeström, 2000a; Lim, 2002; Artemeva & Freedman, 2001; Turner & McEwen, 2004; Turner & Turner, 2001). Affordances and constraints, can be used to analyse the activity in any setting, providing this is related to the goals of that setting. Furthermore because it is recognised that the classroom is an atypical environment for more traditional activity setting analysis (Kennewell, et al., 2008), the origins of CHAT lying as they do in analysis of activities within the workplace (Engestrom, 1981), and because of the attention to fine detail of goal-directed action that Kennewell's ATLAS framework allows, it was deemed appropriate to use this model as a framework for observing and recording classroom practice, details of which can later be extracted for analysis within the activity setting triangle.

Summary

This chapter has established the relationships between the mediating factors of the activity triangle as described by Engestrom (Engestrom, 2000a, 2000b, Daniels, et al., 2010, Kaptelinin, 2005) and discussed how it can be used to analyse what is occuring within an activity. These relationships allow the researcher to develop an analytical tool. This analytical tool is developed by examining the relationships within the activity triangle and finding disturbances. The existance of these disturbances implies that the activity system is unstable and in need of change. These disturbances are recognised as being contradictions of the system.

Contradictions exist on a number of levels from primary to quaternery depending on where and how those contradictions exist. There is also a link between the recognition of the the contradiction and learning. If the subjects or individuals of the activity system are open to change then they are likely to recognise the contradiction and bring about a change to their practice.

In the course of this chapter and study there has been reference made to both Activity settings and activity systems. It has been useful to make this distinction in that activity settings refers to the descriptive raw material, what is happening and when. However when using those mediating factors to develop a unit of analysis within Engestrom's triangle then this becomes an activity system.

Chapter Four – Methodology

The choice of methodology depends on a number of factors including the aims of the research and the research objectives which are formed to fulfil that aim. Therefore in order to establish the desired methodology it is useful to examine the research aim and the associated objectives. The aim which the research set out to address was to explore teacher's perceptions of ICT capability and whether their practice in the classroom matches their personal constructs. As discussed in previous chapters this is particularly pertinent given the current environment of curriculum change in Wales.

1. To investigate teachers' constructs of ICT capability at KS3 in Wales;

2. To investigate the relationship between individual teachers' personal constructs of ICT capability and their classroom practice;

3. To identify changes in individual teachers' perceptions during a period of curriculum review;

4. To investigate how individual teachers' changing perceptions are mediated by their environment.

These research objectives lead the form the research takes and how the data is collected and subsequently analysed. The research objectives can be aligned to two differing styles of research; the first objective can be linked to positivism whilst the remaining objectives will be using a more interpretivist approach.

The first research objective, where there is an attempt to investigate the understandings of ICT capability by teachers across Wales requires data and findings which are much more general in nature than the in-depth methods of qualitative data collection and analysis used when researching the individual teachers' understandings and the relationships which may exist between their classroom practices and the impact of the external environment on their changing perceptions. A more positivist approach was deemed as being appropriate in this instance as it allows the researcher to observe the data whilst maintaining a separation from the interpretations of that data, in that the data can be independent of both the study and the context of that study and that the collection of the data can be produced by collecting facts (Flick, 2014). For the first research objective, the method of collection of data was a questionnaire which was sent to all the secondary schools in Wales. In doing this the

researcher is a step removed from the data, and whilst the data will analysed it will be the facts gleaned from the collected data that will be analysed and a conclusion made that fits that data.

Oppenheim (2001) notes that there are a number of disadvantages and advantages to using questionnaires within the research design. These advantages include the relatively low cost of the questionnaire. Attempting to interview a large sample of ICT teachers within Wales to establish their broad constructs of ICT capability would be costly in terms of time, organisation and feasibility, however it is possible to send a large number of questionnaires throughout Wales either traditionally through the postal system or via email to bring about a similar result. The research objective stipulates that it is to investigate ICT teachers' constructs, this is not required in any depth as the purpose of this objective is to examine the broad perceptions of the ICT teachers in Wales. A further advantage of this method is that it can limit any influence or bias of the interviewer as the interviewer is able to remain separate from the process other than when designing the questionnaire. It also allows the interviewer to gain a perspective from a large geographical area that face to face interviews would make infeasible. However, disadvantages can include relatively low response rates. In an effort to try and alleviate this disadvantage the option of electronic and traditional postal questionnaire was given to the respondents. The last contra indications cited by Oppenheim, no opportunity to collect data via observations; no control over the order of questions answered, and no opportunity to correct misconceptions are valid, however careful design of the questionnaire can limited these disadvantages.

According to Creswell (2003) there are three main forms of research methodology, qualitative, quantitative and mixed methodology. He suggests that research practices tend to exist on a continuum between qualitative at one end and quantitative at the other end. The nature of this enquiry is that one of the research objectives, the investigation of the teacher's constructs of ICT capability will use a quantitative approach. In order to answer this, a questionnaire was used to try to understand how teachers across Wales view ICT capability. However, when researching the personal constructs and classroom practice of the teachers there was a need for a qualitative approach. Therefore a mixed approach was necessary, using a questionnaire with positivist characteristics for the first research objective in order to see if there was a

consensus of opinion about the nature of ICT capability across Wales and an interpretive approach for the research objectives concerned with individual teachers' personal constructs and their accompanying classroom practices. In order to explore how teachers' changing perceptions were mediated by their environments against a background of curricular change Activity Theory was used as an analytical tool in this study.

Ormeston et al., (2014, p. 11) discuss Interpretivism as being a way of finding knowledge by using the interpretations of both the researcher and the participants involved in the study in "understanding the phenomenon". In this research where the objectives are concerned with investigating the teachers' personal constructs; their classroom practice and their changing perceptions, it is appropriate that Interpretivism is used to gain an understanding, allowing the researcher to interpret the meaning within the data. This is also appropriate for the use of Activity Theory as an analytical tool, where the data collected from the interviews and observations are coded in order to find common themes for use within the activity setting.

Cultural Historical Activity Theory (CHAT) as the analytical tool relies on interpretations in the construction of meaning. Within this it is also acknowledged, CHAT facilitates the examination of change incorporating the perceptions and ideals of individuals and small groups. Within CHAT, reality exists fundamentally within the "network of subjective meanings that sustain rule-like actions" (Glanz, 2008). This may be interpreted that the reality or truth within CHAT can be ascertained from the interpretations of the mediating factors within the activity settings, which allows for contradictions within the system to be recognised. Ultimately these contradictions can also be compared to give rise to an understanding of how the individual teacher's perceptions compare to their classroom practice. When this is linked to the research objectives of this study, as previously discussed, the use of qualitative enquiry as a methodology and more specifically the use of Cultural Historical Activity theory as a specific analytical tool were deemed appropriate.

The predominant reasoning in this case is that the participants are social beings and interpret and interact accordingly, shaping their actions and activity in a way that is meaningful to them. In CHAT and in terms specifically of this study, much of this

sociality will exist in the relationships and routines existing within the activity and its environs that is the classroom, the school and in general the educational arena. From an epistemological point of view it becomes clear with CHAT that the reality or truth lies within the understanding of the processes which build that reality; this has both a social and a cultural impact. This can be recognised in the research objectives relating to perception and the ability to put that perception into action. There is also relevance in that the activities generated by teachers who are applying their perceptions of ICT capability to the development of pupils' knowledge and skills will largely take place within the social environments of the classroom and not in isolation, and cultural because the culture of the educational environment will have a role in building the reality.

Creswell (2003) also discusses theoretical and philosophical claims in relation to the use of qualitative and quantitative data collection. Amongst these stances are those of social constructivism. In education, socio constructivism is regarded as being the construction of new ideas through dialogue. This is the stance that this research takes. It is collecting data from the individual teacher's experience and perceptions. The interviews used in building the case studies are focused on their views built on their understanding of ICT capability and these views will have been influenced by past experiences. Observations of their practice are also used for data collection, again making meaning out of their experiences in the classroom.

Case Studies

According to Yin (2009) a case study is a preferred methodology, when researchers are asking how and why questions. In the case of this research, this would apply to why the teachers teach in the way they are teaching, and how this development of ICT capability matches with their own personal constructs. Another reason for choosing case studies is that it allows the researcher to focus on occurrences in the here and now, rather than historical events. It is also applicable when the researcher has little control over the events taking place in the macro environment. All of the above three factors are true for this research. Furthermore, Yin (2009) suggests that case studies are an appropriate methodology when the researcher needs to study "contemporary

phenomena" within real life boundaries and particularly when those boundaries may be blurred. He also cites case studies as being a method of choice when the data required comes from multiple sources. It is for this reason that case studies have been deemed appropriate for this study, the research objectives clearly require the researcher to gain an understanding of the teachers developing constructs of ICT capability and their class room practice, the context of the environment is a changing environment. The contemporary phenomena of ICT capability are not phenomena that can realistically be investigated alone and independently from the environment in which it is found, and in this case that environment is one of change. The research objectives dictate that it is necessary to obtain data in a variety of ways, pre and post interviews, more than one observation of classroom practice, and the use of case studies supports this multiplicity of data. Further, in order to evacuate the impact of the changing environment case studies allows for the whole context in which the data is collected to be incorporated into the analysis (Yin, 2009).

Regardless of the choice of methodology there are advantages and disadvantages within any form of research methodology, according to Yin (ibid) and use of case studies for research is one of the most challenging of all the social science methodologies used in research. One of these challenges is to design the case studies in such a way that any bias is absent and the analysis contains sufficient rigour to ensure validity. Yin (ibid) suggests that the researcher first explains and demonstrates how such a rigorous methodological path throughout the research is designed and that the researcher adhere to formal and explicit protocols and procedures within the data collection. These procedures and protocols involve explicit demonstration of the protection of the data against threats to validity, maintaining the chain of evidence, and rigorously testing any explanations or theorems which may come from analysis of the data. Within this study this was achieved by examining the research aims and devising a means by which data may be collected which was thought suitable to answer the research objectives. The data collected to form the case studies was aimed to bring about an understanding of the participating teacher's individual perceptions of ICT capability. This was carried out primarily through an interview. The next purpose of the data collection was to build an understanding of how this perception of ICT capability influenced the teacher's practice within the classroom. Observations of

classroom practice and a post observation reflective dialogue was proposed. Finally a further cycle of observation and final interview were thought to be appropriate to establish if there was any change in perception or practice taking place. This change may be due to the changes occurring in the external environment, or may also be due in part to the process of research and a recognition by the participating teacher of any mismatch in perception and practice. Having established a method of data collection appropriate to the research objectives and the aims of the individual case studies it was important to ensure rigour. In order to do this a system of data collection was devised that was repeated in the same way with the three participating teachers. All the interviews were conducted in the same way, data from the observations were collected in a focused manner using the same observational framework. The data itself was transcribed in the same manner and coded thematically according to the same criteria in order to try to ensure that each case study was formed in the same manner. Chadderton and Torrence (2011) regard case studies as an approach to research data collection that enables in-depth study, providing that the rigour of that data is maintained as emphasised by Yin (2009). One area which may present challenge is the definition of the boundaries of the case, can the research 'produce a definitive account' (Chadderton & Torrance, 2011) or a series of perspectives. The boundaries of the case studies were linked to the research objectives and these were established to reflect this. The focus of the study became the perceptions and practice of the participating teachers. As such there were a number of aspects which fell outside the boundaries of this research, these include any discussion of the perceptions of ICT capability with any other teachers in the school assisting with the teaching of ICT; the way in which ICT is assessed and any of the teacher's perceptions or practice of assessment of ICT. Another constraint of the research is that the case studies would be limited to three. However those three schools were selected through the researcher's local knowledge as having very different strategies in the teaching of ICT in order to build breadth into the study.

Chadderton & Torrence go on to define case studies as:

> *"An approach which seeks to engage with and report the complexity of social and educational activity, in order to represent the meanings that individual social actors bring to those settings and manufacture in them"*
> (Chadderton & Torrance, 2011, p. 53)

This definition implies that there are a number of foci present within the methodology, that the setting or environment is important and that the encounter or individual activity, whether it be observation of a lesson, or interview has its own impact on the study. The richness of the case being built and the information gathered from it, is as much in the data gathering procedures as the data itself. In the case of the research taking place in this study, highlighting a particular aspect of ICT Capability through an interview question may in itself have an impact on the answer of the individual. The highlighting of material and perceptions which may make the characters being interviewed or observed question their own constructs and bring about some change in their attitude. Building case studies in this way does not preclude any of the techniques which may be common in other research methodologies. Providing the techniques are appropriate to gather the information needed to construct rigorous triangulated and unbiased data, then they are appropriate within the case study. The analysis of case studies tends to bring about fresh ideas, and as such the boundaries of case study may be ever-changing dependent upon the results of the analysis undertaken (Bassey, 1999, Chadderton & Torrence, 2011) . With this being the case it is vital that data is analysed as an on-going basis and timely with its collection; it is not possible to evaluate or analyse the data when all had been collected else an idea emerges and the opportunity to gather evidence for that idea is missed. However, with the need for evidence being closely related to the data collected on an on-going basis, this research was carefully constructed in that time frames for the occurrence of the various interviews and observations were negotiated with the participating teachers. There are likely to be clear constraints, especially in the form of time and access, which will influence the amount of data collected. Having collected a piece of data that data was examined and transcribed promptly in order that any nuances were not lost and that the data collected was accurate. This also allowed for the recognition of details which needed further investigation either in the observations or in later interviews. However it was important to refer to the research objectives throughout, in order that any changes occurring were within the remit of the study.

Case Study Design

As noted earlier by both Yin (2009) and Chadderton and Torrence (2011) having chosen the construction of case studies as a form of research methodology, and because those case studies can be constructed by use of a variety of different techniques and procedures it is important to design the case study in order that the researcher gains the appropriate data for analysis. However, it was also mentioned earlier that the emergent boundaries of that data are likely to be dependent upon the information resulting from that data, and as such this design is likely to need an element of fluidity and flexibility.

There should be, according to Savin-Baden and Winpenny (2007), a statement of the factors one is looking to investigate, in order that those participating as the subjects of the case studies are clear about the research undertaken. In this case this investigation will be focusing on the change of perception and practice of the teacher concerning the nature of ICT capability. These factors included the timescale of the research, the design of the research, the number and order of interviews and observations, and the ethical considerations afforded to the study.

In recognition of the individual teachers' responsibilities and workload within the schools, appointments were made with them so that the research could take place at times convenient to both the teachers and the researcher.

The case study approach allows for a variety of different techniques and practices to gather the data, (Chadderton & Torrance, 2011), in this study this involved a cyclical process similar to those often found in action research methodologies, and involved interviews, classroom observations, post – observation reflective dialogues, prior to a further observation and final interview. It was hoped this would allow the teachers, involved in the interviews and research, a chance to reflect and change their practice and possibly their perceptions. In the design of this methodology it was felt important to ensure opportunities for development for the teachers; for them to be able to change their practice if their reflection of their perceptions of ICT capability dictated change (Mumford, 2006).

Case studies were built using interviews, observations, and opportunities for teachers to reflect on the changes in their own practice. The spacing of interviews pre and post observation of practice was intended to generate a greater discussion through the interview process.

The case studies are designed to answer the research objectives concerned with investigating the teachers' constructs of ICT capability are and how their practices in the classroom relate to these perceptions. A further aspect which developed during the data collection and the building of the case studies was how the changing environment impacted upon the teachers' understanding of ICT capability and whether that change also had an impact on teachers' classroom practices.

The scope of the investigation, focused on what the teachers thought ICT capability was, what IT teachers did within the classroom to develop ICT capability, whether there were any influences either from the culture of the school or from the changing external environment, and how did these influences impact on the teachers' understanding and practice and any model of teaching that the individual teachers employed.

The data collected in order to answer the research objectives was through interview, and observation of each teacher's actions. This was because the chief question concerning the teacher's perceptions cannot be answered by interview alone. Perception is influenced by the surrounding culture, by the events taking place at any given time period and by the environment in which these influences occur. The environment in which this research is taking place is also constantly changing and the use of case studies allows for this changing context to be taken into account within the analysis. Finally the criteria for interpreting the study's findings were the analysis of qualitative data. Interviews were used and activity theory employed to interpret the data. The interview questions have been designed to question both the teacher's perceptions of ICT and their thoughts on its development. This has included their thoughts on what the curriculum is and what they believe it should contain.

Due to the present climate of curricular review and change, it was probable that this external change was likely to influence their perceptions of the nature of ICT capability. The interviews were coded according to themes; these were established by finding recurrent ideas or topics running through the dialogue. The research is also concerned with whether their teaching and development of ICT capability matches their personal constructs.

Classroom observations were made in order to gain data to support this. The collection of the data used the ATLAS framework (Kennewell, 2001) in order to give the data collection a structure and focus on the development of ICT capability. It was felt that to collect data solely under the headings of the mediating artefacts of CHAT would limit the data collection. However it was also important to have a framework for the collection of data. This framework allowed similar data to be collected in all the observations which in turn introduced a sense of rigour to the data collection. The use of ATLAS allowed the observer to focus on the features of the learner; features of the setting and the product of the activity within the classroom. The interactions taking place within the setting, the affordances and constraints the orchestration of learning by both the teachers and the learners and the activity directed at achieving the goal of the lesson. The final aspects concerned the evaluation of both product and process by focusing on the role of 'reflection –in-action' and 'reflection-on-action' in the construction of knowledge. Use of the framework in all observations allowed the observer to ensure that data was collected on the same aspects of classroom setting and practice regardless of the school or class observed. This framework and the way in which it was used can be seen in appendix IV. In order to answer this question it is necessary to analyse the teacher's activity and so Cultural Historical Activity Theory and specifically Engeström's Triangle (Engeström, 2000) was used to structure the analysis of both interview and observation. This analytical tool was used to determine contradictions between different activity settings, and by applying this to both interviews and observations it was possible to detect contradictions between the teacher's constructs and their practice in the classroom. It will also be possible to examine if there are any changes over time between the interviews and assess any impact on the changing environment on their perceptions; the same is possible for changes in practice by comparing the activity settings within the two observations.

Interview

According to Kvale (2007) the use of interviews humanises research in that it recognises that interviewees are more than just data, and that conversation and discussion can often generate knowledge. He further notes that the word "inter-view" depicts an exchange of views, supporting this is the view that interviews are an opportunity where dialogue can be devised to allow fellow participants, the interviewer and the interviewee, to exchange ideas and theories about the subject of mutual interest (Cohen, et al., 2007, p. 347).

Thus the interview becomes a flexible and fluid tool in which data can be collected (ibid), allowing for opportunities not only to use the written word, but more diverse areas of communication; verbal and non-verbal communication for example during the course of the interviews the interviewees reaction could be noted. In one case, one of the interviewees was quite passionate in their condemnation of the current changes. This form of communication would not have been noted had the data been collected via a questionnaire rather than a face to face interview. The interviewer was also able to rephrase questions and probe to elicit fuller responses than might otherwise be obtained. However, the use of interviews does have its drawback, in that the time taken for the interview, for the transcribing of the interview and ultimately the time taken to analyse the material received can be costly (Cohen, et al., 2007). It is for this reason, that whilst it is recognised that the use of interviews offers the capacity to collect rich data, the interviews have been restricted to an initial interview, and then a final interview to conclude the period of investigation for the case study. These interviews were then analysed in depth.

Kitwood, (1977) examines various aspects of the interview; the first being that of transfer of pure information; the second is that there is likely to be a bias that has to be controlled and recognised. Kitwood explains that each participant brings with them their own viewpoint or bias to both the question and the expected answer. Having recognised this bias, it was managed by attempting to build in controls, and in the interviews conducted in this study the controls existed in the form of pre-set questions which were the same for each initial interview. Prompts were used but kept to a minimum, whilst a dialogue was achieved this took the form of question and answer

where the focus was on the form of answer given rather than conversational, giving an equal importance to both sides of the communication. The interviewer tried to maintain a separate stance within the dialogue. Cicourel (1964) advocates that the interview is a social situation not simply a process of information exchange, and goes on to list five unavoidable features that would normally be regarded as a problem, these include as mutual trust; interviewee may feel uneasy, and if the questioning is uncomfortable may adopt avoidance tactics, such as reverting to previous questions of a more comfortable nature. A further point be aware of is that both interviewer and interviewee will hold back part of what may be their answer; the interviewer needs to be aware that the meanings of the questions or objects and investigation may be clear to them, however, this may not be the case for the interviewee. Finally, this is a meeting of two individuals, with their own personalities, precepts and bias and as such it is not always possible to be able to manage every aspect of the situation (Cicourel, 1964). As previously stated, it is very nature of the dialogue and conversation which allows, not only, for rich data to be collected but also, because there is a likelihood that a different perception and bias may be within situation, that alternative lines of enquiry may be stumbled upon in the course of that dialogue. It is also important when considering the use of interview to be aware of the purpose of the interview and in this case where it is important to gather data pertaining to educators perceptions it is desirous to have some degree of interview process within the data collection.

In this study it was recognised that when interviewing the teachers in an attempt to gain an understanding into their perceptions and personal constructs of ICT capability and its development that there was likely to be an element of bias based on their individual background and expertise. For example a specialist teacher who has a background in computer science may view the questions differently than one who has a background in ICT. These differences in background and the possible influence on the teacher's perceptions of ICT capability were noted and discussed as part of the case study analysis. This ability to add context to the data analysis further supports the choice of case study as a methodology. The interviews were also conducted as a social dialogue; this enabled the researcher to use the trust that existed between the interviewer and the interviewees. This format allowed for a relaxed and free discussion

of ideas. This again was important as it was possible to evaluate the personal constructs of the individual teachers without an atmosphere of a test or interrogation.

Observation

Unlike interviews, observations offer neutrality to the researcher. With interviews there is a dialogue between the interviewer and interviewee with the observation the researcher can separate themselves from direct involvement in the classroom activity. (Cohen, et al., 2007). However, it should also be recognised that no matter how careful the observer may be in their attempts not to alter the dynamics of the setting, the mere fact that there is a different person in the room may in itself have influence on the surroundings.

The foci within the case studies are the teachers' practice in developing ICT capability, and the use of cultural historical activity theory in the analysis of the data collected. In order to analyse the activity in the classroom, it was necessary to observe the teacher in person and record what was occurring within the classroom. This would allow the researcher to compare what the teachers thought took place as described through the interviews and what occurred as practice within the classroom.

The complexity of activity theory (Engeström, 2000a) dictates that the data required for analysis is complex and interconnected. The teacher is the subject of the analysis and the object is the development of ICT capability, the remaining mediating factors of the triangle interpret a variety of different aspects of the classroom activity. In order to collect data of this degree of complexity, there is a need for a focus on behaviour, verbal and non-verbal interaction, reflection on action and reflection in action (Kennewell, 2001). Observations allow for the collection of data regarding other aspects of the situation which may have an impact on the activity itself, aspects such as the architecture of room, the rules of the classroom, the interaction between pupil and teacher or indeed between pupil and pupil. Some of the data required can be obtained through discussion with teacher. However, with the teacher being part of the activity and thus part of the data in need of collection it is entirely possible that they

may be unaware of some of their own actions. For this reason observations were chosen as a means to collect this data.

There are different degrees of participation when observing a situation (LeCompte and Preissle, 1993) The "Participant-as-observer" where the observer is part of the observation documents and records the events under scrutiny, and it is this stance which was taken within the study. This stance was taken in order to ensure that the data collection was open and transparent and that the teachers under observation were fully aware of the data being recorded. Notes were taken openly and the teachers were able to see what was being recorded if they so wished. This stance was also thought to be a way of building trust between the observer and the teacher participating. However, it was made clear that the observer would not interact with the classroom practice but remain aloof in order to limit any impact that the observation would have on the dynamics of the lesson.

Research Design

Case studies were built using interviews, observation and teacher reflection. With teachers reflecting on the changes in their own practice the spacing of interviews pre and post observation of practice is intended to generate greater discussion through the interview process.

An initial interview with each individual participating teacher was conducted at the start of the data collection process. The aim of this is to ascertain the teacher's personal constructs of ICT capability. Questions regarding their personal beliefs regarding the nature of ICT capability, how this was dealt with in Wales were posed. The interview also attempted to address issues such as: the changes taking place in England at the time; the issue of motivation amongst pupils, especially the drop in motivation between KS2 and KS4; and to what extent ICT capability could be developed on a cross curricular basis. All these questions would enable analysis to discern a number of factors relating to how they defined ICT capability, what its role was within the curriculum and how they thought it might or should change given the changes being discussed in England. By analysing how they felt the concept of ICT

capability should change there would be an indication of how they perceived the development of ICT capability and those applications or tools which might be required to develop ICT capability as an entity. During the interview process it was originally hoped to discuss issues such as schemes of work and their relationship to the development of ICT capability, and whilst the schemes of work were not discussed in detail, the teaching strategies employed were discussed and these schemes of work were made available electronically via a forum set up for this purpose.

As stated previously, the chief question concerning the teacher's perceptions cannot be answered by interview alone, and because part of the research question is concerning whether the activity in the classroom during the development of ICT capability matched their personal constructs of what ICT capability was, then observations of classroom practice were also employed as a means of data collection.

This involved observation of specific lessons where the teachers used the development strategy highlighted within their interviews in teaching ICT capability. The interactions and intra actions were observed according to ATLAS (Kennewell, 2001). The framework included aspects such as intra-action where the features of the learner are noted, these features may include the year group, their gender, their ability for example whether they are high, mixed or lower attaining groups. Intra-action also includes the features of the setting, which may include the type of environment in which they are being taught, whether this was their usual classroom and how comfortable the pupils were in that setting. The last category within intra-action is that of the product, from the teacher's perspective this will be the learning taking place, whilst from the pupils' perspective it is likely the task they engage with in order to bring about learning. Interactions include the actions and engagement which takes place within the learning environment to bring about learning. This includes the orchestration of opportunities for learning, orchestration by teachers and others, and orchestration by learners. Interactions also include perceived constraints, the structure within which the learning is designed, for example the success criteria of the task and perceived affordances, the potential for learning which exists within the lesson. Finally for this category the goal directed activity or task. The final category for data collection within the ATLAS framework is that of evaluation of product and process, this allows the collection of

data to focus on the reflection-in-action and reflection-on-action, the combination of which results in the knowledge construction aspect of the lesson. The use of this framework, whilst not being used as an analytical framework, allowed the researcher to collect the data in an organised and structured way. This also allowed for greater rigour to be built into the system as for each observation the data was collected in the same way.

The teacher was encouraged to discuss this as part of a post-observation reflective dialogue, to establish the teacher's reflective thoughts on the observed lesson, how it relates to the development of ICT capability according to the personal constructs and beliefs of the teacher, and how it may be adapted or improved for the next observation.

A final interview was conducted to explore whether there had been any changes in the teacher's personal constructs of ICT capability over the period or any changes in their strategies for the development of ICT capability. The teachers were also asked to reflect and evaluate the use of their chosen teaching strategy in the development of ICT capability.

This collection of data took place over a period of nine months, during 2012 as can be seen in the table below.

School	Initial Interview	Initial Observation	Final Observation	Final Interview and Post Reflective Dialogue.
School A	14th March	24th April	29th November	5th December
School B	28th March	25th April		10th October
School C	3rd April	15th April	12th November	17th November

Table 4.1 -Timeline for data collection

The data is drawn from three different schools, each with a differing approach to delivering ICT capability, in accordance with criteria as laid out in the Welsh NCO 2008.

Within Wales all secondary schools are assessed on performance within four categories and then placed in a one of five bands dependent upon how they have 'scored' in this assessment, with Band 1 denoting the highest achieving schools. The categories which are assessed are based on GCSE results, attendance and socio-economic data and whilst this study is concerned with KS3 and not KS4, the information is relevant in giving a contextual background to the school and the subsequent observations and interviews.

The first school, which will now be known as School A, is an 11 to 18 comprehensive school situated within South Wales. There are 76 teachers, of whom 10 are part-time, making a full-time equivalent of 69.5, and a further 54 support staff, a full-time equivalent of 40.4, there is 1 specialist ICT teacher. The school seeks to develop a personalised approach to learning. It strives to be 'a learning community that recognises not only the importance of success in terms of grades and levels but also success in all other aspects of school and wider life.' The school aims to value the richness of the different cultures which make up the school community and see to celebrate and respect these. School A is in Band 1.

School B is an 11–16 mixed comprehensive school in South Wales. The ability of pupils is broadly below average with over one third of the pupils in the current Y7 having a reading age of less than 10 years. Furthermore, almost a fifth have a reading age of less than eight years. This trend is replicated throughout the other year groups within the school with over one third of pupils on average having a reading age of less than 10 years. In addition, standardised test results for each year confirm that, on entry, the pupil profile is below average, while the number of pupils identified as being above average is relatively low - less than 10%. School B is categorised as Band 5.

School C is an 11 to 16 English-medium mixed comprehensive from South Wales. The school has a high proportion of pupils eligible for free school meals; indeed it is amongst the highest in Wales and is significantly above the national average. Pupils at the school represent the full range of ability. With nearly half the pupils having a special educational need of one type or another. The school also has an

enhanced resourced provision for pupils with moderate, severe, profound and specific learning difficulties and some with autistic spectrum disorders.

Analytical Framework.

The analytical framework for the data is the use of activity theory, specifically the use of the activity setting as previously outlined. This framework enables the identification of a number of key aspects of the research. It allows the investigation and analysis of contradictions within the learning paradigm, by comparing the information gained from the interviews with the actuality of the activity as recorded in the observations of classroom practice. When this is linked to the original research questions as listed at the start of this chapter, then the results of this analytical process will help us to understand how the individual teachers of ICT conceptualise ICT capability. The interviews in particular are designed to explore their personal definitions of ICT capability and to evaluate how their classroom practice is associated with this definition. By comparing the information gathered from both the interview and the observations, through themes and activity setting analysis any contradictions which may arise between the teachers' personal constructs and their practice may be evaluated. In order to do this critically it is vital that this qualitative data is handled in such a way that it is rigorous and without bias.

Qualitative data analysis

The key purpose of analysing data is to organise, account for and explain the data. It is important to make sense and to carry out this evaluation in relation to the context and situation in which this data was collected. The way in which the data is portrayed, should be fit for the purpose of analysis (Cohen et al., 2007). In this instance this will mean that the data analysed using activity theory, which is the framework for analysis

One of the primary decisions to be made when ensuring that qualitative data is fit for purpose is to be clear about exactly what the data is designed to investigate. Cohen et al., (2007) highlight a number of purposes in relation to qualitative data including data

which describes; portrays; interprets; generates themes; understand individuals and ideographic features; demonstrates discovers commonalities differences and similarities and explores amongst other. One of the key purposes of this research is to explore perceptions, and evaluate or discover commonalities between those perceptions and practice or indeed to discover differences between those perceptions and practice.

Because the framework for analysis is activity theory (Engeström, 2000b) there was a need to be able to link the mediating factors of the system with this activity taking place in the interviews and in the classroom observation. In order to accomplish this, the data was coded in a thematic way picking out recurring themes. Where possible these themes were linked to the analytical activity system, enabling the construction of the activity triangle. There were some themes which emerged that did not relate to activity theory, particularly from the interviews and these were dealt with through a cross case discussion.

Thematic analysis is a method for identifying and analysing patterns of meaning in a dataset. It illustrates which things are important in the description of the investigation and the end result of the thematic analysis should highlight the most salient meanings present in that dataset. Such findings may include affective cognitive and symbolic dimensions. Thematic analysis is a method of evaluating qualitative data when investigating a specific perception or belief system (Joffe, 2011). A theme may contain something which is directly observable, or it may contain more latent content, i.e., references which refer implicitly to an action or activity or perception. Joffe (2011) believes that when defining a theme the researcher must be specific concerning what can or cannot be coded within that theme, she states that the theme contains both explicit and implicit content, for example when coding an interview response, the hesitations, implicit content, may be as important as the answer itself, explicit content, and that if this criterion of the theme is not specific then the resultant dataset is subjective.

When evaluating and analysing interviews, where there are likely to be open questions resulting in open and varied answers, the use of themes and thematic analysis allows

the analyst to refine a possibly unwieldy dataset to a more manageable and focused study (Gibbs, 2008, Guest & McLellan, 2003) It is therefore appropriate to use activity settings as the unit of analysis, and to use the elements within the activity setting, i.e. that of rules / codes of behaviour; Individuals / groups; community / organisational structures; Community / organisational structures; Roles / division of labour; tools / artefacts and finally the tasks and outcomes. These themes can also be used for evaluating the context in which the data has been collected, considering school, regional and indeed the political influences which may be impacting upon data. According to Yin (2009), this is why the use of case studies as a means of research is so valuable. Case studies allow for dynamic change and the context of the case study is also part of the data. The outcomes within the activity are likely to differ depending on the perspective of the teacher. This means there will be different activity settings for different interviews even though strictly speaking the activity of an interview takes a similar format. As previously stated when coding the data there were other themes running though unrelated to activity theory, and whilst the teachers' perceptions can be regarded as part of the 'object' as stated previously, there is also a need to analyse these perceptions from a pedagogical stance and therefore it would feasible to have a further categorisation, examining the pedagogy used in the development of ICT capability. It is for this reason that ATLAS has been used as a framework for collecting data within observations, in order to recognise the orchestration which takes place to enable the development of ICT Capability within the learning environment. Furthermore any themes which emerge which are outside the scope of the activity setting will be discussed across the three case studies as part of the cross case analysis.

Questionnaire

The questionnaire was distributed at the beginning of the study and was designed to answer the first research objective: that of investigating teachers' constructs of ICT capability at KS3 in Wales.

Prior to the design of the questionnaire it was decided that all the teachers in Wales teaching ICT would be asked about their perceptions of ICT capability. This meant that in order to pilot the questionnaire it would be necessary to use a sample of ICT

teachers who were not teaching in Wales, and for this reason the questionnaire was piloted in England.

In the case of my questionnaire it was largely of an exploratory nature, trying to determine perceptions and feelings of teachers involved in the field. It was not examining test results, or hard facts but was concerned with their perceptions. And whilst the questionnaire is exploratory, the aim is defined; it is to identify the perception of teachers of ICT capability. The questionnaires were sent to every school in Wales both English and Welsh medium schools, in electronic and hard copy format. The questions were designed in order to gain an understanding of the teachers' perceptions of ICT capability. Unlike the case study the aim was not to investigate their practice as well and so the questions were limited to an understanding of ICT capability. The purpose was also to try and establish what elements of the curriculum they deemed as being important to ICT capability in order to try to understand what elements built ICT capability. In establishing these perceptions of ICT capability through questioning all the schools in Wales it is possible to establish the extent to which the case studies are an indication of how ICT capability is perceived in Wales. The population surveyed within this questionnaire was the teachers of ICT throughout Wales. There is no record of the numbers of teachers specifically teaching in ICT in Wales because in some schools teachers with an interest in ICT but who are not Specialist ICT teachers are used in the development of the subject. This meant that it was not possible to send individual questionnaires to the teachers, whether electronic or in hard copy, but these were sent to the ICT departments in the schools with requests that departmental leads would distribute either the hard copies or the link to the electronic version. In some cases this did occur. This was evidenced by multiple hard copies being returned, however due to the ethical anonymity of the process it was not possible to identify either which schools did distribute the questionnaires to all the ICT teachers or indeed any schools who may have had multiple ICT teachers within the department.

Electronic vs Traditional

With increased technological advances over the last 25 years and the availability of the internet for research there has been a growth in the use of electronic questionnaires for the gathering of information. Using an internet search for electronic questionnaire tools for the production of electronic questionnaires revealed 3,640,000 results (Google16/10/2013 11:12) showing popularity in the use of electronic questionnaires. However, the use of electronic questionnaire in academic research is not as simple as merely transferring a traditional paper based questionnaire into electronic format. There are constraints that need to be considered with regard to design, data collections, ethics, demographics and sampling which require consideration.

For the purpose of this study the questionnaire was a means of establishing the personal constructs of ICT capability amongst ICT teachers in Wales. For this reason, when designing the questionnaire there were a number of components all designed with the aim of gaining insights into this perception. The design included attitudinal questions; questions that rated different components of ICT capability and ratings for different software applications used in ICT to attempt an understanding of teachers viewpoints of aspects pertaining to ICT capability. Questionnaires are snapshots in time of the data collected; that is the data collected is accurate at that given time. The data gathering is carried out with the intent of describing what is occurring, and in the case of this study focuses on the strands of the curriculum that the teachers believe make up ICT capability, the software applications which they may use to develop ICT capability and also their attitude to the components of ICT capability. In questioning their attitude to the components there was particular focus on the use of higher order skills, as opposed to the application of software.

A form of cross-sectional questionnaire has been used. In this instance the questionnaire is a means of positioning findings of the case studies within the target population. Initially it was decided that the questionnaire was to take an electronic format, and an online questionnaire was produced with the link sent to all the schools in Wales to establish whether opinions and perceptions emerging from case studies were representative of the nation at large. Whilst Denscombe (2010) acknowledges

that the electronic or internet survey can have advantages such as cost and if the recipient is willing to participate then they can be faster, however he also acknowledges that like postal or more traditional questionnaires any response rate can be influenced by both the visual appeal of the survey and the ease with which it can be answered. With this in mind the questionnaires were designed to be clear and easily filled out through the use of tick boxes. Questions were kept to a minimum and were organised within clear sections. The first section contains a researcher's name and contact details, brief aim of the questionnaire, and an ethical statement. The following sections were concerned with teacher's details such as their position in school the years they have been teaching ICT and which key stage teachers are currently teaching. Subsequent sections, dealt with the perception that teachers had of ICT. These included attitudinal statements, questions about different strands appropriate to ICT, and their viewpoints on the importance of certain software applications.

Denscombe (2010) advocates use personalisation when inviting recipients to answer questionnaires in an attempt to increase response rate. Because the questionnaires were designed with anonymity in mind, it was not possible to personalise the questionnaires in any way. In order to counter an initial low response rate, the survey was repeated, however on this occasion postal surveys identical to the electronic survey was sent in both English and Welsh medium to all the schools in Wales with a further invitation to complete and return in the stamped addressed envelope. The link to the electronic survey was also included in this invitation in order that the recipient could participate through the medium of their choice. By giving the ICT teachers the choice of using electronic or paper format it was hoped that the response rate would be increased. This repetition brought about more responses to the survey, both electronically and through returned hard copy.

One of the disadvantages of Internet questionnaires is that if they exist on open website, whereby any visitor to the Internet is able to access the questionnaire and answer it, any subsequent information may be invalid. In order to ensure that this did not happen within this research the questionnaire was designed in a closed manner and was not published on an open website but was only accessible via individual electronic links which were sent to the targeted sample of individuals. Denscombe

(ibid) highlights other the disadvantages of using Internet questionnaires which include links between Internet access and socio-demographic bias. However, given that the target sample population were all teachers of ICT this was not relevant, in fact it was felt that given their subject specialism they were more likely to be comfortable using the online method than the more traditional postal questionnaire.

Having examined the possible advantages of using electronic questionnaires it was also acknowledged that emails can be more readily ignored and there may be a danger that when emailing the school with the link to the electronic questionnaire this may get mislaid amongst the plethora of emails which schools receive as part of their daily business. With this in mind it was decided that copies of the questionnaire in hard copy would be sent to the school for dissemination to the appropriate teachers, however there would also be a link to the electronic format if the teacher preferred to engage with the questionnaire electronically.

Sample

Having decided on the purpose of the questionnaire, the next was to examine the sampling area and where to pilot the questionnaire. Because all the schools in Wales were being targeted for the research, it was necessary to pilot the survey in a different location. This was carried out using a number of schools in England. The purpose of piloting the questionnaire was to establish any flaws in the survey so that they could be addressed before they were ultimately sent to the recipients in Wales.

Within the questionnaire there was an opportunity for participants to state whether they would like further involvement in the study. This enabled the selection of willing participants for the case studies. With the contact particulars the teachers were approached and using local knowledge was able select three schools all with a different approach to teaching ICT.

It was not possible to accurately define the sample size due to the fact that there is no accurate register of teachers teaching ICT in Wales, it is only possible to say that all schools within Wales were invited to fill the questionnaire. Out a total of 224 schools, 140 questionnaires were returned either in electronically via the survey site or in hard

copy format. Whilst anonymity was maintained respondents were asked to state their Local Educational Authorities (LEA's) and it was established that these included a majority of LEA's across the whole of Wales. There was an ethical statement included assuring their anonymity but there was an option of them submitting their addresses if they wished to be involved in any further research. This is in accordance with BERA guidelines and the ethos of informed consent.

Distribution

Having chosen to use an electronic questionnaire in addition to the postal survey, the site of choice was Surveymonkey.com. There were a number of reasons, the recommendation of a colleague, and the ease with which the formation of questions could be manipulated, the ability to build complex attitudinal questions, yet still maintaining a minimum of questions, in order not to put off any participants.

The questionnaire can be found in Appendix I. The questions used were mainly of a closed nature with a proportion of attitudinal questions to try to achieve answers to the perceptual nature of the research
The Questionnaire started by asking questions about the participant, such as

- Their position in the school

- How long they had been teaching

- ICT qualifications

- First degree subject

- What they taught ICT

These were in the questionnaire in an attempt to position the research. For example an ICT specialist may have a differing perceptions about ICT capability to a non-specialist ICT teacher, likewise someone who has been teaching ICT for a number of years may have differing perceptions to that of a newly qualified teacher. Another question that arose in this area when designing the research was whether teaching at KS4 and or 5 would have an impact on the teaching to those just teaching at KS3.

The form of answers was kept as simple as possible with the use of mainly check boxes with flexibility added in the form of a free text to cover eventualities which the tick

boxes may have neglected. The rationale for this was that by keeping it simple there would be a greater chance of completion (Oppenheim, 2001), also be pre-defining many of the criteria the analysis would also be simplified. However due to the evolution of ICT as a subject, many teachers may have a different earlier subject, or variation in the type of ICT/ computing/multimedia degree, and so free text boxes were used for flexibility.

The next question was attitudinal in its approach with a Likert scale answer with grading of

- Strongly Agree
- Agree
- Unsure
- Disagree
- Strongly Disagree

The question was asking to agree with a mixture of statements concerning factors or elements of ICT capability that had arisen during the literature review thus far. It was a mixture of positive and negative statements and the aim was to try to understand the teacher's perceptions of what constitutes ICT capability.

Questions 7 was aimed at establishing the participants' thoughts on which were the most important strands of the KS3 curriculum, keeping in the strand of "Control", which still exists in the English curriculum but in the Welsh revision has moved to the design and technology curriculum. At KS3 there is a presumption that many teachers may believe that control is essential as an introduction to computing and programming in preparation for higher levels of education in the subject. In this instance a rating system again using check boxes was used.

Question 8 was similar in context, however instead of concentrating on the strand of the curriculum, it concentrated of the applications they thought were important in teaching the skills and concepts required to achieve ICT capability at KS3.

Question 9 was an open response asking if there was any aspect that in their opinion should be included in the curriculum which currently was not and why, and finally an opportunity for anyone to input their email if they wished to participate further or receive copies of the ultimate findings. This question was used to inform the selection of the Case Study schools.

Attitudinal Questions

Attitudinal questions are formulated in such a way that the research is able to discern the attitude of the participant, but what is attitude? Allport (1935) defined it as being:

> "A mental state of readiness organised through experience, exerting a directive or dynamic influence upon individual's response to all objects and situations which it is related"
> (Allport, 1935, p. 810)

The key themes to this definition are clearly, organised experience and influence, where the experience influences actions in an organised manner.

A further definition is supplied by Riley
> "a predisposed response to situations, objects, people, other self-defined areas of life. It has both a perceptual and affective component. The latter produces a direction in the attitude – positive or negative. This is turn can influence the perceptual element – we see what we want to see"
> (Riley, 1996, p. 75).

This definition implies elements of feeling and evaluation attached to attitude and empowers those elements with the ability to influence how we see things. This aspect can lead us to believe that this will also impact upon behaviour.

Attitudes also have internal elements which can be categorised in three ways. These components are:
- *"Cognitive* – the flavour is 'the way we see it' it is concerned with the object in terms of attention to it, awareness, learning about it, understanding it –

placing it in relation to other entities. Looking at consequences, causes, outcomes, objectives

- *Behavioural* – the flavour is one of action, it relates to any action implicit with perception of the object and sees it in terms of behaviour, intention and action. Looking at teaching, understanding, demonstrating, practising.
- *Affective* – the flavour here is to like/dislike it is concerned with the object in terms of interest, evaluation, feelings towards it and belief in."

(Walker & Augoustinos, 2006, p. 115).

The relationships between these three elements are neither static nor always equal but vary according to circumstances. Circumstances which can influence the elements to the greatest extent are:

- How much the person already knows about the given object
- Whether or not the person can clearly identify the object
- How much interest they have in the object.

These factors need to be considered when designing the attitudinal questions and in the analysis of the results. In designing this questionnaire attempts were made to maintain a balance between affective, behavioural and cognitive questions.

However the questionnaire is more about perceptions than attitude, and this can be argued as being similar and natural as the cognitive aspect will influence the outcome of the question and the perceptions of the participant.

Pilot

Prior to disseminating the questionnaire it was piloted and the findings analysed. This was not to get a feeling for the ultimate findings but to establish that the questions designed were giving the depth of response required to answer the research. This is imperative with attitudinal questionnaires as there is a need to establish whether the attitudinal element of the design is being understood by the participant.

Attitudinal responses are dependent on the three elements outlined earlier. The cognitive element is concerned with how we see the object, and as such the participant will need to understand what is being asked to be able to see the object and know how to place it in relation to the other aspects. Attitudinal questions are hard to design and the analysis of the pilot was used to refine and amend questions. In the case of my pilot questionnaire there was one sub question of the attitudinal section that was unanswered by all responders - I drew two conclusions either it was misunderstood, or there was no clear opinion to give, either way the question was subsequently re-designed in an effort to achieve a response.

I had 18 responses to my pilot questionnaire and although this was a small response, the analysis was focused on the form of questioning and response rather than empirical data collection so this was considered sufficient. The pilot was analysed with this in mind and subsequent alterations made before dissemination to the target audience.

Ethics

According to the most recent recommendations regarding an ethical approach when researching in education, particularly in schools (BERA, 2011) all the data collection has been carried out with complete transparency and in the best interest of the subjects involved. Permission for conducting the research was actively sought from all parties involved at all levels, including Head teachers and participating teachers. Ethics approval was sought and granted following the procedures of the University in force at that time. Pupils were not involved in the research other than their presence within the classroom during observations. The observations of teachers' practice did not alter in any way from strategies within the classroom the pupils were used to experiencing. Pupils' opinions were not sought neither was any discussion undertaken with them during the observer's time in the classroom. The whole of the research has been outlined, anonymity preserved, and any party has had the option to withdraw at any time.

The ethical guidelines of the British Educational Research Association (BERA 2011) suggest that from an ethical stance the researcher has a number of responsibilities which must be met, including that all participants give informed consent and that this consent is not in any way coerced. This was achieved in two ways, the first was with the all Wales questionnaire, where there was a clear statement at the beginning of the questionnaire which was the same for both the traditional postal questionnaire and the electronic questionnaire giving a summary of the intent and purpose of the research. These questionnaires were also anonymous and if the participant did not wish their views to be used they did not have to fill in the questionnaire but simply ignore the request. The second form of informed consent was given by the schools participating in the case studies, this was carried out by informing a number of teachers of the intent and purpose of the research and a request via the questionnaire that if there were any respondents who wished to be involved further in the research to indicate within their answers. This resulted in a number of ICT teachers indicating that they were interested in the research. Some indicated that they would appreciate seeing the results of the research once completed and published whilst a small number indicate that they wished to take an active role. It was from this group of respondents that three schools were selected.

Having selected the schools as discussed in the paragraph outlining sample, the teachers involved were approached and the research was discussed openly and frankly to establish if the volunteer teachers had a clear understanding and were able to give informed consent. This was then extended to the head teachers to request permission to conduct research in their schools. Written consent was taken at each point. Examples of these consent forms can be found in the appendix II

There was an open and transparent discussion between all the teachers volunteering for the research. This enabled any of the volunteer teachers to ask questions concerning the research, in also allowed the researcher and teachers to discuss how reflective process built into the research design might impact on their classroom practice. It was in this discussion that the relationship between researcher and participant was also established. This included the stance of observer that the researcher was going to take when recording classroom practice, and the format that

the interview was likely to take. At the same time it was made clear that all data would be kept anonymous and that any of the participants would have a right to withdraw that they would be able to initiate at any time. If this right to withdraw was initiated by any of the teachers or schools involved then any data pertaining to them would be returned or destroyed.

There were no incentives given to any of the participating teachers in this research and every effort has been made to maintain the anonymity of both the participants and their associated schools within this research. Furthermore ethical approval was obtained through the university according to their policy and procedures as discussed above.

Summary

The methodology is socio-cultural, using Cultural Historical Activity Theory as an analytical framework, and is of an interpretivist nature in as much as the data collected and analysed allows for the interpretation of knowledge at that moment in time. Case studies were used in order that the full context of each case could be used to interpret the findings in such a way as to engage with not only the questions under investigation but also the whole social and cultural environment which surrounded the research. The data collected, in order to build the case studies, included interviews and observations of practice focusing on individual specialist ICT teachers from three schools. The schools were picked from volunteers and the researcher used local knowledge to investigate schools with clear differences in their practice. Data collection was carried out allowing for a cycle of interviews, observation of classroom practice, post reflective dialogue, further observation of classroom practice and a final interview. This model of data collection was designed to allow for any change in either perception or practice to be detected.   The research was conducted in accordance with BERA (2011) guidelines as outlined in the paragraph above, and finally the research design was conducted in a cyclical fashion using: interviews; observations; teacher reflection, a repeat of the observations and a final interview. Opportunity for teacher reflection was used so that teachers could reflect on their practice in an

attempt to highlight any changes in practice or perception which may have taken place over the course of the study.

Chapter Five Quantitative analysis, CHAT Analysis and Findings

Introduction to Quantitative analysis

In order to answer the first research objective, "To investigate teachers' constructs of ICT capability at KS3 in Wales", a questionnaire was sent to all the schools in Wales, through the mediums of both English and Welsh in both electronic and paper format. In order to ascertain what those constructs were, the following chapter details the analysis carried out on the returns from that questionnaire. First, the perceptual aspect of the questionnaire was analysed, the second level of analysis was to explore any differences between the respondents' views according to their background. For example, do their years of teaching ICT or whether they are specialist or non-specialist ICT teachers or whether they are in a senior position within the department have an impact on their opinions or constructs of ICT capability?

However there was little or no clear evidence which supported the theory that the level of specialisation made significant difference to the way in which the questions were answered. This may be due to the way in which the questionnaire was designed and should be recognised as a limitation of the study, it may have been more appropriate to carry out the questionnaire after the collection and analysis of the qualitative data, in order that the questionnaire became more relevant to the overall study. The detailed analysis of the questionnaire may be found in Appendix III. A summary of the results follows here:

In summary, there was a consensus of agreement with a number of statements and disagreement with some others. The agreement centred on aspects such as the skills within ICT capability, *"Technical ICT skills are essential building blocks for developing ICT"; "ICT capability requires knowledge of the correct software package for each task"; "Problem solving is integral to ICT capability"* and the use of conscious thought implying the use of higher order metacognitive thinking skills. Whilst there was a disagreement with the statement, "ICT is just a tool for carrying out work in other subjects". We may infer from these results that there is more than one component to ICT capability. There may be both higher order skills, required for problem solving component, which are more than just tools for other subject, and technical building

blocks. The agreement with the statement concerning technical skills being building blocks also implies that there is a technical aspect to ICT capability as well. This train of thought is in line with the perceptions expressed within the initial interviews of the case studies, particularly Schools B and C.

There was still more agreement with statements concerning the development of ICT capability. Statements such as *"ICT skills develop with systematic practice"; "ICT skills are best learnt through personal exploration"; "ICT Capability is best developed by pupils practicing in class"* and *"Teacher demonstrations are essential for the development of ICT".* The implications of these statements are that the majority of the participants were of the opinion that not only that ICT was best developed with practice and exploration but in the classroom under the guidance of the teacher. This perception is further supported by the disagreement with statements connected with parental influence, and natural talent influencing the ICT development and a varied response to external exposure to ICT influencing its development.

There was a disagreement about whether coding is related to ICT capability; an aspect traditionally associated with computer science, however proportion of respondents who agreed with .this was a higher than expected and it is possible that this is an early indication of some teachers recognising the possibility of a change within the curriculum. However, when the statement *"ICT capability has nothing to do with knowledge of hardware"* another aspect traditionally associate with computer science, was analysed there was a varied response.

Further interesting points, which emerged from the questionnaire was concerned with the use of peer assessment and paired or grouped working. There was agreement with both these statements and the observations and activity settings present in the case studies highlighted the use of both of these strategies in all three schools . However, claiming the use of peer assessment does not necessarily guarantee the use of effective peer assessment, as it can be used in a superficial format where pupils are only required to recognise the presence of success criteria with limited opportunity to use the analytical or evaluation in the thinking skills associated with higher order metacognition or higher order ICT capability. Indeed the use of peer assessment, which

was discussed as part of the case study analysis in School A tended to be of a superficial nature.

The data was tested to see if the background of the respondent had any bearing on the way they agreed or disagreed with the statements, particularly where they showed a bimodal result. These results were evaluated to determine whether the position the respondent held in the school; specialist or non-specialist ICT teacher and indeed the years they had taught the subject influenced their responses. The years teaching appeared to have the biggest impact however that impact was small in all cases according to the effect size generated. There are a number of suppositions that may explain this particularly with the lack of impact being an ICT specialist had on the responses. The variation in responses which depended on the years teaching experience the respondent had were that in the case of the statement *"ICT concepts are often ignored when teaching ICT at KS3"* those with the lesser experience were more likely to disagree with this statement than the teachers with ten or more years' experience. This indicates that those teacher with ten years or less experience were more likely to think that the concepts where not ignored when teaching ICT at KS3 implying that they are teaching concepts. The supposition is a continuum with ICT capability consisting of tools of the software applications and higher order metacognitive skills at one end and ICT capability being restricted to the tools of the software application at the other end. This analysis implies that teacher's with less than ten years' experience place ICT capability closer to the end of the continuum associated with higher order skills than that associate just with the software tools.

Similarly analysis of *"ICT capability requires knowledge of the correct software package for each task"* the Mann Whitney U test indicates that those teachers with ten years' experience or less have a stronger agreement with the statement. The developing knowledge of specific software applications indicates that it is possible to distinguish between packages and therefore be able to use the appropriate software for the tasks. This takes conscious thought to make that choice and as such implies that ICT capability has the higher order metacognitive skills as part of its components.

This also puts their perception of ICT capability closer to the end of the continuum associated with higher order skills than that associated just with the software tools. Interestingly this result was repeated when the analysis was carried out to see if the position in the department had an impact on the responses given by the respondents. The result indicated that those who were an ICT co-ordinator or Head of Department, had a greater level of agreement with this statement, indicating that their perception was placing ICT capability at the higher order metacognitive skills end of the continuum.

However when applying the test to the following statements, that of *"Teacher demonstrations are essential for the development of ICT"* and *"Problem solving is integral to ICT capability* "the result were less obvious.

"Teacher demonstrations are essential for the development of ICT" The implication here is that those teachers with less than ten years' experience have a greater number expressing that they "Strongly Agree" with the statement, however those teachers with ten years or more experience have a higher level of "Agreement". This indicates that whilst agreeing with the statement the teachers are split in their level of agreement. This would imply that the teachers used demonstration as a way of developing ICT capability. Similarly, to the previous statement, when analysing *"Problem solving is integral to ICT capability"* the variation shows a split in the level of agreement, however the majority of teachers agreed or strongly agreed with this statement. Once again this places ICT Capability towards the end of the continuum of perception, which links it with higher order skills.

Conversely when the statement concerning originality was analysed the results clearly shows that the key difference between the two categories is the proportion of teachers who had been teaching ICT over years felt that originality was important, however those teachers who had been teaching ICT 10 years and less indicated that a higher proportion were in disagreement. The indication in this case is the opposite of the previous statements discussed. Before equating these results to the continuum outlined previously it is helpful to consider the term Originality. Originality is generally linked with creativity, and both of these attributes are closely associates with

metacognitive thinking skills. Thus the result implies that those teachers with ten years or more experience who agree with the statement place perceive ICT capability to be closer to the end of the continuum associated with higher order skills than do the teachers with less experience. Previously, particularly in the first two statements discussed this is opposite where the teachers with less experience place ICT capability closer to the end of the continuum associated with higher order skills, than those teachers with more experience.

The last Mann Whitney U test, to be carried out, was concerned with the teachers' perceptions of the clarity of ICT capability within the KS3 curriculum. In this instance the implication is that those with ten years and more experience have a greater level of disagreement with the statement. This may imply that they are more used to the vagaries of the curriculum as outlined in the literature review and their experience allows them to teach the appropriate components for ICT capability.

It could be expected that there would be a difference in the responses as subject knowledge can have an impact on the pedagogical knowledge within a subject (Shulman, 1987). This lack difference between the way specialist teachers of ICT and non-specialist teachers of ICT answered somewhat disagrees with the model. However, one supposition to answer this may be that the relationship between the non-specialist teacher and the ICT department may be such that the subject knowledge and pedagogical knowledge is on par with that of a specialist teacher; however there is not the data present to analyse if this should be true.

The teachers' perceptions of the various components of the curriculum indicated that when rating the strands of the curriculum, the two which were perceived as being of most importance were that of communication and e- safety. This is perhaps not surprising, given the development in Web 2.0 technology, the predominance of the internet within popular culture, and the requirements within the curriculum to teach e-safety. When examining the applications (Figure 52) which they considered important in the development of these strands the highest rated were: the Internet, once again followed by spreadsheets, and word processing. Programming was rated as being the second least important, and as stated earlier was higher than expected,

which may be due to the influence of change occurring in England at the time of data collection. A full breakdown of the analysis of the quantitative data can be found in Appendix III.

Introduction to Chat Analysis

Cultural Historical Activity Theory (CHAT) was used as the analytical tool. The overriding question for all three case studies was to gain a greater understanding of the individual teacher's perceptions of ICT capability, the development of which is the core purpose of the Information Communication Technology curriculum in Wales (2008). The different stages of the data collection for each case study have been analysed by building activity settings in order to understand and analyse the qualitative data, so that patterns and differences across the activities can be identified. Whilst the interview is not an activity, the reason for the interviews within the research design is to establish the teachers' perceptions of those activities which relate to the key competencies inherent to ICT Capability and the development thereof.

The following case studies contain the elements or mediating factors of Engeström's triangle. The mediating factors have been described in detail in the Activity Theory chapter, however it is important to note that when associating themed elements with the mediating factors of the activity triangle, the "Task/Outcome" can have more than one perspective and this will depend on the 'Subject' of the activity setting, the group or individual to whom the setting relates. For example, when using the activity triangle to analyse the observations there was the practice of the teacher to be considered which was concerned with the development of ICT capability or the learning taking place within the activity, however there was also the activity of the pupils within the class whose object was the successful completion of the task which may or may not have resulted in the learning or development of ICT capability.
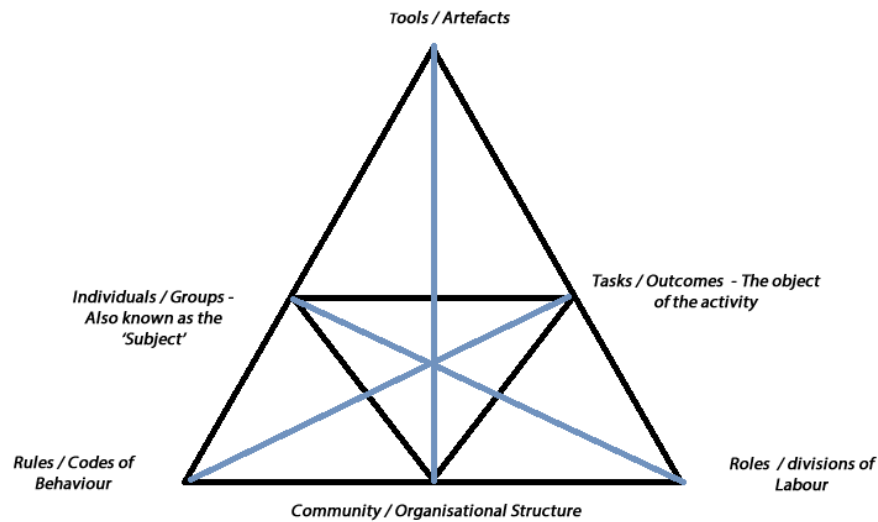
Figure 7 Engeström's Activity Triangle

In the process of the analysis and the building of the case study the data have been analysed independently of each other in that the Interview has been coded and themed as described in the methodology chapter and then the observation and so forth until all the collected data has been themed. These 'themes' were then applied to the mediating factors of the activity triangles. This was carried out by evaluating what the themes were, for example the curriculum was a tool in developing ICT capability and as such was linked to the mediating factor of Tools and Artefacts. Separate activity triangles were built for each set of data, this enabled different sets of relationships to be established and considered.

Descriptions of the mediating factors have been described in the previous chapter detailing activity theory, however in relation to the use as an analytical tool for the case studies it is worth reiterating how these factors fit with the underlying questions. There are a number of themes which have occurred throughout the mediating factors, some of these themes reoccur cross case study, whilst themes specific to each case study may occur in different activity settings or indeed in different mediating factors. This is because the perspective of each activity setting differs. For example in discussion the use of metacognition may link to both the task and outcome of the triangle and a tool and artefact used in the development of the task outcome, however on observation of the development of ICT capability the need for metacognition may also be linked to the rules and codes of behaviour.

Tasks/ Outcomes. Within the triangle this mediating factor is also known as the object, that product which is sought from the activity, in the case of this study this is the development of ICT Capability. Furthermore in this instance whilst with the development of ICT capability may have different foci for the different participants in the setting, because this is directly related to the teacher's perceptions of the development of ICT Capability this analysis does not relate to any perceptions the pupils may have. Other themes which may be associated with this mediating factor depending on the focus of the activity setting may also include use of applications; skills vs tools; independent learning ; knowledge construction; production of the specific task e.g. video; independent learning; thinking, higher order skills and problem solving; goal directed activity; appropriate use; knowledge construction; planning.

Tools /Artefacts. These are likely to include the curriculum; perception of the curriculum – e.g. plans schemes of work; software applications and hardware; language and conceptual understanding. This may also include strategies for teaching used in that particular observation, those these strategies may also exist as a Rule or code of behaviour depending on whether it is a strategy used on a singular or regular basis. This mediating factor is associated with the means needed to successfully support a definition of ICT capability and or in the case of observation of classroom practice the tools needed to successfully bring about the development of ICT capability, and may include: Cross curricular ICT, the curriculum, teachers' perceptions of teaching and education; settings/ environments; differentiation; needs of the learner; worksheets; task aims; task instruction; success criteria; schemes of work; facilitation; problem solving; tutorials and videos; metacognition; differentiation; progression; subject knowledge; constructivist approach; discussion; learning ladders; relationship with pupils; dialogue; questioning; and task discussion.

Individuals / Groups. These may also be known as the subject in more traditional activity theory triangles (Murphy & Rodriguez-Manzanares, 2008), and they describe this element as being 'the individual or group whose viewpoint is adopted'. For the case of this study this is simple. The perception or view point sought is that of the specialist ICT teacher taking part in this study. However, there are different foci

depending on whether the activity setting is concerned with the ICT teacher's personal construct of ICT capability or whether the activity setting is concerned with the teacher's classroom practice and the development of ICT capability. In using activity settings in this way activity settings have also been built from a pupil perspective. This was carried out to see if looking at classroom practice from a different viewpoint supported the perceptions of the teacher. It is worth noting that the perceptions of the teacher are likely to concentrate on the orchestration of the learning and the learning which they wish to take place, whilst any activity setting from the perspective of the pupil is likely to focus on the task being produced rather than the learning taking place to enable that task production.

Rules / Codes of Behaviour. This may include the attitude of the participants, for example the motivation of the pupils. It may also be linked to how the key competencies are perceived as in cross curricular development vs. higher status of discrete lessons; the relationship with pedagogy; any use of specialist knowledge and also any perceptions of the students which may change the status of ICT to a societal role. It is within this aspect of the triangle where the researcher can get an insight into the culture of the activity setting, in that as stated earlier it gives an insight to the status given to ICT and the level of importance attributed to ICT capability. This aspect of the activity setting has the potential for real impact on the outcome depending on the teacher's chosen approach. Furthermore the development of ICT capability through facilitation and stimulation of the pupils' desire to learn and the encouragement by the teacher for the pupils to take control of their own learning through the use of metacognition is closely related to the affordances and constraints and in turn the orchestration of those constraints and affordance put in place by the teacher. Similarly these mediating factors have a variety of themes depending on the perspective of the activity setting and the case study to which that particular setting is attached. These include learning styles; skills and tools; possible misconceptions; allowed use of mobile phones; attitude to technology; constraints and affordances; status of ICT; peer group relationships; seating arrangements; external use of ICT; progression; motivation; teaching pupils to teach themselves; learner orchestration; external change; learner input; teacher input; on-task behaviour; individual learning; exploration; pupil controlled learning; independent learning; motivation ; interest;

"Buddy" system; peer involvement; pupil expertise; lesson structure; class rules; pupil pairing.

Community / Organisational Structures. A strong factor here may be the culture relating to the development of the skills. The environment of both the school and the wider community influence this area of the activity, which comes in the form of change. There is a political drive to change the ICT curriculum, this is already taking place in England and is currently under review with recommendations to Welsh government under consultation. These changes have been prominent within the ICT teaching community and networks within Wales and have brought about mixed debate regarding the need for change within the curriculum and the introduction of computer science or computing at KS3, or the need to maintain the status quo. The political arena and the impact of the changes proposed are likely to vary depending on the culture of the school and the environment in which that school is situated. School culture; political culture; socio-economic culture; ICT developed cross curricularly; master-classes; ability set groups; time table; status of ICT; pupil perception of ICT; peer group; pupil grouping by attainment; school ethos; features of the learner; focus on computer studies; change; essential skills Wales; departmental model; criteria based assessment; change vs. perception of pupil need; ideals; external perception; features of the learner; features of the setting; lesson structure; paired working; environment; trust; SEN, are the themes associated with this mediating factor for the various activity settings.

Roles / Divisions of Labour include those who participate and their level of participation, strategies bringing about the development of the outcome, in this case ICT capability, the key roles are that of the teacher under interview. They also include such themes as Teacher capability; data resources; teachers with the lowest ICT capability liked to the pupils with the lowest attainment classes; approach and materials designed by specialist teacher; orchestration by pupils ; orchestration by teachers; teachers / learners / peer discussion; data; resources; assessment; teachers capability/ pupils capability; teacher facilitation; independent learning; teachers capability; model of pupil involvement; differentiation; pupil participations ; discrete ICT lessons; peer assistance; pupil lead; SEN.

When collecting the data for this analysis, interviews were transcribed and coded into themes, however when recording the data for the observations there was a need for a structure so that the data could be collected objectively. To enable this, the ATLAS framework was used as described in the Methodology Chapter. It is for this reason that when linking the themes to the mediating factors of the activity settings, constructs such as "Knowledge construction"; "affordance" and "constraints" have become evident.

The use of activity theory has allowed the examination of this key question of the perception of ICT capability and the development of it in the teacher's KS3 pupils. This resulted in a number of activity settings, many of which had the same 'Object', the nature of ICT capability and its development, and the same subject; the specialist ICT teacher or on occasion their pupils. However the different activities of interview, observation and reflection had different foci amongst the different mediating artefacts of each activity setting or triangle produced. These different foci may have been from a community or organisational perspective which allowed for a discord in the setting and resulted in contradictions within the whole setting. The result of the use of activity theory in this way has enabled the analysis of the data to discover changes which may have otherwise been overlooked. Activity theory has acted as a means of being able to establish not only similarities and differences within the individual activities or actions, but also between the activities within each case study and further having highlighted those differences to establish how those they may contradict the overall perspective and practice under study.

The analysis works by examining the individual components of the activity system and looks for contradictions which are essentially disturbances within the system; they emerge as discords between the mediating factors of the activity system. In order to achieve this data has been scrutinised for themes which are then aligned or matched to the various mediating factors of the activity triangle. The emerging themes may take the form of the curriculum or for example the teaching strategies. If the interpretation of the way in which the teaching strategies are use do not match the interpretation of the curriculum, then there is deemed to be a contradiction. The importance of these

contradictions is that they highlight an element of the activity which does not support the ultimate outcome of that activity and would indicate a need for change. However that change may not be forthcoming depending on whether the community and subject of that activity system is open to change of learning. (Daniels, et al., 2010; Engeström, 2001). Contradictions exist on a number of levels depending on whether the contradictions are disturbances within a particular mediating factor of a single activity setting, and these are termed "Primary "contradictions; those existing between one mediating factor in a single activity system; "Secondary" contradictions, those contradictions existing between different mediating factors in the same activity system. Tertiary and Quaternary contradictions are those disturbances which arise between historical and concurrent systems respectively.

Having identified these contradictions it has been possible to see if they exist in all the case studies forming a basis for the cross case analysis.

After linking the data to the activity systems in this way, there were further themes which emerged such as the external influences and the curriculum change being proposed for England. The teacher's perceived need of their pupils for particular aspects of learning with the subject, and the idea of a pedagogical tool emerged. This could be defined as a tool designed specifically to support pedagogical action. These alternative or additional themes for analysis will be dealt with separately in a cross case analysis where there will be an opportunity to look for differences and similarities within the three cases. The cross case analysis will also evaluate any similar or different contradictions which may have emerged from the use of activity theory in the individual case studies.

Introduction to Case studies

Interviews were carried out with the specialist ICT teacher in each of three differing schools, this was followed by observations of their practice, a post reflective dialogue and further observation and interview. Because the analysis is primarily concerned with the teachers' personal constructs of ICT capability and their development of that capability, there is much discussion of 'Skills' and 'Tools' and in particular 'Higher order

skills'. For the purpose of the discussion it is important that the terms are defined so that we can establish if, firstly the teachers' perceptions of ICT capability are understood, and secondly what the teachers understand by the use of the words.

In this instance the 'tools' are synonymous with the tools of the software applications used. These will include techniques and routines as outlined by Kennewell (2000) and discussed within the literature review. Similarly the reference to skills, relate to those skills as outlined in Bloom's taxonomy (1956) with skills such as those of analysis, synthesis and evaluation being examples of the higher order skills.

Within Wales all secondary schools are assessed on performance within four categories and then placed in a one of five bands dependent upon how they have 'scored' in this assessment, with Band 1 denoting the highest achieving schools. The categories which are assessed are based on GCSE results and attendance, and whilst this study is concerned with KS3 and not KS4, the information is relevant in giving a contextual background to the school and the subsequent observations and interviews.

During the time of the data collection there had been a speech by the then Minister for Education in England recommending the inclusion of and specifically 'coding' into the National Curriculum, and advocating the suspension of the curricular orders of the time. This change had been influenced by industry and The Royal Society (January 2012). This was later supported by the Welsh Education minister, the result was that in the external environment there was much debate and uncertainty concerning the future of ICT as a subject within the national curriculum. In England ICT was suspended from the national curriculum, whilst a review took place. A new program of study, now called 'Computing', incorporating elements of both information communication technology and computer science was proposed for commencement in September 2014. In Wales a review was commissioned which was published in September 2013, this has been opened for comment, however the process has been overshadowed by a complete review of the curriculum in Wales. The result of this has been possible uncertainty of the future of the curriculum amongst teachers in Wales together with wide ranging debate over the efficacy of the inclusion elements of computer science and programming into the curriculum at this level.

School A Case Study

School A is an 11 to 18 comprehensive school, the proportion of pupils with special educational needs (SEN) approximately one quarter of the pupils within the school. Around one fifth of the school's pupils are from a minority ethnic or mixed race background. There are 76 teachers, of whom 10 are part-time, making a full-time equivalent of 69.5, and a further 54 support staff, a full-time equivalent of 40.4, there is 1 specialist ICT teacher. There are currently 1,213 pupils on roll, including 230 in the sixth form. The percentage of pupils entitled to free school meals like those with special educational needs is approximately a quarter of the school, which is significantly higher than the Welsh average secondary schools. To that end, the school seeks to develop a personalised approach to learning. It strives to be 'a learning community that recognises not only the importance of success in terms of grades and levels but also success in all other aspects of school and wider life.' The school aims to value the richness of the different cultures which make up the school community and seeks to celebrate and respect these.
School A is situated in Band 1.

Within this school the ICT was delivered to the whole year group at once through a series of *"Master - classes"* lasting between 1 hour and 1.5 hours each morning throughout a week, followed up by workshops set by attainment for the rest of the scholastic day. The master - classes were delivered to the whole cohort as a lead lecture by the ICT specialist and follow up workshops by the specialist ICT teacher with a number of non-specialist teachers interested in technology. There are as such no discrete ICT lessons for KS3 other than those given in this format once a year.

The Initial Interview Activity Setting

When discussing the nature of ICT and trying to establish the teachers perceptions of ICT capability in school A the key themes that emerge appear to exist on two levels those which are concerned with the operation of a specific application *"this Microsoft application process that we're going down in our current curriculum"* (Appendix IV School A 1 II:20) and on another level those competencies which are concerned with the use of higher order skills and the concepts existing within ICT, e.g. *"increase capability by working at higher order skills and teaching not just skills but the content*

behind it". There was also an allusion to the need for metacognition within ICT capability. One of the other aspects which dominated the discussions was the need to match ICT capability with those needed within the socioeconomic global arena and particularly for industry and employability *"wanting extra skills in industry"* (APPENDIX IV School A 1 II:18)*.* However, there are apparent contradictions between the two interviews.
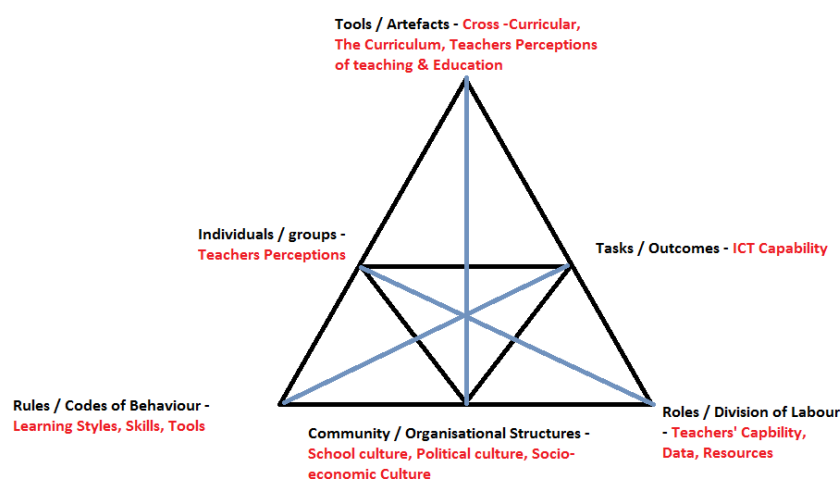
Figure 8 Interview analysis

Tasks/ Outcomes. Given that the outcome is the teachers perceptions of the ICT capability, when asked to define these skills there is a feeling that these key competencies or skills are synonymous with the tools used to operate the various applications, however later in the dialogue there is reference to *"to increase capability by working at higher order skills and teaching not just skills but the content behind it"* and again later to *"higher order "*skills*; "Problem solving that goes with it"*; *"need to understand*"; *"The concepts behind"* and *"Need to develop both on knowledge base and conceptually*". All this leads to an interpretation that the teacher perceives ICT capability as having a number of facets, some of them include the application of the tools within the different software applications but the other elements or facets of ICT capability include the use of the higher order skills, the conceptual understanding.

Tools /Artefacts. During the interviews the teacher discussed the particular method of developing the key competencies within their school and felt it aided the students at KS3. Within their school they develop the competencies predominantly through a cross curricular approach, but with a week a year per year group where there is an intense

course of ICT. *"Different approach - focus on skills which they have to repeat those skills through ICT & cross curricularly"; "The tools are built up in the specialist weeks and then the other subjects can use those skills in their subjects."*. It was felt that the ICT curriculum is currently is not motivating enough for the pupils and that their approach to the curriculum is more motivating for the pupils in their school. *"that the current ICT is demotivating for the kids"; "move away from the boring routine of regular classes and do cool stuff with ICT."; "I believe our pupils are much more enthused doing the subject how we do it than they would through normal discrete teaching"*

Individuals / Groups. In this case it is the view of the individual teacher. Within the system being discussed the teacher is an ICT specialist who designed the unique approach to developing ICT competencies used within the school. Whilst in this case because no other opinion is sought there is unlikely to be contradiction, it may be useful to note that there is likely to be a degree of bias.

Rules / codes of behaviour. Whilst the interviewee had expressed a belief that this method suited her pupils *"our pupils are much more enthused doing the subject how we do it"*, from a status point of view this method implies that the subject is not held in the same esteem as other subjects afforded an hourly lesson a week. This is also supported by the way in which the workshops are led, with the most able being supported by the ICT specialist and the least able supported by the non-specialist with the least subject knowledge. *"It works very well here because the curriculum is the way it is and it enables us to use non-specialist"*.

Community / organisational structures. The current review of the ICT curriculum by the Welsh government is an element of the external community which has influenced the perception of the ICT Capability within this study, in that in the beginning there was a clear focus on skills and tools with an acknowledgement of higher order skills as recognised under the tasks and outcomes, however here there is more of an emphasis on the skills needed for a socio economic view point with allusions to industry and the world of work. *"Need to look at what skills they need in the wider world to know what they will need at schools"; "Games design, new technologies, multimedia developing*

their own apps, crucial for going into an office job or into an industry job all relative to what they are actually doing in schools," . All these comments can be linked to changes emerging in the external environment of the education system within England and Wales.

Roles / Divisions of Labour. In this case the themes are the strategies bringing about the development of the product, in this case ICT capability. The key roles are that of the teacher under interview and her 'team' of non ICT specialist teachers who help facilitate the workshops within this system. The key theme relating to this in the initial interview arise from resourcing, or the lack of resourcing in regard to specialist teaching, *"it has all been integrated into non-specialist,"* and *"moved to the cross curricular areas"* . There is also a link here to the teacher's perceptions of the status of ICT in that there is reference to the ICT capability of the teacher and the development of ICT capability within the pupil, however it is contradictory in nature. *"Pupils do not get the highest levels in KS3 with non- specialist teachers."* and also *"The level of the teachers ICT capability does affect the level"*, and yet apart from the top set of the year for one week of the school year ICT capability is developed by non-specialist teachers.

Development of ICT Capability - initial observation

When analysing the activity within the classroom there are at least two different foci, with corresponding activity systems taking place; that of the teachers where the product is likely to be the development of the ICT capability and the learning that they wish to take place and that of the pupils. Within the activity setting of the pupils the product or object of the system is likely to be different, in that they are less likely to recognise the development of ICT capability as the objective, but are more likely to be concerned with the successful completion of the task whether it be the production of a movie, or a presentation.

It is for this reason that when analysing the observation of classroom practice, there will be two activity settings, which will be examined: that of the teachers, where the object of the activity, also known as the task or outcome of the activity, will be the development of ICT capability, and that of the pupils where the focus of the setting is likely to be task based.

Teacher's Activity Setting
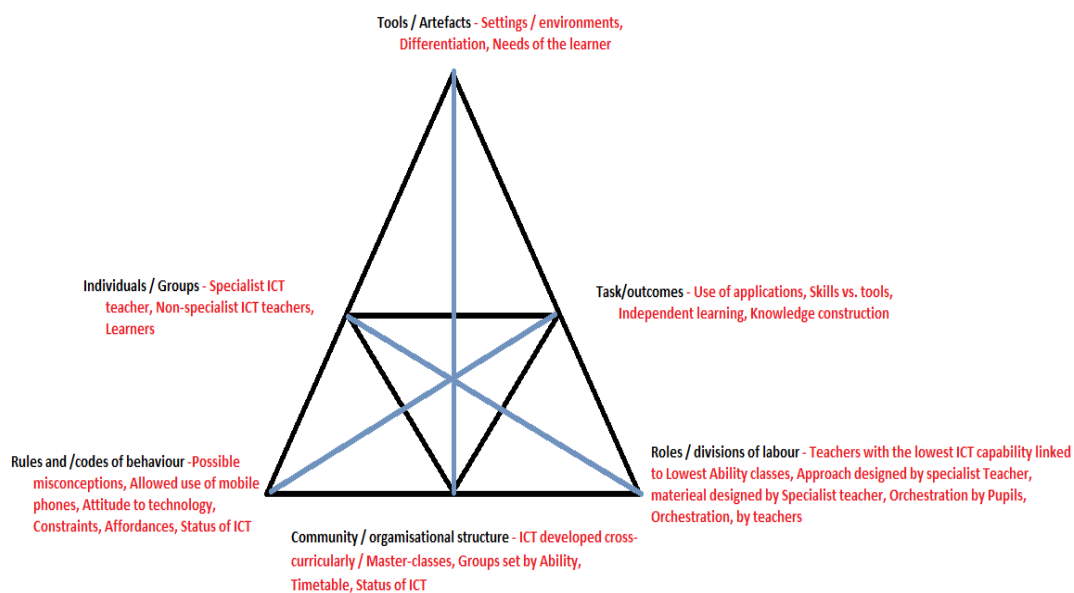
Figure 9 – Initial Observation – teacher's activity setting

Tasks/ Outcomes. The object of this activity setting is akin to the activity setting derived from the interviews above and is focusing on the development of ICT capability, however, in this instance the observation showed that there was a strong emphasis on the use of the applications associated with the tasks. Both the master -class and the subsequent workshop concentrated on what certain tools within the application were for and what the subsequent effects were. The product here was task based, with task criteria and expected outcomes shared and reinforced with the group. During both 'master-class' and the workshop based recap and exposition there was an absence of the higher order skills but the sessions were based on the use of the tools of the software, as such the likely outcome is going to be tool based. It may be quite polished depending on the individual skills and creativity of the pupil; however evaluation and reflection is likely to be absent.

There was evidence of a construction of knowledge to a degree, certainly by the end of the observation, the pupils appeared more competent in the use of the particular software under investigation, however. This must also be viewed in light of the fact that they were a high attainment set and as such it would be expected that by year 9 they take some responsibility for their own learning and are able to orchestrate their

own affordances and constraints in the pursuit of the learning object, that of producing a movie trailer. This is likely to present an internal contradiction within the triangle in that the learning objectives and thus the object of the activity according to the specialist and non-specialist ICT teachers are the understanding of communication and the concepts of 'Audience' and 'Purpose'.

Tools /Artefacts. The initial observation was of a master - class and lesson which concentrated on the strand of the KS3 ICT curriculum "Communicating Information", and the media for implementing this was the production and editing of a video using Serif Video Plus.

This was not a typical week, or indeed a typical lesson; there were two settings: that of the main hall where all pupils were seated and listening to the lead teacher, and a variety of classrooms with IT capability. The class observed were situated in the IT capable portion of the library for the workshop.

Individuals / Groups. The individuals and groups consisted of the lead specialist ICT teacher, the non-specialist ICT teachers, who were supporters of technology within the school, but apart from the master - class weeks were not involved with the development of ICT key competencies apart from on a cross curricular basis. There were no learning support assistants present in the group observed, and the pupils were a top set year 9. The attainment sets were formed from data of Attainment and attainment provided to the specialist ICT, however it is the viewpoint of the specialist ICT teacher which is adopted for the purpose of this activity setting.

Rules / Codes of Behaviour. The motivation of the students when observed was high, and this may be due to the perception that this was not an ordinary week of lessons. The theme was 'Harry Potter' and whilst now this may be a little dated, at the time of the data collection the final in the series of films was still current. The operational delivery of ICT within the system again leads back to the isolated occurrences of specialist delivery, and as such the subject may be perceived as a tool rather than a subject in its own right. There may be a degree of misconception brought into the lessons which will need correcting due to the pupils' use of ICT outside of the

classroom. There is a culture within the school of pupils being allowed access to mobile phones within the school day, if not within the classroom. Pupils can therefore, operate any of the games or apps within their lunch breaks and free time. This may reinforce the perception of ICT as a tool instead of a subject.

Community / Organisational Structures. The learners are the whole of year 9. These are set in attainment groups; however there is still a degree of mixed ability within each set. The degree of autonomy of learning is dependent on the overall attainment of the group and the confidence that this attainment brings. Therefore this autonomy is likely to decrease as the needs of the learner increase in the less able groups. The observed group was 'top set' and as such high attainment; this group had the confidence to explore the tools of the software independently and had developed clear ideas about how they wished their finished product to appear. Due to the lack of status given to the subject of ICT at KS3 since it is not perceived as worthy of discrete lessons throughout the year but largely developed on a cross curricular basis, it is likely that the learners are going to be more concerned with the tools aspect of the subject than the concepts lying behind those tools.

Further, due to the development of the skills largely on a cross curricular basis within the school, it is entirely natural that any conceptual thinking within the subject will take second place to the subject in which the ICT is being developed.

Roles / Divisions of Labour. As highlighted under individuals and groups the key players throughout the observation process were the specialist ICT teacher, the non-specialist teachers and the year 9 pupils. Participation of the members varied because during the master - class portion of the teaching and learning experience as the learning was in the hands of the specialist ICT teacher, there is no opportunity for interaction other than in a superficial way checking the recall of the instructions given. There was also no participation from the non-specialist ICT teachers at this point.

However, in the workshop setting, there was opportunity for greater questioning regarding the workings of the software under investigation. There was also opportunity for the pupils to interact with their own learning as when on task in the

workshop, the learners in the group had a greater control over how they organised the learning of the software, there was evidence of exploration as a strategy and if the effect was favourable, they discussed this with those sitting close by. In this way the learning was shared. Whether this was evident throughout the different attainment groups cannot be ascertained as there was only the opportunity to observe the one group in the workshop setting.

Differentiation was designed for all the groups by the Specialist ICT teacher, and was a combination of electronic resources and worksheets; however this was delivered by a non-specialist ICT teacher who had been briefed by the ICT specialist teacher.

Pupils' Activity Setting
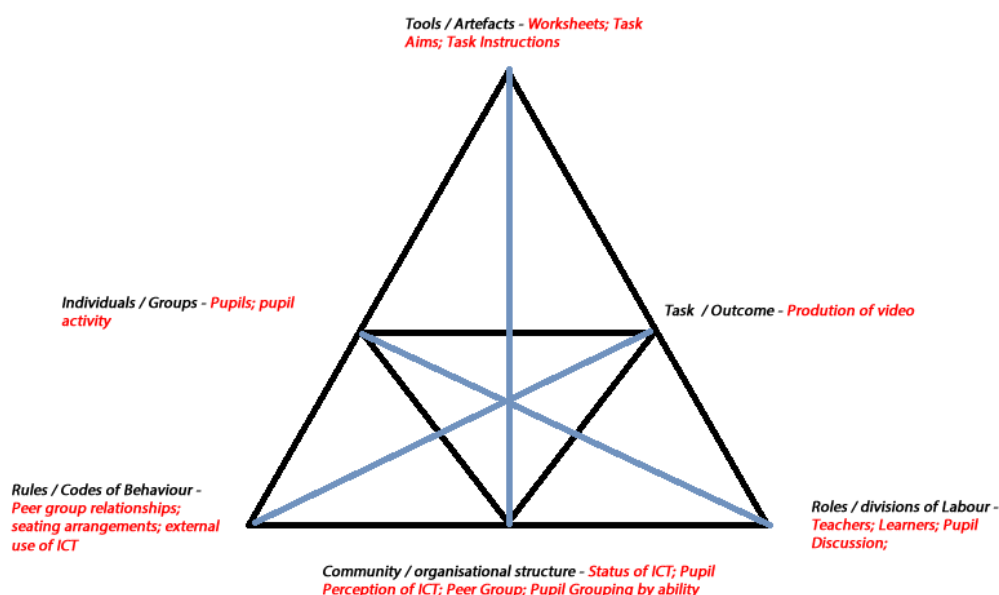
Figure 10 Initial Observation – pupils' perspective

Tasks/ Outcomes. The object of this activity was the production of a movie trailer for Harry Potter in the form of a short video. This is a task based activity with a clear production orientated goal at the end of it. The pupils unlike the teacher are unlikely to see the deeper learning taking place. This is because whilst the aims of the lesson were discussed in the master - class portion of the observation there was no opportunity for reflection from the pupil perspective, and any interaction observed was focused on the pupils' understanding of the task they were to undertake. This was further reinforced in the workshop portion of the observation where the shared objectives were task based as opposed to learning based objectives.

Tools /Artefacts. The tools and artefacts in this instance are the worksheets and task objectives as used and understood by the pupils; whilst this is a slight contradiction to the teachers' activity setting the principle is the same. With the teacher it is the curriculum within the school and the scheme of work and lesson plan used to design the delivery of the lesson, with the pupils it is the worksheet used to support the completion of the task. This will vary depending on the attainment of the pupils with a greater use of differentiation and supporting tools or artefacts with those pupils of a lesser attainment. For those students of a higher attainment within the group observed the tools tended to be orchestrated by the pupils, in that they were using their ability to explore the software applications in order to achieve the task to the best of their ability. However whilst this indicates some use of higher order skills this tended to be superficial, as there was little discussion of why the use of certain techniques or tools improved the ultimate outcome but was focused more on how the tools were used within the application to bring about specific effects.

Individuals / Groups. Similar to the activity setting of the teacher where the individuals and groups focused primarily on the specialist and non-specialist teachers together with the learners, in this instance individuals and groups will be the pupil's and the specialist teacher and non – specialist teacher. However, the relationship between the pupils is also likely to have an effect here as discussion between friend groups and peer groups may affect the foci or practice which will bring about the ultimate production of the object.

Rules / Codes of Behaviour. This mediating factor includes the relationships between the pupils, any seating plans or arrangements and the degree of discussion or dialogue taking place within working groups. During the master - class the pupils were seated in form groups, with the ICT champions, or non-specialist teachers interspersed in order to maintain order and assist in the management of the class. There was little interaction between either the pupils, or the pupils and the specialist teacher. As previously stated the majority of the delivery in this portion was didactic in nature with brief episodes where the understanding of the task was checked. However, when the pupils moved to the workshop area of the observation, the pupils were placed in set

groups by Attainment. This ability had been determined by the specialist teacher and this setting or grouping was based on the use of general attainment data. The pupils within the group which I observed appeared to sit within friendship groups. After the initial reminder of the purpose of the workshop by the teacher in charge the pupils proceeded with their task. There was discussion amongst the pupils, which was permissible and focused upon the use of the tools within the software application and how to achieve desired effects. There appeared to be little or limited discussion about the purpose of the task indicating that the object of the pupil activity setting was the use of tools to enable the production of the video rather than any reflection or deeper construction of knowledge focusing on why these tools or software application may be appropriate.

Community / Organisational Structures. This element of the activity setting deals with the status of ICT which can be related to the importance or credence given to the subject by the greater community within the school as previously discussed from a teaching perspective. Within the pupil activity centre, we cannot speculate as to how they view it as their opinions were not sought, however, the pupils were seen to be motivated and there was a degree of anticipation, perhaps even excitement. This can be attributed to the fact that they were partaking in a different teaching or classroom experience than was the norm.

Roles / Divisions of Labour. Like the teacher observation activity setting, this will also include the learners and the teachers, however again this will include the discussion that exists between pupils. These discussions will assist the pupils in creating their own affordances and constraints and in turn a construction of knowledge. This construction of knowledge, given the focus on the tools of the software applications is likely to be task based rather than knowledge constructed using the higher order skills of justification, evaluation and analysis.

Post reflective dialogue activity setting

On discussion post observation in an attempt to gain the teachers reflections regarding the methods employed in the development of ICT capability two additional themes emerged, that of assessment and that of motivation. The approach was deemed to be

motivating to the children because it was *"Something different not being bombarded with skills all the time"* the teacher felt that this difference assisted the pedagogy of the subject in that it increased the motivation of the learners. This was evidenced by comments such as *"engage with the fun of it all", "They can get to grips with something that they enjoy", "motivated by it and they engage because it is so different" ,* and *"At the end they have awards and things as well."*

On analysis, when looking for contradictions in order to establish if there is a contradiction between the teachers perception of the lesson and the activity itself the main area that warrants investigation is this idea of motivation. The perceptions of the teacher have matched the description of the observation in that in both instances the students are recorded as being active and engaged, however there may be contradictions between the object of the triangle. It has been previously noted that the object for the learner and the object for the teacher are likely to be different in that the object for the teacher is the development of ICT capability and that of the learner is the completion of the task, in this case the production of a video trailer for the up and coming Harry Potter movie.
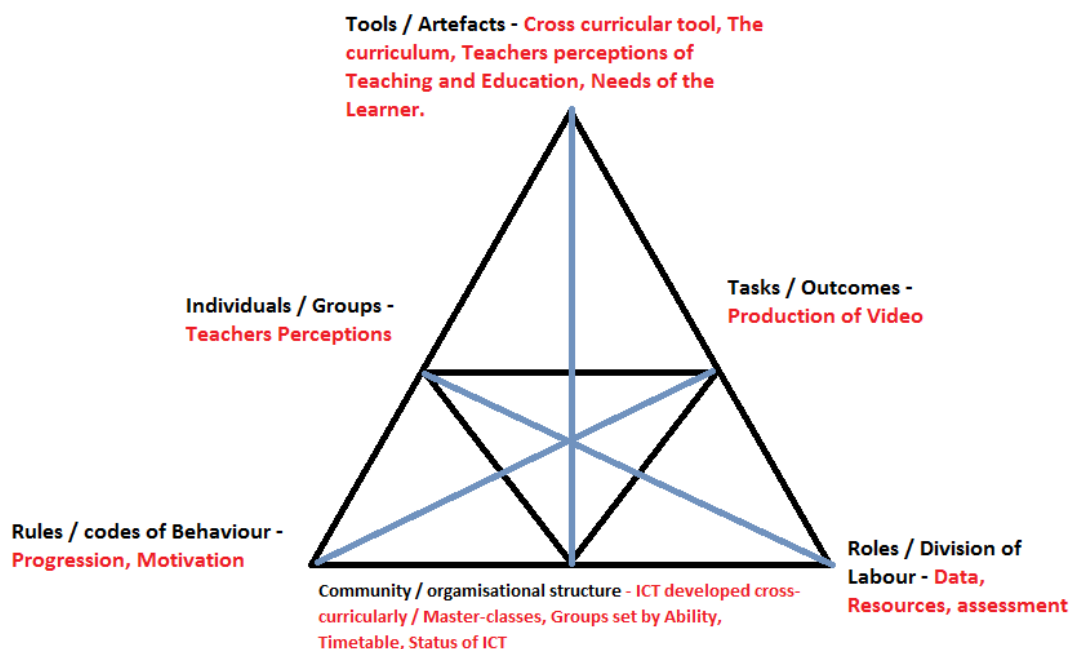
Figure 11 - Post reflective dialogue Activity Triangle

Tasks/ Outcomes. In this instance there is a change to the task or outcome in the mind of the teacher. In the original interview this focus of the triangle is specifically concerned with ICT capability and what that entails, in the initial observational triangle

the focus was the intended learning that was taking place at least from the perspective of the teacher and one might expect that the task and outcome would be reflecting on a similar outcome, however the discussion concentrates on the production of the video, and from this point of reinforces the early stages initial interview where the teacher links her perception of ICT capability to the tools required to operate the software, *"They know how to make a spreadsheet, or video.* Similarly when comparing this element to the initial observation activity triangle where there is a contradiction between Skills and Tools, this dialogue would seem to support the use of Tools to develop ICT capability.

Tools /Artefacts. This elements corresponds closely with the themes which emerged in the initial interview, the cross curricular approach, with the key tools or skills taught through the master - class and practiced and developed on a cross curricular basis. The curriculum itself, the teacher's perception of teaching and learning and with an addition of the needs of the learner, this latter aspect being demonstrated by comments such as *"This sort of style really suits our pupils here"*, and *"Teaching ICT as the curriculum is in most schools can be boring, have to teach the same things year in, year out, but with this you concentrate it all into one week of the year"*. However, the latter statement can also be taken as justification of the way in which School A approaches the development of ICT and may be less about the needs of the pupils but about the political aspects within the school and the possible pressure to deliver ICT in this way.

Individuals / Groups. Similarly to the initial interview, this dialogue is between the researcher and the individual specialist ICT teacher and so this element returns to the perceptions of that teacher. There was no opportunity to discuss this with other non-specialist teachers delivering the other workshops.

Rules / Codes of Behaviour. It is in this element of the triangle or activity setting, where there is major change, and this comes in the form of Motivation and Progression, again it is important to note that the motivation and progression discussed are the teacher's interpretations, as this is the teacher's post reflective dialogue. *"They really engage*

with the fun of it all." and *"I believe yes they can use the skills they learn in this week and use them in other subjects"* respectively.

Community / Organisational Structures. The element here again matches the community and organisational structure of the original interview. This is to be expected given that the organisation has not changed between the interview and this post reflective dialogue. The organisation of the observation was different in that the triangle was focusing on the structures within the organisation. The key aspect here is the status of ICT as this is influenced within the school; the mode of delivery and the lack of prominence of the development of ICT as a specialist subject reduces the status of the subject within the school. This links in with the tools and artefacts element where there is a possible need to justify the mode of delivery. This again supports the view that ICT capability may be a tool rather than a subject incorporating higher order problem solving skills and concepts, in that if it can be developed for one week of the year and supported by non-specialist ICT teachers on a cross curricular basis then there is little need to understand the concepts behind the subject, but there is a need to "*champion*" the use of ICT in developing learning on a more general basis.

Roles / Divisions of Labour. The delivery of the workshops is the responsibility of the specialist ICT teacher and the non-specialist teachers, the design and assessment is the sole responsibility of the ICT specialist teacher, and this is carried out with the assistance of general cognitive data as a reference point for the differentiation materials.

Second Observation Activity Setting
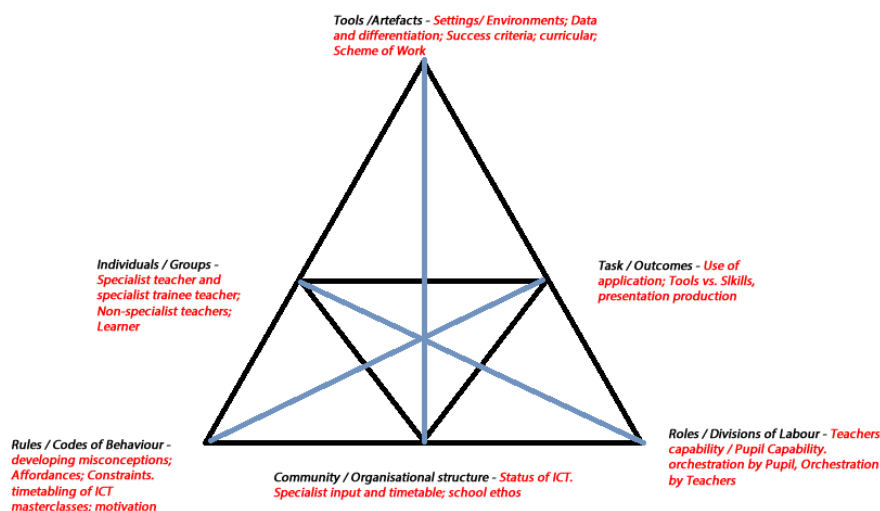
Figure 12 - Second Observation – Teacher's Activity

Tasks/ Outcomes. The tasks and outcomes are very similar to the initial observation in that the object of the activity is the development of ICT capability, through the production of a presentation. There was the same contradiction between the use of tools and skills as defined previously, however as will be seen in the presentation of the 'Tools and Artefacts' element of this triangle there was a change to support the development of the skills, however the ultimate outcome was still task based and did not reflect any great use of the higher order skills which may have been expected.

Tools and Artefacts. The final observation showed an introduction of success criteria for the pupils to work with; this was different to the initial observation, where the task was described in detail but no success criteria given. Like the initial observation the observation included both the master - class and workshop and the mode of delivery was similar in both instances. The master - class was predominately didactic in nature with little opportunity for reflection on-action by the pupils, there was a degree of reflection in-action by the pupils in that they discussed the presentation with their peers and made suggestions for improvement. These discussions tended to follow the rationale of "2 stars and a wish"[1] and as such any reflection tended to be superficial with the focus on aesthetics rather than deep learning. This further reinforces the development of ICT capability as a set of tools where the pupils learn to operate a

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[1] "2 stars and a wish" is an Assessment for Learning technique where pupils can evaluate their own or their peers work. The 2 stars are aspects of the work which they like, and the wish is an aspect which can be improved or added. These aspects of the work under review are generally linked to the success criteria of the task.

variety of software applications, rather than having the opportunity to analyse appropriate application or indeed justification of why the software application is used. As part of the delivery they are informed of the software they will be using and the elements that they must include in the production of the task. Affordances were such that like the previous observation resources were made available to the pupils via a shared drive, though they were able to search for material themselves where necessary. These affordances were also evident in the feedback given by the specialist teacher and specialist trainee teacher also present. However these suggestions tended to focus on the appearance of the presentation as opposed to the concepts involved in the production of a successful presentation or for the communication of information in this instance.

Individuals / Groups. The individuals and groups were again similar to the previous observation, including the specialist teacher, non-specialist teacher, learners and on this occasion a specialist trainee teacher. As with the initial observation there are differing outcomes which are dependent on the activity of the subject or individual or group. For the purpose of this activity setting the focus is on the teachers, both specialist and non-specialist which relates to the object as described. The focus from the learners' point of view would create a different triangle or activity which has been seen when analysing the initial observation.

Rules / Codes of Behaviour. The rules and codes of behaviour of this setting include aspects such as the affordances and constraints which exist within the workshop and master-class, specifically those which have been created by the pupils. Whilst affordances and constraints created by the teachers could also be grouped here, it was felt that these would be influenced heavily by the scheme of work and curriculum used to develop the ICT capability and as such would be viewed as a tool or artefact. These affordances showed a variation from previously in that when the pupils searched for images text or other media using the internet they were required to log a source for that material. This did not add to the construction of capability other than the requirement to cite material used, however it did enable pupils to share their resources with peers and to find those resources easily once again should they need to. Whilst this is an addition to the rules and codes of behaviour of this activity setting

it does not constitute a contradiction, as there is no real impact on the outcome of the triangle.

The behaviour of the pupils had changed since the previous observation, in that during the master - class portion of the observation, there was a reminder to the pupils to be aware of their behaviour within the transition to the workshop and also within the workshop environment (APPENDIX IV School A FO:4). When the specialist teacher was questioned about this there was an admission that this year there had been instances of behaviour issues in the previous lessons. This may be that being year nine, this year would have taken part in a similar week during year eight and perhaps the novelty of the week's events were not so great.

Community / Organisational Structures. There is little change within this mediating factor, the status of ICT within the community of the school remains the same, it is still developed cross curricularly with a week per school year per year group of intense specialist tuition. The ethos of the school, remains that pupils are allowed to use mobile technology of their choice during their free periods and breaks, and this persists as being a tool, with pupils using Apps to enable them to listen to music or play games for example.

Roles / Divisions of Labour. As with the previous observation the roles and divisions of labour were split between the specialist teacher, specialist trainee teacher who assisted the specialist teacher with the 'top set' whilst the remaining groups were taught by the 'ICT champions' who had been selected for their roles this week by their use of ICT within their specialist subjects on a cross curriculum basis. In the same way as the previous observation the 'ICT champion' was assigned to a group depending on their own ICT capability with those non-specialist teachers with the least ICT capability teaching the groups with the lowest level of attainment.

When analysing the previous observation the activity within the master - class and workshop were examined from the angle of the teacher and from that of the pupil or learner. The activity setting of the; learner in this instance was so similar to the activity

setting of the learner in the initial observation that it was not deemed as being necessary to add to the case study.

Final Interview

Tasks/ Outcomes. Due to this being the final interview, the object of this activity setting is once again the teacher's perceptions concerning the development of ICT capability. There appears to be a change regarding what ICT capability refers to in that during the interview when asked about opportunities for the development of the higher order skills and specifically ICT concepts the teacher referred to activities which will *"tick all the boxes"*, this is a little concerning as it may imply that ICT capability and the higher order skills which were described as being part of ICT capability are merely aspects to be ticked off a list and move on to the next one. Further when discussing a 'Skills based curriculum the teacher refers to *"for example in spreadsheets….we are looking at the actual tools within the application"*, and when asked if they felt that skills were synonymous with tools they agreed that they were.

Tools /Artefacts. These like the initial interview focus on aspects such as the curriculum *"we focus on different skills from the National Curriculum"*, and again the approach or curriculum that is used for the development of ICT capability within School A. there is recognition that whilst the teacher is in full support of the system they use in the development of ICT capability *"I have to say it has been absolutely Fabulous"*, *the kids have loved it"*; *" The kids love it they are engaged because it is different , it is a chance to do something different"*, there has also been a recognition that with any change in the external curriculum there is likely to be the need for a change in the way in which the school operates in the teaching of ICT.

Individuals / Groups. Within the system being discussed the teacher is an ICT specialist who designed the unique approach to developing ICT competencies used within the school. Whilst in this case because no other opinion is sought there is unlikely to be a contradiction, it may be useful to note that there is likely to be a degree of bias. There is no change here form the initial interview.

Rules / Codes of Behaviour. Key themes emergent from the interview in support of this were *"And at the lower end there will be greater differentiation and making sure they have the support"* (APPENDIX IV School A 1 FI:4)*; "The tools are built up in the specialist weeks and then the other subjects can use those skills in their subjects."*, *"Demonstrating the skills and then they will then think of looking at skills and take that with them to go into their other classes."; "Their capabilities you see very quickly"*. This is in contradiction to much of the literature especially that of Shulman (1987), who believes that the capability or subject knowledge of the teacher has an impact on the learning experience of the pupil.

The development of ICT capability through facilitation and stimulation of the pupils' desire to learn and the encouragement by the teacher for the pupils to take control of their own learning through the use of metacognition is closely related to the affordances and constraints, and in turn the orchestration of those constraints and affordances, put in place by the teacher.

Community / Organisational Structures. *"ICT is changing"; "Greater programming so we get better industry";* with that change there is likely to be a change in the way in which the model is delivered in School A *"there will be huge effects, it will change everything"*. However quite what that change may be and how it may affect the status of ICT is speculation and outside the remit of this research

Roles / Divisions of Labour. One of the key themes that emerged here was that of resources and differentiation. As stated earlier the higher the attainment the higher the specialism of the teacher supporting the workshops. All the material including differentiation material is designed by the specialist, but this carried out using data and attainment scores as apart from a week a year she does not teach the pupils concerned. *"And at the lower end there will be greater differentiation and making sure they have the support. We have so much data, we don't know how they will react to things, that is one area that is a fast learning curve. Based on global grades, that doesn't show how good they are in ICT, they might have a fabulous grade and not be good or be in the STF unit but be great at ICT."; "Their capabilities you see very quickly. You have to differentiate very carefully, and we will set the classes by achievement";*

"In secondary schools generally it would need more money, for example to have specialist teachers, I mean at the moment I am a department of one"; "We use teachers who have a particular interest in the use of ICT, all of them are masters at using ICT within their own subject area".

School A Scheme of Work

In evaluating and analysing the scheme of work referred to in the previous analysis it would not be appropriate to continue with the use of activity triangles as a unit of analysis because the scheme of work is not in itself an activity but part of the mediating factor Tools and Artefacts of these activity triangles.

The Scheme of work includes task sheets for the movie trailer and for the presentation. There are also sheets allowing the pupils to take screenshots of their work to enable them to be assessed for the Essential skills Wales qualification on which there is a request to explain what the screen shots show. This question is a closed question and would not promote the use of higher order skills of such as analysis, synthesis and evaluation as discussed previously, but is more likely to elicit a descriptive answer which will satisfy the lower order skills as proposed in Bloom's taxonomy (1956). There is also opportunity for evaluation in the final task of the week (see evaluation Harry Potter). This document requests that the pupil evaluates the learning over the week, which would link to a reflection on action and to a deeper construction of knowledge, however the prompts used to elicit the answers are limiting in that they promote answers of a descriptive and superficial nature "*I carry out the following complex searches …… (say which searches you carried out – use your search log in your Harry Potter folder to help you, say that you also used complex searches e.g. NOT/AND/OR".* This reinforces the culture within the school that ICT capability is a tool and that it can be developed without the use of the higher order skills. "*I created a movie to…….* *The purpose of my presentation was to ……. (use your work to remind you, explain what your purpose and audience were",* whilst the question is asking the pupil to use higher order skills in that there is an opportunity to justify the use of the particular software application and to discuss how the use of certain tools, skills or techniques would allow you address the concepts of audience and purpose, the suggested answer "*explain what"* allows the pupil to answer in a descriptive way, had the suggested answer said

"explain what your purpose and audience are and how you have addressed this! There would be greater use of those higher order skills.

Finally when examining the task sheets which went with the scheme and noting that they were also supplied with OCR crib / help guides the task is prescriptive and limiting in its criteria.

Contradictions

Below is a table summarising the contradictions which have been identified within this case study.

Activity Triangle	Type of contradiction	Mediating factors	Location of Contradiction
Initial Interview	Primary	Tools and artefacts	School A master - class / workshop scheme of work vs. national curriculum orders
Initial interview	Secondary	Tools and artefacts / Roles and divisions of labour and the Task / outcomes	Contradictions between a number of the mediating factors of the triangle affecting the teachers perception of ICT capability and its development
Initial observation (Teachers)	Secondary	Tools and artefacts and the Task / outcomes	Contradictions between the curriculum, the NCO and the task orientated learning taking place
Final Interview	Secondary	Tools and artefacts and the Task / outcomes	Contradiction between the task or outcome, which is now tools based and the national curriculum which states that ICT capbility has an aspect within it which uses higher order skills, and problem solving.
Initial and final interviews	Tertiary	Tools and artefacts / Tasks and outcomes	Change in outcomes which in turn brings about the a new contradiction between the outcome and the tools.
Both obserations and initial interview	Tertiary	Roles and divisions of labour, tools and artefacts and the object	The design of the system by the speciaist teacher and the matching of groups with lesser attainment to teachers of lesser attainment and the use of higher order or specialist conceptual learning in ICT capability. Further the scheme of work used and the delivery of it appear task based.
Post reflective dialogue , Interviews and final obervation	Tertiary	Rules and codes of Behaviour and tools and artefacts	Where the use of a differnet curriculum has less of an impact on the motivation, further the use of this different curriculum has a contradiction with ICT capability as including the use of higher order skills
Initial Observation – Teacher activity and Pupil activity	Quaternery	Roles and divisions of labour; rules and codes of behaviour and the object	Within the teachers activity the level of capability of the teacher is matched to the the attainment of the pupil with the specialist teacher teaching the 'topset'. The pupils' activity showed the ability to orchestrate learning .

Table 5.1 - Summary of Contradictions of Activity Settings of case Study A

Discussion of Case A

This study concentrates in not only attempting to establish the teachers perceptions of those key competencies which are inherent to ICT capability, but also on the use of activity theory as an analytical tool in determining the perceptions of the teacher, and further seeing how those perceptions match with the practice in the classroom.

Firstly, the use of activity theory as an analytical tool it allows the researcher to break down a number of perceptions into an activity, using it in this way is an attempt to analyse what the teachers believe they are doing and furthermore it then allows the researcher to make a direct comparison to the activity of developing key competencies in the classroom setting. In both these instances, that of aligning the interviews to activity triangles and identifying key elements from the observation, the identification of the key unit of analysis can be problematic due to the richness of the data collected. This was particularly true when using the observational data in that, when observing the activity of classroom practice, there are a number of possible actions taking place simultaneously, there is the action concerned with the interaction between teacher and pupil; the action between pupil and teacher; between pupil and pupil; pupil and task and possibly most importantly pupil and the desired learning from the teachers perspective. It was this last aspect together with the interaction between pupil and the task, which were analysed for the initial observation. However, the analysis of the pupil's activity showed little contradiction from the teacher's activity that further analysis within the final observation would not add to the case study.

This use of activity theory has highlighted a number of contradictions which warrant further investigation, the first of these are a primary contradiction in the teacher's perceptions of ICT capability highlighted in the activity setting of the initial interview. Within the tools and artefact element of the initial interview analysis the curriculum used by the school is one where ICT capability is developed largely on a cross curricular basis. This is entirely in accordance with the advice given in the NCO for Wales (2008), however, the school uses a system where at KS3 this cross curricular development is supported by taking the pupils off time timetable for one week of the year and giving them 'intense' teaching of the 'skills' with daily master - class and workshops. It can be seen from the scheme of work designed by the school that whilst there is an opportunity for the pupils to consider and evaluate their work, the tools and task

sheets which are given to the pupils to accomplish this do not promote the use of the higher order skills as described by Bloom's (1956). This contradiction can further be emphasised by a secondary contradiction existing within the initial interview activity, where the teacher describes the nature of ICT capability as including the use of those higher order skills previously discussed. If the observation activity promoted the use of higher order skills in this scheme of work this contradiction may have been rectified, however when examining all the observation activity settings we see that the activity in the classroom, from the pupil and teacher perspective support the interpretation that ICT capability is developed by the use of the tools of the application attached to the task within the lesson, rather than any evaluation of analysis of the concepts behind the use of said software application. Further examination of the Rules and Codes of behaviour together with the Community and Organisational structures, those mediating artefacts of the triangle where the analyst can start to gain an insight into the cultural influence within the organisation, indicate that the status of ICT and thus the use of ICT capability do not match those of the teacher. Within the analysis of the interview it is clear that the teacher who is being interviewed believes that ICT capability is about more than the use of tools within applications, with references to 'problem solving' in their conversation. However the school culture within community and organisational structures clearly indicates that the status of ICT is lower in that it is not afforded the same position as other subjects who have an hour lesson a week and are taught by subject specialists. Furthermore the use of mobile technology by the pupils outside the classroom tends to further suggest that the perception in this instance is that ICT is a tool associated both with learning other specialist subjects and as a social medium, but less so as a subject with its own right with its own set of concepts. This contradiction implies there is a possible lack of confidence in the teacher's personal definition of the subject. This is further supported by a number of secondary contradictions particularly when examining the rules, community and roles, all of these relate to a lesser status within the school, the organisational structures are that the subject is taught to each year group at KS3 for a single week of the year and the rest of the year the subject is developed on a cross curricular basis. Those teaching the subject, even in the dedicated week of specialist teaching are one specialist and a number of non-specialist teachers. All these factors have a result in lowering the status of the subject in comparison to others which is in contradiction to the specialist

teacher's perceptions of having a subject which in itself develops higher order key competencies such as problem solving and metacognition.

There was little difference within the activity settings of any of the observations, whether from a teacher's practice or from the pupils' interaction. All mediating factors pointed to ICT being a subject which developed software application use and the tools which that involved. Any capability being developed appeared to be devoid of the use of higher order skills. However in comparing the teachers perceptions of practice from the interviews and the triangle which emerged as a result of the classroom observation, some interesting contradictions are highlighted, in that, there is no contradiction in the task and outcome of these triangles, both are concerned with the development of the ICT capability, but on closer examination of the tasks and outcomes leading to the practical development of ICT capability, the focus has more depth including an acknowledgement of independent learning and knowledge construction. However, there are contradictions between those outcomes and the other mediating factors within the triangle. Once more elements such as tools and artefacts are in contradiction with the outcomes since the tools used in the development of the key competencies are tools based, the production of a video or a presentation, they do not require the pupils to utilise higher order skills such as evaluation, justification or indeed problem solving as expressed in the first triangle. Whilst knowledge construction may have taken place, given the nature of the week long workshops to achieve an overall goal and a likening to cramming for exams, it would be interesting to revisit the group at a later date and reflect to establish whether this knowledge is superficial and likely to disappear or whether Vygotsky's zone of proximal development has truly been bridged.

A further contradiction is the use of not only non-specialist staff in the development of these competencies but the assigning of those staff with lesser ICT competencies to the lower attainment groups. Referring to Shulman (1987) and his work, where the development of learning within a subject is dependent on the level of proficiency of subject knowledge of the teacher, and then there is an argument that the lowest attaining classes would need those teachers with the greater specialist subject knowledge in order to achieve the same level of learning.

The key theme emerging from the post reflective dialogue was an almost defensive insistence that the method of development of ICT capability within the school suited the pupils at the school much more than the way it was delivered in other schools. "*Teaching ICT as the curriculum is in most schools can be boring, have to teach the same things year in year out, but with this you concentrate it all into 1 week of the year*" APPENDIX IV School A PRD:5). This sentiment tended to run through subsequent conversations in observations and interview. There was also a strong dialogue about the increased motivation of the students with this mode of development. In the initial observation this was seen to be true, however in the subsequent observation, which took place the following year again with year 9 pupils there was evidence of the beginnings of some behavioural issues amongst the pupils indicating that the motivation, evident previously, was not as strong. "*The session was started by a greeting and a reminder to the whole year group of work and behavioural expectations. There was an implication that there had been a series of unacceptable behaviour previously in the week*" (Appendix IV School A FO:4). This may be due to a number of factors, including the disposition of the year group which would be outside of the remit of this research, or may be that this particular group would have experienced a similar week albeit with a different theme during their time in Year 8 and the novelty factor which appeared to increase the motivation so strongly may not be quite so evident second time around.

In examining the activity triangles in a historical aspect, from initial interview to final interview and including observations of practice we see the following interpretation emerging. There is a primary contradiction in the object – the intended learning – between the tool-based teaching observed in lessons and the goals stated in the initial interview which refer to 'problem solving' 'higher order skills' and concepts: "*Communicating information often is posters and PowerPoint. The kids have the skills - they get those skills in primary school - we don't need to spend the time developing that skill, we need to be looking at the concepts behind it*". However, there are apparent differences in the goals between the two interviews which warrant further investigation. In the final interview, there is no reference to higher order thinking and the discussion of skills focuses on tools: "*for example in spreadsheets ... we are looking*

at the tools within the application" and at one point the teacher expressed the view that the term 'skills' was synonymous with the term 'tools', indicating that the key competencies within ICT were perceived to be of lower order.

This change in the object of the activity may resolve the primary contradiction, but leaves a secondary contradiction between the Tools/ Artefacts and the Object of the teachers perceptions, in that the teacher's perceptions tend to focus on the lower order tools used to operate a variety of applications and less on the higher metacognitive skills which are discussed within the National Curriculum in Wales (ACCAC, 2008a), where ICT capability is described for example as having the ability to use ICT in problem solving. Examination of the scheme of work also supports the need for evaluation: *"state ways in which you can improve your work".* However, in reality, this was superficial with an absence of any real metacognition.

Thus a change in the perception of the key competencies is emerging, the teacher's perception is moving from one incorporating higher levels of metacognition to a merely tool-based definition, which matches the practice observed. The contradiction within the object – between the espoused goals and the practical objectives – has been resolved but the contradiction is now between the object (learning to use tools) and the artefacts (the scheme of work and the National Curriculum). Furthermore, examining the rules, community and roles, all point to a lesser status for ICT within the school compared with other subjects, which is at contradiction with the lead teacher's initial perceptions of having a subject which in itself develops higher order key competencies such as problem solving and metacognition.

In evaluating the links between the teacher's capability and the utilisation of non-specialist teachers in developing ICT capability amongst lower attainment groups there is an anomaly emerging. Currently it is the specialist ICT teacher who is responsible for the formation of the scheme of work, the system of teaching and the differentiation taking place to enable both the less able and the more able student. However, because this teacher does not teach at this age group apart from isolated periods throughout the school year, she does not know the students but is reliant on general data concerning cognitive ability. The non- specialist teachers know students as they teach

them in other subjects. Furthermore the rationale driving this is that the higher attaining group needs the specialist teacher so that she can 'push' them, however her object is tools based and given that the very students she is 'pushing' have the ability to explore tools, to orchestrate their own learning, to build their own constraints and affordances to bring about the knowledge construction, whereas the lower attaining pupils would need the constraints and affordances as implemented by the specialist teacher. Shulman's (1987) work suggests that the development of learning within a subject is dependent on the pedagogical content knowledge of the teacher rather than just subject knowledge and knowledge of learners, and it may be that those classes with the least attaining would gain most from a specialist ICT teacher whereas students with good higher order skills would gain most from being challenged to apply ICT in learning other subjects. This was reinforced by observations of the top set where the pupil's through discussion were able to create both affordances and constraints in the creation of knowledge, that these affordances and constraints related to a learning which encouraged the use of ICT. The development of their ICT capability as a tool and not as a discrete subject with the use of analytical processes and development of metacognition is more reliant on the way in which ICT is perceived and developed within this environment than the abilities of the pupils to construct knowledge and develop metacognition.

This study has demonstrated change, predominantly the change in teacher perceptions of the key competencies of ICT. The realisation that the teacher's object is really the learning of ICT tools rather than higher-order skills may have been brought about by the study itself, or indeed by external influences such as the present political and educational arena within England and Wales. In order to resolve the contradictions and implement the current curriculum, a number of changes to the activity system will need to be adopted. There will need to be changes to the curriculum as it is perceived within the school, in that there will need to be more expectation and support for the students to use the metacognitive skills. At present, the scheme of work and mode of teaching limits the students to a tool-based construction of knowledge. Furthermore, in order to effectively achieve this, there may be a need to re-assess the scheduling of the subject to allow for the students to reflect on their learning and explore the use of the applications in differing situations. As the political environment drives change in

the subject towards a more conceptual nature the impact on the mediating factors of community and organisational structure within the school environment may take the form of greater status afforded to the subject. Any subsequent increased teaching time is likely to have cost implications as there may be the need to employ further specialist teachers.

Finally, there may be a need to further evaluate the pedagogical knowledge which is fundamental to this scheme of work and use specialism where there is greater need with those less able students. By facilitating the more able students to orchestrate their own learning and construction of knowledge using self-created affordances and constraints, especially those which may be prevalent in problem solving scenarios, whilst correcting any misconceptions which may occur, then those higher order metacognitive competencies which are being highlighted within the subject area are likely to be better developed.

School B Case Study

School B is an 11–16 mixed comprehensive school with approximately one fifth of pupils in receipt of free school meals. The pupils are drawn mainly from areas which are within three miles of the school. The majority of pupils walk to school and this population contains almost 10% of ethnic minority pupils, many of whom are supported. The attainment level of the pupils is broadly below average with many of the pupils in the current Y7 have a reading age of less than 10 years. Furthermore, a distinct proportion of Y7 have a reading age of less than eight years. This trend is replicated throughout the other year groups within the school with over a third of pupils on average having a reading age of less than 10 years. In addition, standardised test results for each year confirm that, on entry, the pupil profile is below average, while the number of pupils identified as being above average is relatively low, less than 10%.

School B is situated in Band 5.

The school affords a degree of status to the subject of ICT similar to other comparable subjects in that ICT is taught for the equivalent of an hour a week throughout KS3, by specialist ICT teachers assisted by a non-specialist teacher who has some expertise in the subject. The department has designed a system of facilitation, in order to attempt to encourage the pupils to take control of their own learning. This format moves away from the more traditional four phase lesson structure and uses lesson structure more akin to one suitable to facilitate coursework at KS4.

The teacher gave a very short recap, outlined a problem and directed the pupils to the tools to solve that problem. The desired aim was to enable the pupils to develop their metacognitive skills in solving the set problem. This problem included the exploration of a given software and the selection and utilisation of particular tools of the software application in order to solve that problem. Familiarity with the tools of the software were not demonstrated, however there have been a number of work sheets, help guides and on screen videos which are stored on both the intranet of the school and within the Moodle pages of the school.

The pupils were directed to and reminded of the location of these resources and encouraged to use them in their exploration of the software under investigation. The aim of this style or pedagogical tool was to enable those pupils who are more able to take greater control of their own learning and to use their metacognitive skills to construct knowledge, this also allowed time and opportunity for the teacher to support those pupils who were less able. However, with this form of lesson structure the motivation to learn is key for the teaching style to be successful.

A further point of relevance is that the teacher involved in this study has a background in computer science prior to coming to teaching. This may mean that some of the external changes taking place in England, the debate over the future of ICT as a subject and the proposals that computer science be included in the curriculum from foundation phase (KS1) to KS5, may have an impact upon his perceptions. This expertise led the school to re-evaluate the use of their resources, in particular the use and related duties of the teacher taking part in this study during the course of the collection of data. The result of this was that the teacher was moved from teaching at KS3, to teaching solely at KS 4 and 5, in order to better utilise his knowledge of computing and computer science. Since the remit of this study was investigating the teachers personal and developing constructs of ICT capability and their classroom practice at KS3, this change in responsibility has meant that there were no further opportunities for observations, as the other key stages were outside the remit of this research, there was a final interview and the culmination of this particular case study.

The key themes which emerge from the data associated with School B, are that of facilitation as the role of the teacher, the use of metacognition linked to the definition of ICT capability and the use of independent learning on behalf of the pupils.

The Initial Interview Activity Setting
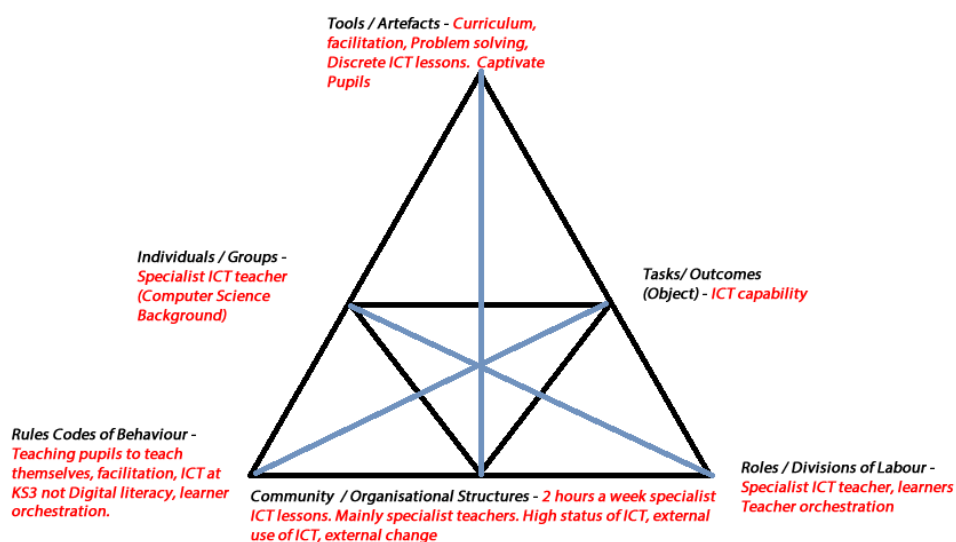
Figure 13 - Initial Interview Activity Setting

Tasks/ Outcomes. The teacher was quite thoughtful in their responses throughout the interview process; there was an indication that they felt that many people *"think they are more capable than they are"*. However, there were also strong indications that ICT capability was partially about giving the pupils cross curricular tools *"Giving them the tools to learn for themselves"*, although the use of tools in this context was not solely referring to the tools used within software applications but also to higher order skills and metacognition, *"Ability to find a solution is far more beneficial"*, *"I have a problem, how do I solve that problem"*, "*Part of ICT capability is learning to learn"*. There was also reference to the term Digital Literacy, and this may have been due to the use of this term by "Computing for Schools" and BCS, The Chartered Institute for IT who had recently published material in England regarding proposed changes to the ICT curriculum. The teacher attempted to make a distinction between the two terms; their feeling was that ICT Capability is about using computers, whilst digital literacy is more about having a knowledge and understanding of how those computers worked. There was also an acknowledgement that his definition was not in accordance with the national curriculum, though this was based upon the definitive strands within the national curriculum, and not the accompanying skills as stated within those orders.

Tools /Artefacts. The main themes which emerged and were aligned to this aspect of this mediating artefact of the activity setting included the curriculum within the school, which in the case of this teacher linked to his approach of facilitating the learning as opposed to any didactic teacher centred approach. This was carried out through enabling the pupils to *"teach themselves"; "the other day the year 7's they come in, they were told what to do, in very basic terms, they then go on to the Moodle course they watch the videos, they look at their learning diary to see what they did last time & how they need to improve things, so it's much more based on what they have said they have done and what they've got to do"*. There was an allusion that this method *"giving them the tools to learn for themselves"*, was not in accordance with the national curriculum as discussed previously. A further theme in this element is the national curriculum orders, and when discussing certain components of ICT capability a perceived need to make the curriculum more relevant to emergent technology is also noted. There was a discussion that to effectively teach there is a need to "captivate the learners" and that a facilitatory approach, where the pupils are in control of their own learning supports this. All aspects of the 'Tools and Artefact' supports the teachers perspective that ICT capability is not just the development of tools within software applications, but also to be able to develop the metacognition and problem solving attributes within the learner to support appropriate and justified use.

Individuals / Groups. The individual or group in this instance is solely the teacher being interviewed, this is because their perspective that is being sought. There are allusions throughout the interview to the pupils' role within the teacher's style of developing ICT capability, however there was not the opportunity to interview those students and as such any perceptions of ICT capability they may have will be outside the remit of this activity setting.

Rules / Codes of Behaviour. The focus here is a need to not only teach those tools within any software applications, which may be used to fulfil the criteria of the task but also to promote the higher order skills which bring about metacognition. The teacher discusses how pupils are given broad criteria for the fulfilment of a task. This task includes the production of a tutorial for their peers *"So whilst they are teaching themselves they are also preparing resources to teach other people, without knowing it*

to a certain extent"; "Watching the videos so they can then produce their own tutorials maybe doing it in a PowerPoint things like that". The pupils are then encouraged to decide how to fulfil the task and to search out self-help/ tutorials through the schools virtual learning environment in order to bring this about. Learning diaries are also used to enable the pupils to synthesise their learning and justify their methods of choice. In a similar way to the tools and artefact element of the setting, this mediating factor also does not contradict the teacher's emerging perception that ICT capability is predominantly concerned with higher order metacognitive attributes.

Community / Organisational Structures. Examining the community and organisational structure surrounding the teacher allows us to develop an insight into how the perception of ICT capability may be supported or sustained. The pervading external culture at the time of the interview was one of change as discussed in the introduction to the case studies earlier in this chapter. This is likely to have influenced the perceptions of the teacher, indeed there is reference within the interview of change and of the need to teach computer science as well as ICT and also some caution as to the need for too great a change *"A risk in any curriculum be it England or Wales in going too far down the computing route and not sticking with some ICT because ICT is possibly what has got them interested in computers in the first place"*. From a scholastic point ICT is developed through specialised ICT lessons on at least a weekly basis. The department is populated largely by specialist ICT teachers. There are active after school and lunchtime clubs within the school and this organisational viewpoint of the importance of ICT in the school life affords a high status to the subject.

Roles / Divisions of Labour. This includes the teacher being interviewed, however as the discussion has focused not only on their perception of ICT capability, but also how they best see the development of ICT capability. There has been a focus on the use of specialist teachers within the department, but also on the use of learners in supporting their own learning. This mode of facilitation is not widely practiced within amongst the other specialist ICT teachers, but is an element of change within the teacher's practice which they are looking to develop. The preparation of the resources is the responsibility of the teacher but the way in which they are used is the responsibility of the learner *"a lot of preparation but it is minimal input during the actual session from*

us as teachers and they are working independently all together – helping each other". Once again this supports the definition of the teacher that ICT capability involves metacognition.

Development of ICT Capability – observation
Teacher's Activity Setting
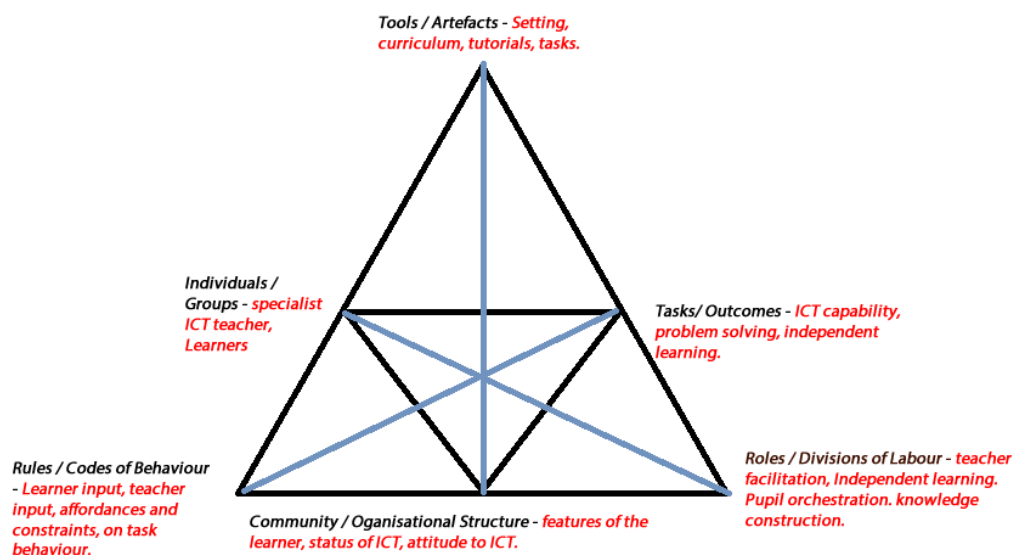
Figure 14 – Initial Observation – teacher's activity setting

Tasks/ Outcomes. The theme of the activity was the production of a website; however the focus of the teacher included not just the tools of the web development software application, but also appropriate use of those tools. Thus there was the inclusion of concepts such as 'Audience' and 'Purpose'. The task included the need for their pupils to explain and justify why the used the tools in the way that they did. This can be seen within the task in that the second part of the task was for the pupils to recreate tutorial videos and help sheets for fellow pupils to enable their peers to re-create the website.

Tools /Artefacts. The first artefact was the fact that they used their regular classroom, this was safe and secure with an ambience of learning, pupils were relaxed and motivated this sense of safety within their learning environment is likely to improve their interactions as they feel secure in doing so. The pupils were also directed to their "Learning diaries" in order that they may decide what they had already accomplished and what they had yet to achieve. The pupils are setting their own targets and

initiating their own self- assessment according to the success criteria provided. In operating in this way the teacher is clearly trying to enable the pupils to develop their own problem solving skills, in that they have been given the problem, in needing to recognise what they have already achieved, and solving that problem, what they need to achieve and how they are going to carry this out. This last aspect of the task means that they have to resynthesize their learning and put that learning into context, which is incorporating the development of metacognitive skills. Given that in the interview the teacher was quite strong in their belief that ICT capability should include the use or development of metacognition, then these tools used in the development of ICT capability strongly support that definition of ICT capability.

Individuals / Groups. Whilst the individual whose activity or practice is under analysis is the teacher, the teacher sees their role as more of a facilitator, with the classroom practice being very pupil led and this links very strongly to the socio-constructivist approach of Vygotsky and in particular the "Zone of Proximal Development (ZPD)" (1978). For this part it is also worth examining the learners as a group in their own right, as it is their interaction with this approach which will enable the ultimate completion of the product or outcome, and whilst their perspective of this outcome is likely to be more task orientated than learning orientated, the use of metacognition within the setting may impact on their view of the practice. The learners were year 9 and were 'top set', indicating that they had the confidence in their own abilities and hence to take the control over their own learning and progression that this approach would require.

Rules / Codes of Behaviour. As previously outlined the input by the teacher in terms of orchestration within the observed session was minimal. The teacher reminded them of the task; the success criteria; the resources and tutorials though the schools virtual learning environment and the use of their required use of their learning diaries and then the learners proceeded to the task in hand, that of the production of a website, and tutorial package. The constraints which were in place were the use of Adobe Dreamweaver as a web creation software application and the need to have a number of elements within the website, i.e. a number of pages, text images, and navigation bar for example. The success criteria were designed to match the assessment

requirements for the Essential Skills Wales qualification, however, these were presented as a 'must have' list, how the pupils determined where and how they were going to fulfil these criteria was down to themselves, and indeed it was observed that often the pupils went above the specified criteria in order to improve the appropriateness of the website; for example the use of 'roll-overs' as well as hyperlinks to improve the quality of the site. Further to this the teacher circulated the room offering advice and feedback to the pupils, there was a relaxed atmosphere and by enlarge most pupils were on task. One drawback to the approach is that it is reliant on the pupils' own motivation to achieve and to take control of their own learning environment; however this was not always the case. For some pupils the lack of constraints and the reliance on the pupils creating their own affordances gives them opportunities to stray off task, and with evidence of this occurring in a 'top set' where they are cognitively able to create their own affordances, those sets capable of lesser attainment or possessing lesser maturity may struggle with this approach. However, the rationale strongly supports the development of metacognition and problem solving which is in accordance with not only the teacher's definition of ICT capability, but the definition within the National Curriculum for Wales (2008) and the recommended national assessment criteria for KS3 in Wales at the time of the research.

During the observed session there were a number of pupils who were off task this meant that when they did eventually concentrate on the task in hand the work carried out was rushed and whilst fulfilling the success criteria given it had none of the finesse of the work created by other pupils who had used their thinking skills in order to determine the best and most appropriate way in order to achieve the final outcome.

Community / Organisational Structures. As previously mentioned the community being taught within the observed session were a year 9 'top set'. The setting was determined by general cognitive scores however, they were a set capable of using metacognitive skills and taking control of their own learning. The group would be choosing their options shortly; they were relaxed and confident in themselves and their own learning. They had good literacy levels and appeared numerate.

The status of ICT was high within the organisation with ICT timetabled to each group for an hour a week at KS3. During years 7 and 8 the scheme of work is operated on a concurrent basis over two years, in that both years are working from the same scheme so that the year 7 are obtaining the same skills as the year 8 over that two year period. At Year 9 the pupils are following the Essential Skills Wales programme so that they will have achieved that qualification at the end of the year prior to taking their GCSE options. The design of the scheme of work allows for the pupils to work independently, which in turn facilitates the pupils in the achievement of the higher grades within the programme. This timetabling along with the design in the way in which ICT is develop affords the subject a higher status than that of a cross curricular tool.

Roles / Divisions of Labour. The main role of the teacher has been the preparation of the video tutorials and help sheets, and the placement of these files through the virtual learning environment to enable this form of facilitation to take place. During the course of the observation there was no evidence of group reflection on action as would have been expected in a traditional teaching episode through the use of plenaries to expand and reinforce the learning. However the pupils were encouraged to discuss their actions amongst themselves and to share their practice with their peers and this certainly fulfilled the reflection in action when evaluating the construction of knowledge. Further to this was the requirement for pupils to update their learning diaries where in their own language they discussed their progress and in this way reflected individually on their own action and learning. The pupils' independent construction of knowledge was further evidenced in their production of video tutorials and help guides where they had to reconstruct their knowledge in a language that their peers would understand. Combined there is re-synthesis of not just the 'how' demonstrating the use of specific software application tools, but also the 'why' using higher order or metacognitive input.

Pupil's Activity Setting
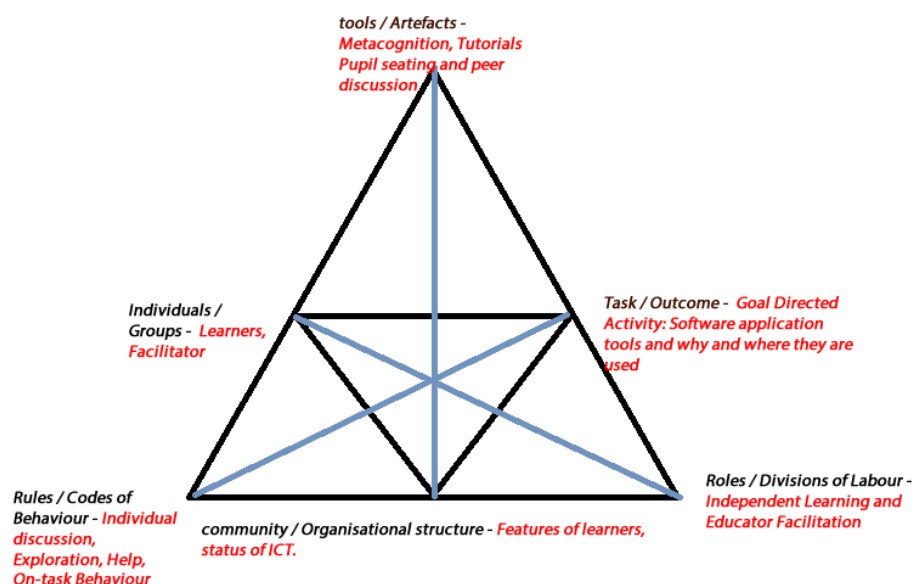
Figure 15- Pupil's Activity Setting

Tasks/ Outcomes. The task and outcome within the pupils practice are predominantly goal orientated in nature, their activity is directed along the pathway of producing a series of products, that of a website appropriate to particular audience and of a particular purpose, help guides and video tutorials in order that their peers may re-create all or part of their website. In order to do this they would also be using metacognition, however whilst this would be part of the outcome of the teachers activity, this is more likely to exist as a means of achieving the end product and as such should exist as a Tool or Artefact.

Tools /Artefacts. This element you will find the metacognition of the pupil, as this is used as a tool in order to successfully achieve the product. As such it also supports the whole research with the perception and development of ICT capability, both for the teachers practice and that of the pupil, as including the higher order skills and metacognition as part of its make-up. Tutorials also exist in this mediating artefact; but not those tutorials that the pupils are preparing as part of their outcome, but the tutorials produced by the teacher to ensure they know how to use some tools within the software application. It is through these help guides and tutorials together with both teacher and peer discussion that any misconceptions which may arise from a conceptual point of view can be recognised and corrected. Lastly the seating plan or lack of it can also be considered a tool supporting the successful outcome or

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completion of the task. This can be considered as a constraint, in that by allowing pupils to sit where they are comfortable, they are likely to choose to sit with and work in friend groupings. This will be a structure for action in that they were able to enter into peer discussions about the activity. They compared their progress and discussed the best methods of achieving the product in light of what tools and techniques would work best for the optimum audience and purpose of the website. This ability to generate peer discussion resulted in a number of pupils generating their own learning and constructing their own knowledge, which existed on a technological level in that they were able to judge and decide how best to use what application tools where, and on a conceptual level in that they were striving to achieve an optimum audience for their website.

Individuals / Groups. The individuals and groups are the learners as it is their activity which is being examined, and that of the teacher facilitator as the feedback given by the teacher and guidance allows the learners to successfully partake in their practice.

Rules / Codes of Behaviour. This included the encouragement for individuals to discuss the task and any problems or misconceptions which may have arisen from it. This individual discussion allowed the learners to orchestrate their own level and also led to reflection in action and reflection on action in the construction of knowledge. There was also an expectation that they would be able to search out their own help, especially with the mechanics of the software application being used. There was evidence of them searching the tutorials and help guides uploaded to the school virtual learning environment for their use, and with the more motivated pupils referring to and updating of their learning diaries on a more regular basis.

The expectation when discussing this model of teaching and development of ICT capability with the teacher was that having control of their own learning was more motivating more captivating for the pupils and for the most part the observation supported this theory, however there were a group of year 9 boys who failed to be "captivated" and spent much of the lesson discussing a variety topics unrelated to the lesson. The teacher suggested strongly that they return to the task and this eventually has some effect, however those pupils were now behind and ended up rushing their

work meaning that they achieved a much less sophisticated product and used less metacognition in the process.

Community / Organisational Structures. Similarly this mediating factor is very similar if not identical to that of the community and organisational structure existing in the teacher's activity setting for the observation. This is not remarkable in that the community of the classroom are the same in both instances as are the organisational structures existent within the school.

Roles / Divisions of Labour. The key roles assigned to members of the activity setting were to the pupils and the educating facilitator, the pupils in that they were in control of their own development of ICT capability and the task or outcome, through the accessing of help guides and tutorials and the teacher in their self-chosen role of facilitator who produced the help material and tutorials the pupils used to complete the task, but also who circulated the room attempting to keep pupils on task and discussing misconceptions and progress with the pupils.

Final Interview
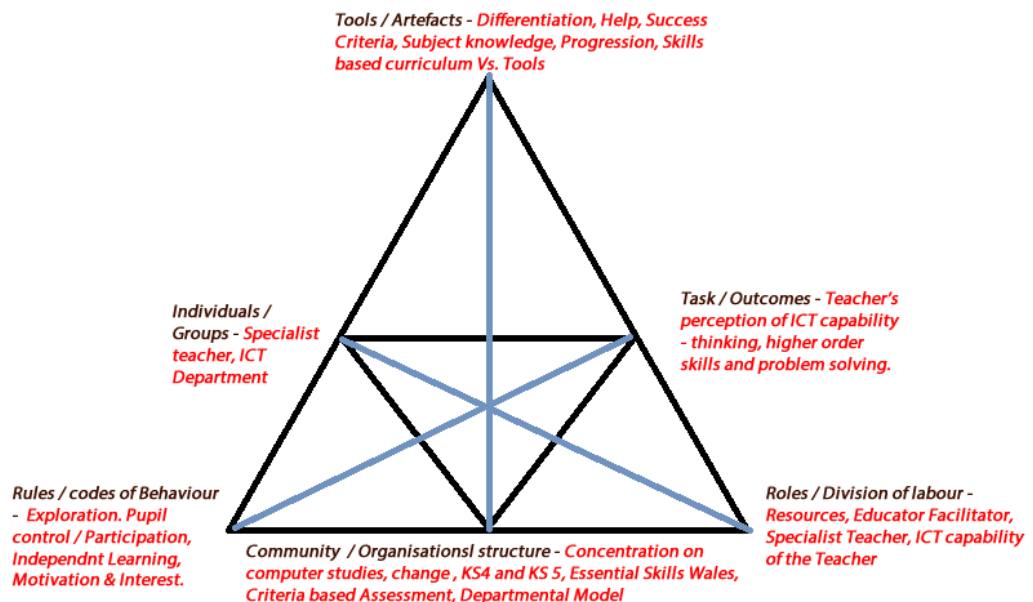
Figure 16 - Teacher's final interview

Tasks/ Outcomes. In discussing the teacher's perception of ICT capability, like the previous interview and the observation of the teacher's model to develop ICT

capability in their pupils there is a strong implication of the inclusion of problem solving and the use of thinking skills, *"That could be part of developing ICT capability that ability to think for themselves."* or *"the use of those higher order skills"* there is also a discussion that some of the other aspects, whether it be in the curriculum, or assessment do not always support the use of metacognition and higher order skills within ICT capability. *"Skills based curriculum well it is supposed to mean using a wide basis of skills not just ICT but also thinking problem solving, not sure that this is the case in reality."*

Tools /Artefacts. The discussion focused on a number of issues in the support of ICT capability and in the support of development of the higher order and metacognitive skills. The teacher felt that the most important aspect was the pupils being enabled to develop control over their own learning, in so far as long as the pupils understood their success criteria they were able to determine their own progress and learning *"and they can compare this to their success criteria. It means they're able to think for themselves."*; *"They know where help is."* However, it was also interesting to note that there was an allusion that this model of development worked best when the subject knowledge or capability of the teacher was of a sufficient depth to support the model *"This tends to work best when the subject knowledge is strong"*. The rationale was that when handing the control of the learning to the pupils in this manner there was no guaranteed format to gauge how they would interpret it so that in order to ensure that misconceptions were kept to a minimum and corrected when they arose, the subject and pedagogical knowledge of the teacher has to be of sufficient depth in order to either answer some of the more unusual questions or direct the pupil to where they can find the answers accurately. When probing deeper it was discovered that whilst the model had been designed on a departmental basis this teacher was the only teacher within the department who used this style because, *"the model was used mainly by myself"*, *"I suppose that because it suits my style"*. Reflecting on the observation it was noted that the class observed were high attainment and capable of creating their own affordances and constraints on the subject of differentiation there was a recognition of a need for greater steering of the pupils in enabling them to manage their own learning and a supposition that for SEN pupils this would not be the ideal approach. *"less able it just means that you will be directing them little bit more"*

and *"It's different with the SEN classes, those classes need a more structured approach I don't think the freedom allowed to those more able works with them so well"*.

Individuals / Groups. The individual as the subject of the analysis is the specialist ICT teacher who was the focus of the case study. At the point of the final interview his responsibilities had been changed and was no longer teaching ICT at KS3, but was teaching computing and computer science at KSs 4 and 5 respectively.

Rules / Codes of Behaviour. This model of developing ICT capability is dependent on the pupil's ability to explore the software being used and in the confidence to remember and explore the resources within the virtual learning environment of the school. It is designed that the pupil controls the level of his/ her input to the lesson through that exploration and through their own motivation and interest in creating their own orchestration for learning and construction of knowledge. To enable this to happen, the teacher/ facilitator needs to know exactly what the pupils knowledge and attitude to learning is in order to create the appropriate resources to match the needs of the pupils. *"When they first come you have taken back to basics so that you can establish exactly what they know"*, *"there is a lot more resource building there is a lot more work from an initial standpoint but once you're in the classroom you're more of facilitator."* and *"and I had a lot of success with some of the year seven pupils, maybe it's because they haven't got used to the sort of teaching that goes on in secondary school"* The model is also reliant on the motivation and interest of the pupil, there was an acknowledgement that there are pupils who need "prodding" to remain on task, however the overall summation was that if you give the pupils control over their own learning you are not only increasing their capacity for metacognition but you increase their own motivation and interest in the learning process.

Community / Organisational Structures. There is a developing change within the community which is occurring through the external political situation. The Minister for Education in England at the time of the research published a speech recommending the dissolution of the National Curriculum in ICT in order that a new subject including Information Technology, Computer Science and Digital literacy, be formulated. The result of this has been that there have been changes in the content of a number of

GCSE's and that there are a number of schools in Wales who have taken this opportunity to increase the depth of computer science and computing within the school curricular in anticipation of any similar change occurring within the Welsh Curriculum. School B is one such school. The result of this has been that the teacher practising the model of pedagogy under discussion is now no longer practising within KS3 but practising entirely within KS4 and KS5.

A further influence here was the way in which Essential Skills Wales assess pupil work in the attainment of an ICT capable qualification at the end of year 9, this was deemed to be largely tools based and devoid of many of the higher order skills which had been the focus of the study. *"Within Essential Skills Wales for example it is a criteria based assessment which means that if they have carried out a certain technique e.g. putting a hyperlink or hotspot the web design, then they get rewarded certain marks"*.

Roles / Divisions of Labour. Whilst the lessons using this mode of development for ICT capability has been acknowledged as facilitatory by nature, the resource production to enable success requires an additional work commitment on the part of the teacher. There is a need to be able assess the requirements of the pupils in the class and then design the tutorials and help guides, textual, video or multimedia to enable the model to work. This needs a high degree of subject knowledge on an ICT level and a pedagogical level, and for this reason the model of delivery is more appropriate to specialist teachers. There is an allusion to the limitations of developing ICT capability with non-specialist teachers *"It goes back to the capability of the teacher, if the teacher is confident in the application, then they are likely to teach why certain things or techniques and routines are carried out. If not then there is a danger that it just becomes "a click this icon and this action will occur" in that case I suppose it becomes a tool based curriculum."* (Appendix III School B 1 FI:19), *"Most non-specialist teachers tend to spend more time on the subject they comfortable with the subjects they know well. This wouldn't work with them."*

Contradictions

Below is a table summarising the contradictions which have been identified within this case study.

Activity Triangle	Type of contradiction	Mediating factors	Location of Contradiction
Initial interview	Primary	Tools / Artefacts	Teacher perceives a difference between the NCO for Wales (2008) and his mode of development.
Observation (Teachers)	Secondary	Rules / Codes of behaviour and Task/ Outcomes	Some pupils off task behaviour and the develpoment of independent learning / higher order skills
Observation (Teachers) vs. Observation (pupils)	Quaternary	Individuals and groups	Some of the pupils are motivated by the opportunity to take control of their learning. Some Pupils see it as an opportunity to be off task.
Final Interview	Secondary	Community / organiastional structure and outcome	The development of independent learning vs. movement of specialist teacher
Final Interview	secondary	Tools / Artefacts and Roles / Divisions of labour	Pedagogical model vs. specialist / non-specialist teacher

Table 5.2 - Summary of Contradictions of Activity settings Case study B

Discussion of Case B

The analysis is focused throughout on the teacher's perception of what ICT Capability entails and how it is best developed pedagogically. On the whole throughout the analysis all mediating factors have supported the teachers claims that ICT capability is made up not just by the tools needed to operate individual software applications, but also the metacognitive skills needed to successfully solve the problems of what tools should be used and to what effect. The way in which this is developed is supported in a similar way, with the role of the teacher moving to the role of the facilitator; at the start of the lesson after the pupils were settled and attentive the teacher spent a short time reminding the pupils what they were studying and what the ultimate goal was together with some success criteria. They did not, however dictate how this was to be completed, instead the pupils were directed to the resources and video tutorials which existed on the intranet for the use of the pupils should they wish or need to use them.

The pupils were also directed to their "learning diaries" in order that they may decide what they had already accomplished and what they had yet to achieve. This style of teaching demands more of a facilitator's role and gives the control more to the pupils. The exception to this when evaluating the comments which arose for the initial interview lie in the perception of the teacher of the national curriculum. Whilst all the mediating factors support their definition of ICT capability as previously noted, there is a further perception of the teacher which places a contradiction between their understanding of what they are attempting to develop and the method they use to do this, and their understanding of the NCO for Wales (2008). The focus point is that the teacher believes that to effectively develop ICT they need to develop independent learning, problem solving and the ability of the pupils to think for themselves "*Part of ICT capability is learning to learn*", however, they see this as being in discord with the National Curriculum for Wales (ACCAC, 2008a) "*In broad terms my definition doesn't relate to the NC definition because we're supposed to show them how to find information and show them how to convert that into something else*", and "*there is nothing in the curriculum telling us to teach them to teach themselves*". In reality there is no discord as within the NCO for Wales (ACCAC, 2008a); there is a clear link with the need to teach problem solving and hence thinking skills. If this is not recognised by the teacher however, there may in time be a danger that they are feeling that they are not operating within the directions of the National curriculum and change their teaching practice.

However, there are a number of other contradictions that begin to emerge when evaluating the relationships of one activity setting, the key focus here is concerned not with the definition of ICT capability, but with the mode of development of that capability.

The first contradiction which emerges is a secondary contradiction which exists between the mediating artefacts of Rules / Codes of Behaviour and Task/ Outcomes in the Teacher's Observation Activity setting. The object of this setting is the development of independent learning and the pupils' ability to justify their use of ICT in their optimum achievement of the end result against the given success criteria. However in order that that be achieved there is a necessity for pupils to engage fully

with the tasks devised to bring about that independent learning and the use of problem solving and thinking skills. Throughout the observation there was a clear indication amongst a number of the pupils that they were not engaging with the lesson and their own indpendent learning. Thus, the situation which arises is that in essence the engagement required which is part of the rules and codes of behaviour as part of the attitude to the activity setting is in accordance with developing independent learning and metacognitive skills. The observation shows that this is only true for that portion of the class motivated to engage with that activity to the required depth. This could also be seen as a quarternary contradiction when evaluating the pupils activity against the teachers activity within the classroom environment.

Conversely the majority of of the contradictions emerge for the analysis of the final interview and some of these appear to be a direct result from the changes taking place externally in the political arena. Primarily there is a discord with the development of the pupil centred independent learning approach as devised by the ICT department of School B for KS3 and its lack of use; there is an admission that the teacher being interviewed in the department is the only person who practises this style of development, and there are also allusions to the need to posess a depth of specialist subject knowledge. One interpretation of this may be that whilst the culture of the organisation recognises the high status of ICT and the need to devleop metacognitive skills, in reality there is not the confidence amongst the makority of the staff to develop it in this way. This interpretation may also be supported by the recognition by School B's community that there are moves externally to include computer science and computing within the curriculum at all levels and the move to giving the option to pupils for GCSE and above requiring the movingt of the specialist ICT teacher with a background in computer science to move the KS4/5 phase of education. This results in a contractiction between the community / organisational structure and the roles / divisions of labour, because whilst there is a pedagogical approach which the ICT department has devised in order to develop metacognition within ICT but no teacher prepared to use that approach. This contradiction ultimately has the potential to impact on the capability of the pupils and its development.

Another interesting point to note within this case study, is that unlike Case study A, there is no obvious change taking place throughout, other than the movement of the specialist teacher to a different key stage. The perceptions of ICT capability being consisting of the use of the tools, the use of metacognitive skills and ability to use those tools and those metacognitive skills in solving problems remains largely unchanged.

School C Case Study

Introduction

School C is an 11 to 16 English-medium mixed comprehensive serving an area of South Wales. There are currently 625 pupils on roll. Over a third of pupils are entitled to free school meals. This is amongst the highest in Wales and is significantly above the national average for secondary schools.

Pupils at the school represent the full range of attainment, however, there is a large number of pupils with special educational needs.

Within Wales all secondary schools are assessed on performance within four categories and then placed in a one of five bands dependent upon how they have 'scored' in this assessment, with Band 1 denoting the highest achieving schools. The categories which are assessed are based on GCSE results and attendance and whilst this study is concerned with KS3 and not KS4, the information is relevant in giving a contextual background to the school and the subsequent observations and interviews.

At the time of analysis ICT capability was developed through discrete weekly lessons for all KS3 pupils, with the scheme of work being designed by the two specialist ICT teachers within the department, and assistance for the teaching of the subject being drawn from an additional non specialist ICT teacher.

One of the learning strategies used within the ICT department is to use a "Buddy" system. This is designed to try to empower the pupils to take a degree of control of their own learning. Having designed their own success criteria, they use what they call a "learning ladder", this ladder has a series of steps which they have designed as success criteria to bring about the successful completion of the task. The Buddy System comes into play whilst they are fulfilling the criteria established within the learning ladder. The strategy is that the class is divided into two teams, in this case they are named after two local rugby teams, and each member of the class is assigned to one of these teams the pupils are then seated in such a way that they are seated in pairs within the team. The system comes in to operation when a pupil is finding difficulty

with an aspect of the task, that pupil first asks their corresponding pair within the team, if that team member is unable to help the pupil will go on to ask another member of their team before ultimately asking the teacher.

The Initial Interview Activity Setting

Tool / Artefacts - **Appropriate Use; cross curricular links; Curricular approach; constructivist approach**

Individuals / Groups - **Specialist ICT teacher**

Task / Outcome - **ICT capability; Appropriate use as part of knowledge construction;**

Rules / Codes of Behaviour - **Buddy System; Peer involvement; Pupil Expertise**

Community / Organisational Structures - **Political arena; school culture; change vs. perception of pupil need; ideals external perception**

Roles / Divisions of Labour - **Teachers' Capability; differentiation and Model of Pupil involvement.**

Figure 17 Initial Interview Activity Setting

Tasks/ Outcomes. The interview, as with the previous case studies is focused on the ICT teacher's perceptions of ICT capability. The key points which emerged here are the perceptions that ICT capability is more than just the tools of the application; that developing ICT capability is also about acquiring the higher order skills to use ICT appropriately in order to solve particular problems. The ability to discern when and how certain applications could or should be used; using ICT to create solutions to problems, *"combining skills, knowledge and 'problem solving'"; "From this point they are able to use accurate ICT terms and phrases in relation to the topic that they are covering".* There is a belief that it is about more than handling information, and that the communication element is vital, *"Anyone who is passionate about ICT will know that it is not only about spreadsheets and databases"* and *"Creating and communicating are so essential"*. The interviewee clearly has a strongly defined personal construct of what they deem ICT capability to be, and throughout the interview this is supported by discussions referring to the need for ICT teachers, specialist or non-specialist to ensure that they are up to date with not only the changes in curriculum which may be proposed but also with changes and advances in

technology and its use. The interviewee, when emphasising their point that ICT was multifaceted and in particular about more than the handling and analysing data strand of the curriculum felt that the predominance of this strand through the curriculum gave a *"false image of ICT"*.

There is a clear acknowledgement of three distinct parts, the tools of the application, the associated terminology and ultimately the appropriate use of the software in order to solve problems." *Though KS3 I feel that you should start with skill development, then move to improving terminology. Once this is in place, look to develop problem solving. In promoting all three together at KS3 this will promote pupils desire to improve on the work that they produce"*.

Tools /Artefacts. The main themes emerging within this mediating artefact of the triangle are the development of appropriate use of ICT; the cross curricular links of ICT; the curricular approach in the development of ICT capability and the more holistic approach used within the classroom in the development of ICT capability. Though in the case of the later theme this was discussed, and observation of the approach will be examined through the analysis of the classroom observation. The development of ICT capability was discussed as involving clear building blocks which went together to suggest a more linear approach, in that the teacher believed that in order to develop ICT capability one needed to firstly approach skills development, however it was evident from the conversation that the use of the word "skills", though not defined, was implying the use of the tools within software applications. The next stage in the development of ICT capability was concerned with a *"move to improving terminology"*, and ultimately the development of problem solving. It is the distinction made between the initial development of skills and the ultimate development of *"Problem solving"* which goes to imply that the use of the term "skills" in this instance is synonymous with developing the use of tools as defined in previous case studies. This distinction between the skills and problem solving further implies that ICT capability involves the use of higher order cognitive skills and supports the perception of ICT capability being multifaceted. There is further evidence and support of this through the comment concerning this development *"here is a problem, this is what you need to produce, what software would you use, why would you use that one instead of that other one"*.

Further conversation concentrated on progression and the approach to developing ICT capability, and in this there is further support of ICT capability being the summation of many parts, the interviewee felt that there was a need to develop "*a good solid foundation, that needs to be put in place in year 7*"; "*Teachers need then to look to build on this through KS3*", and then "*introduction of Essential Skills / Key skills qualifications at KS3*".

Deeper discussion of the curriculum showed reluctance in the teacher regarding any need for change within the curriculum, but possibly an acknowledgement that certain areas of the existing curriculum could be more motivating and innovating; however the suggestion was that this was not the fault of the curriculum, but the lack of innovation from the teachers developing the subject. "*To hear teachers say that the current curriculum is too off-putting, too demotivating, too dull raises a number of questions.*"; "*ICT is a constantly changing subject; … so how can it be too dull*"; "*It is simply the teachers that are not stretching the children not the subject*". The implications of this is according to the interviewee's perceptions of ICT capability and the curriculum which promotes it there is little need for change, however teachers of ICT need to be more aware of advances within the subject and teach it according to the curriculum, "*primarily ICT is a forward focusing subject, which requires an appropriate mix of the two strands*".

Individuals / Groups. The activity under analysis is an interview and as such the mediating factor of individuals and groups is the interviewee, and in this case study they are a specialist teacher of ICT. The ICT teacher has clear perceptions of the point of the activity, there are occasional references to the perceived differences between the use of specialist and non-specialist teachers. However, these viewpoints are best discussed under the mediating factors of Roles and Divisions of Labour and Community and Organisational structures. There are no other individuals or groups whose opinion may have impacted on the triangle in this instance.

Rules / Codes of Behaviour. The rules and codes of behaviour within this activity are concerned with the way in which the individual, the specialist teacher perceives the development of ICT capability and throughout the interview the emergent factor concerning that development is the way in which the interviewee believed the development was of a linear nature and that any development is in a progressive format. Whilst this links closely with the tools and artefacts of this activity, supporting this approach, within the tools and artefact mediating factor there is allusion to discourse playing a role within the development of ICT capability linking to a more holistic development. *"I believe that ICT capability comes in the following stages: Skills; Terminology; Problem solving"*. The interview goes on to support this idea in that there is further discussion implying that the "Problem solving" aspect of ICT capability is the last aspect or element to be developed *"From this point you would look to use the skills and terminology to make decisions to solve problems that have been given to them"*. There is also an allusion to the learning styles which the pupils may employ in the development of ICT capability and the interviewee feels that whilst some pupils are able to look at the problem holistically and then work out a logical sequence of strategies to solve said problems, other pupils are not able to take this approach as they struggle to visualise the steps needed. This idea, and therefore the mediating factor supports the perception that ICT capability is made up of more elements than just the tools of the software or application. If this were the case then there would not be the need to use a problem solving approach, but just an operational approach in applying the tools of the application; there would be no need for the utilisation of higher order skills.

Community / Organisational Structures. The community and organisational structures relate to the environment and the culture of the institution. It is within this mediating factor that we can evaluate some of the cultural and environmental factors which are likely to influence the viewpoints and perceptions exhibited within the interview. During the time of the interview there were changes taking place in England and there is a possibility that this change and the media coverage is likely to have influenced some of the emergent themes here. The environmental and cultural arena, which is existent within the school, is also one of change as this school together with two others are undergoing restructuring with the view to creating a large single

comprehensive school in the area. It is unclear at this stage if these two points are going to have an impact on this mediating factor, particularly in reference to the teacher's perceptions of ICT. However they are worth mentioning, particularly if in the subsequent analysis of any contradictions they become an influencing factor.

Similarly to previous mediating factors of the interview activity, there are key themes which emerge, these concentrate on the needs of the pupils and the changes which may or may not take place with reference to the curriculum. The interviewee is quite adamant in their disagreement with proposed changes to the curriculum emerging in England, and in particular to the rationale behind those changes. The teacher believes that there is no need to introduce computer science to the KS3 curriculum. Initially when discussing the present curriculum, the teacher indicates that they believe the subject to be *"forward focusing"* and that with an *"appropriate mix of the two strands"* (Appendix IV School C II:12), ICT capability can be developed. In discussing the curriculum in this way the indication is that the teacher believes that the present curriculum is sufficient to develop ICT capability. This is further supported by the comments made when discussing the moves proposed for the curriculum change in England (Gove,2012) *"I completely disagree with Mr Gove's statement, in fact the first time that I heard it, it angered me"* ; *"To hear teachers say that the current curriculum is too off-putting, too demotivating, too dull raises a number of questions"*. The teacher went on to point out that ICT is constantly developing and that there is always *"always something new to teach"*. The teacher was also were quite adamant on the point that not everybody who is passionate about ICT are "programmers" and felt that if there was a continued drive to introduce computing at this phase then the result may be counterproductive in that it may be off putting to some otherwise interested pupils. Furthermore the school provide discrete ICT lessons for an hour a week at KS3. In the main these lessons are taught by specialist ICT teachers, this affords an insight into the culture of the school and the regard that school has for ICT and ICT capability. As yet there is no influence of computing or computer science in the curriculum at this stage, and the implication of this absence may be that the school community does not deem this appropriate to the needs of the pupils as yet. This supports some of the views which have been expressed by the specialist ICT teacher in that he believes there is perhaps no great need for the curriculum to change, but more a need for some

specialist teachers to change their approach to the subject. Also the decision within the school leadership to resource the ICT department with specialist teachers infers an importance and recognition of the necessity of the subject in the education of their pupils.

Roles / Divisions of Labour. The final mediating factor of this activity setting is that of the roles of the participants who develop ICT and the way in which those tasks or roles were apportioned. The key theme emerging here was the need not just for the development of ICT capability to be carried out through regular discrete lessons, but also for this to be carried out by specialist ICT teachers. The interviewee was strong in the belief that firstly the subject does not need change, but that more teachers need to *"Stretch"* the pupils to a greater extent and if this were being carried out then the subject would cease to be regarded as *"dull"*. There was as stated a strong belief that ICT should be developed using specialist teachers *"Simply put, ICT cannot be taught by 'polyfilla' teachers."* The teacher went on to imply that there were a number of institutions who may have non-specialist teachers developing ICT and that ICT may be used in certain instances to fill in or make up timetables. The teacher further described the consequences to pupil learning when this was the case, *"you will often find that due to limited knowledge in the subject it has an effect on the pupils learning"*.

Development of ICT Capability - initial observation

Teacher's Activity Setting
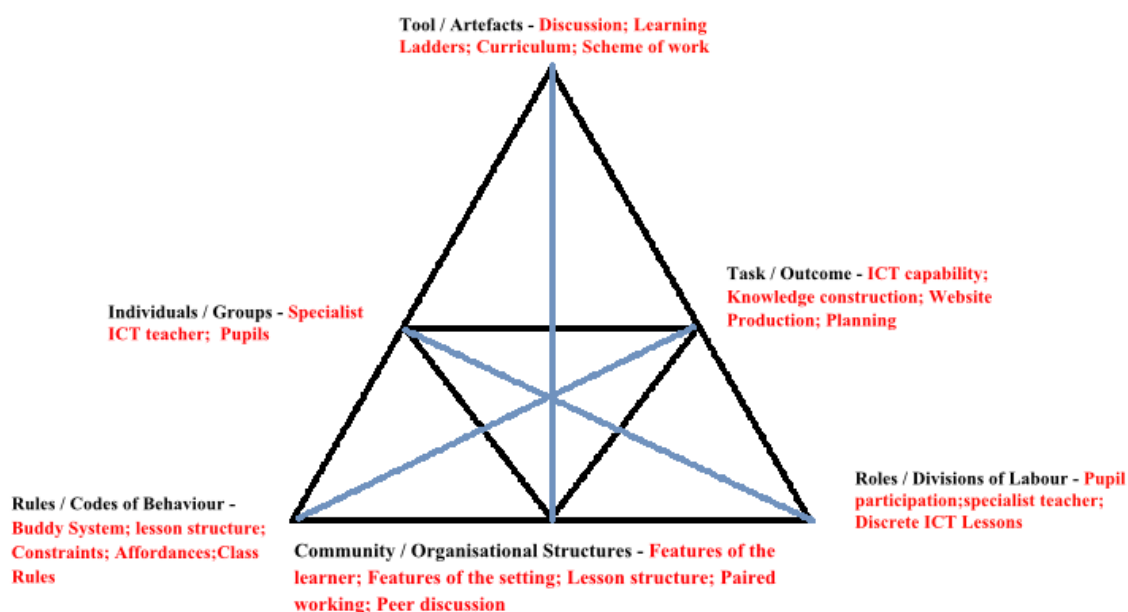
Figure 18 – Initial Observation – teacher's activity setting

Tasks/ Outcomes. Correspondingly with the initial interview, the object of the activity setting is ICT capability, however in this instance in order to establish if there are any contradictions between the development of ICT capability and the teachers perception, the object here is multifaceted in that it will include not only the perception of ICT capability but also the development of ICT capability and the methods which are used in order to develop it. In this instance in support of the ICT capability is the task of the activity, this will be different for the different groups and individuals and for this reason there will be another setting designed around the perceived outcomes of the pupils involved in this activity setting. The ICT capability being developed within this setting is not based solely on the use of the tools within the web development software in use, but also for the pupils to be able to plan the appropriate design for said website. This involves the use of the ICT concepts of Audience and Purpose and looks to develop not just the tools to be used within the software application, but also the higher order skills of problem solving; evaluation and justification in order that the pupils may show appropriate use and design. This task of website production was carried out using Microsoft PowerPoint.

Tools /Artefacts. The lesson started after the pupils had been settled, with a discussion between the teacher and the pupils concerning the lesson objectives and the ultimate task outcomes which the teacher wished them to achieve, this took the form of website production. The aims and the success criteria included opportunities for the pupils to use individual creativity and the need for the pupils to make the end product aesthetically pleasing. To successfully complete this aspect of the task the students would need to comprehend what was required for the website to fulfil the concepts of purpose and audience, there was also a need to ensure there was a 'Welshness' about the website. The program of study and curriculum were designed by the two members of the ICT department, both teachers were specialist ICT teachers.

The pupils carried out the learning activity within their normal classroom environment; they were confident and comfortable within the familiar surroundings. The lesson was started as stated with the lesson aims, objectives, however the pupils were not just told these, but they were invited to discuss them and in doing so they designed, with prompting by the specialist teacher, their own success criteria. This had the effect of the pupils taking ownership of their own learning and being able to fully understand the requirements of the activity. This discussion was developed though questions and answers and dialogic interaction, this links with the socio-constructivist approach, with a level of social discourse involved in taking the learning from one level to another with the pupils. It is also in accordance with the teacher's perception that ICT capability is concerned with not just the tools of the application, but also the need to use higher order skills in the process of using the application to solve problems, in this case the problem is how to produce an appropriate Welsh website taking into account audience and purpose. However, the interview activity setting also highlighted that the teacher perceived the development of ICT capability to be reliant on a linear format, with the development of first the tools of the application, then the associated terminology and finally the higher order skills associated with the ability to determine appropriate use. However the observation clearly shows a level of discourse within the lesson which would indicate a more holistic development where the development of understanding of the associated terminology is concurrent with the development of the tools of the application. Whilst this is a relatively minor point in that the teacher believes ICT capability to be comprised of both the use of the tools and associated

higher order skills as previously discussed and their development of ICT capability appear to be aimed at developing those aspects of ICT capability, the difference between a linear and a holistic approach may indicate the development of a contradiction in this instance.

Individuals / Groups. The individuals and groups for this activity setting are the specialist ICT teacher and the pupils. The perspective of the pupils will be different from the teacher and as such there will be a separate analysis to examine the activity from their perspective. This activity setting is examined with a focus on the specialist ICT teacher. In analysing the development of ICT capability in this way it is possible to see if the practice within the classroom supports or contradicts the perceptions of the nature of ICT capability as described within the initial interview.

Rules / Codes of Behaviour. The rules of the activity focused of the way in which the lesson was structured and the rules of the classroom which existed within that lesson. The rules of the classroom started with the pupils entering as they approached the classroom, they did not line up outside but entered the classroom on arrival and greeted the teacher on entry. The pupils logged on to their given PC's and then came and sat in the middle of the class and chatted with each other and the teacher until the whole of the class were present where upon the formalised lesson began. The lesson was structured with four clear phases, the first was an introduction, this was brief and mainly involved a sharing of objectives and an introduction to what the teacher proposed they achieve that session. This transitioned on to the main exposition, this was dialogic in its approach with input from the class encouraged and supported, and the teacher using a series of prompts in order to bring about the use of higher order skills with the pupils using their own experience to speculate and come to conclusions about how the website should appear. There was also discussion with the pupils reflecting upon how a suitable and appropriate website might look. Pupils were also asked to comment on the tools within the application they would need to bring this about. During this process the pupils formed their own success criteria for the task. This was supported and steered by the teacher and whilst the success criteria were mainly focused on the use of the tools within the application that they were likely to use to bring about the desired result, it was apparent that the pupils were applying

these tools with the audience of the website in mind. Given that the terminology was used correctly within the lesson, if compared to the perspectives arrived at from the interview data, that the teacher believed that ICT Capability was developed in a continuum starting with the use of tools of the application, though the correct comprehension of the terminology of the subject and finally to being able to use problem solving effectively when using an application. The pupils within this class had developed a degree of ICT capability, this capability may be fragmented in that it may be at different levels depending on the software application they are using and the problem they are solving.

Once the class moved on to the task phase they were able to orchestrate their own learning, this involved using another of the Roles or Codes of Behaviour. This orchestration was evidenced in a number of ways, the first was the development by the pupils of a learning ladder linked to success criteria, again of their own design as part of the problem solving process. The second was the use of the "buddy" system when they required assistance before asking the teacher. This verbalisation of the needs of the task and the tools of the software application requires the pupils to re-synthesise the learning and apply it in the context of their "buddies" website production. In evaluating this aspect of the strategy on the activity it enables the pupils to develop both the tools element of ICT capability and the thinking skills which link to the metacognition the specialist ICT teacher referred to in the need for problem solving in the makeup of ICT capability in the interview.

There were both perceived affordances and perceived constraints which also became a theme for this element of the activity triangle. These included the success criteria for example the need to use hyperlinks to enable navigation from one web page to another, the use of Microsoft PowerPoint as opposed to a different web authoring application; and the need for a feeling of "Welshness" being the constraints referred to. The affordances for learning include a clear understanding by the pupils of what was expected of them, this was in part due to the dialogic approach and in part due to the pupils designing their own success criteria in the form of a "learning ladder". This aspect also brought about ownership of the learning by the pupils and increased their motivation.

Community / Organisational Structures. Key themes within this aspect of the triangle are concerned with the ethos and culture of the class and this will be influenced by the social, political and cultural arena in which the school is situated. As such the features of the learner, and by association the features of the setting or classroom environment become a key aspect. The learners are year eight mixed ability group, the school is situated in a deprived area, and as such this is the culture of the majority of the pupils. The school also has a high level of free school meals. Whilst these factors need not have a direct impact on the activity within the classroom observation, the cultural aspects influence how the pupils may or may not react, particularly in the pupils' self-efficacy and self-esteem which may be lower than pupils from a more affluent area. The pupils are open and forthright, however this confidence does not necessary translate to their own abilities. This being the case for them to discuss the lesson and learning in the classroom in an open and relaxed fashion, they need to feel safe, secure and valued within their environment, this goes a long way to showing the culture which exists both in the classroom and within the school. This is also supported by the paired working which enhances that sense of security within the task phase of the lesson. There was no evidence of the political arena and the need for change which played a large role in the corresponding element of the triangle when looking at the interview.

Roles / Divisions of Labour. The predominant themes of this mediating artefact are the pupil participation, the specialist ICT teacher with their inherent pedagogical and content knowledge and the use of discrete ICT lessons in the development of ICT capability. All of which are in support of ICT capability being a subject in its own right with elements of the tools with which to operate the software applications, its own language in its terminology and ultimately the use of higher order skills to problem solve and justify the use of the ICT application in producing the solution as discussed by the specialist teacher in their interview.

The participation of the pupils is evidenced by the pupils supporting each other learning through the buddy system and the orchestration of learning through the construction of their success criteria. This articulation of both the problem on behalf of the learner seeking assistance and the solution on behalf of the learner giving

assistance requires both learners to reflect on what it is they know or do not know using metacognitive skills in the process. This together with the ultimate reflection of the learning in the lesson evidenced in the dialogue which took place in the plenary brings about the ultimate construction of knowledge and development of ICT capability. Part of the responsibility of this learning is taken by the pupils and their interaction within the lesson and the remaining part is the responsibility of the specialist teacher and the ICT department in the production and design of the programme of study and scheme of work. There is also an influence of the culture of the school in enabling the pupils to learn in this way.

Pupil's Activity Setting
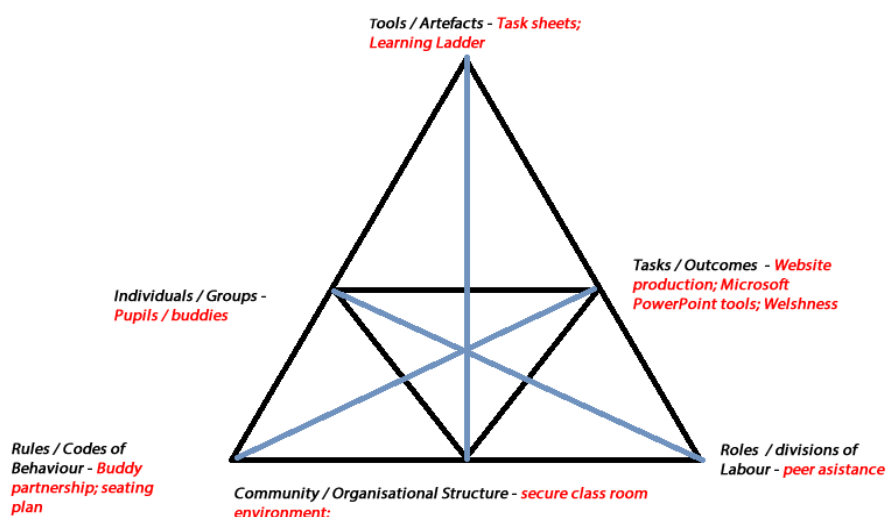
Figure 19 - Initial Observation – pupils' activity setting

Whilst the primary focus of this case study is the teacher's perception of ICT capability and its component parts, the secondary question is whether the methods employed in the development of that capability in the first instance match the teacher's personal constructs, or whether in the second instance this adds to the understanding of what those personal constructs are. In analysing and discussing the activity setting focusing on the development of ICT it has also been recognised that there will be a different perspective if this activity is evaluated from a pupil perspective. Similarities between the two perspectives may give a further insight into the definition of ICT capability within the context of this case study.

Tasks/ Outcomes. The pupil's perspective of the object of the activity is likely to be 'tools' orientated and focused on the ultimate production of a website. The concentration and the learning ladders produced by the pupils focused on items such as the number of pages to be produced using Microsoft PowerPoint and the location and variety of 'action buttons' used to ultimately create hyperlinks and a way of navigating between the pages. There was discussion of 'audience' as concept though this was a little superficial in nature and this discussion tended to concentrate on the use of the colours inherent to Wales and the use of logos which again have associations with Wales such as 'the welsh dragon'. This is in contrast to the object as perceived by the teacher in the previous setting in that the teacher's interpretation of the object had greater focus on the use of higher order skills in evaluating appropriate use of the application and how the tools could be applied in solving the problem of producing an appropriate website.

Tools /Artefacts. There is also a difference in the tools and artefacts used in order to bring about the successful completion of the activity, from the teacher's perspective the tools used to bring about the earning or development of ICT capability where the depth of dialogue and discussion, the curriculum and the design of the intervention and subsequent interaction with the pupils; the production of the "Learning Ladders" and establishment of the success criteria. The pupils also used the "Learning Ladder" which they had created, but also used task sheets reminding them of the ultimate requirements of the activity.

Individuals / Groups. This aspect differs from the previous setting, but is not a contradiction, the difference lies in the focus of the perspective. Previously it has been considered from the teacher's viewpoint, whereas in this instance the activity is from the pupils view point and as such the individuals who are the 'subject' of the activity are the pupils themselves.

Rules / Codes of Behaviour. There are similarities in this mediating factor between the activity as seen by the teacher and the activity as seen by the pupils. In that the rules of the activity have not changed, the 'Buddy system' is still a key part of the lesson structure as is the seating plan and interaction between the pupils.

Community / Organisational Structures. Key within the community of the classroom is the relaxed and comfortable approach the pupils have to the lesson, the ease with which they are able to discuss the lesson with their teacher indicating that they are feeling safe and secure in their environment. From the teacher's perspective, and indeed from the culture of the school, there is recognition of the external environments and the needs of the pupils. This is not likely to be recognised by the pupils. For example the teacher and the school recognise a need to increase the self-efficacy and the self-confidence of the pupils creating a 'safe environment' in which the learning can be effective, these are not aspects which the pupils will be considering. Their perceptions will concentrate more on the enjoyment of the task and possible the social aspect of the classroom.

Roles / Divisions of Labour. The aspect here is once again the 'Buddy system' where they are able to gain assistance from their peers. This division of labour is likely to have two effects, the first being the use of higher order skills, which from a pupil perspective is likely to bring about a feeling of pride and motivation, pride in their own work and pride in being asked to help others, the second a sense of pride in their own team in that they do not need seek assistance from either the teacher or the 'other' team if they can control their own success. Furthermore, an important pedagogical aspect of ICT is the exploration of applications and the sharing of that exploration with each other. Pupils discuss what they are achieving and how they are achieving their desired outcomes, pupils will point out to each other new aspects of the application which they have discovered from this exploration and trial and error. Comments such as "have you tried this" were common place as the task was carried out.

Post reflective dialogue activity setting

Tools / Artefacts - *trust;*
Relationship with Pupils; Dialogue

Individuals / Groups -
specialist ICT teacher

Tasks / Outcomes -
Development of ICT capability;
Pedagogy

Rules / Codes of Behaviour
- *Pupils working with each*
other; seating plan

Community / Organisational Structure - *Safe environment;*
building trust;

Roles / divisions of
Labour - *Pupils taking a*
lead; teacher prompting/
facilitation
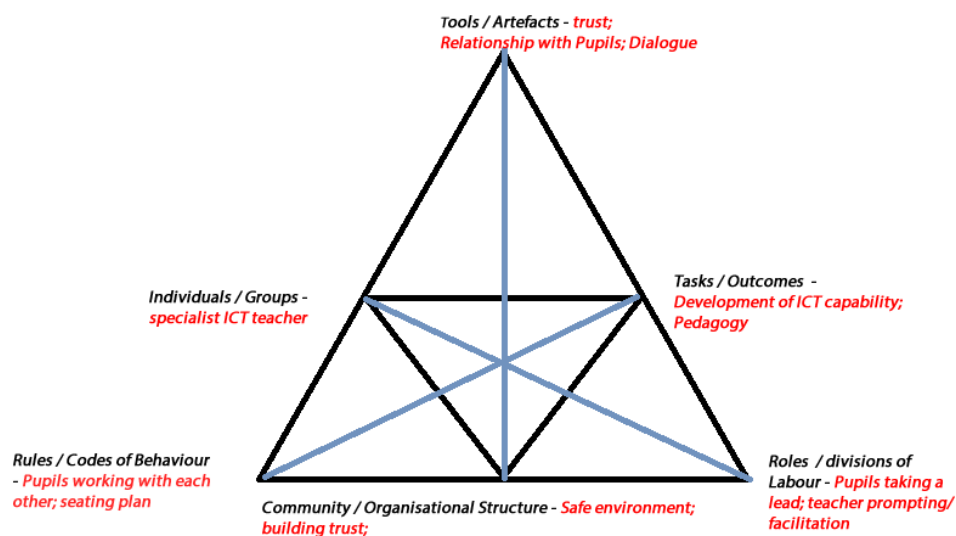
Figure 20 - Post Reflective Dialogue

The post reflective dialogue was conducted shortly after the initial observation and in retrospect the process may have benefitted from a greater time delay in order to allow the teacher a greater time to reflect on their practice. However there were still a number of key themes which emerged which warrant discussion.

These key themes were the pedagogy of the subject; the relationship with the pupils and the need for trust and the use of peer assistance or as the department term it the "buddy system", which has featured throughout the case study.

Tasks/ Outcomes. In this dialogue the focus of the activity has changed slightly, it is still in support of ICT capability and the development of that capability; however the clear focus here is the pedagogical style and the teacher's personal practice, *"teaching in this way where they are free to voice their opinions"*.

Tools /Artefacts. One of the key factors here is the need to develop *"Trust"*, the teacher states quite clearly that it is the trust developed within the classroom which enables the use of dialogue and discourse to enhance the learning. The pupils are free to *"voice their opinions"*, the teacher continues his reflection highlighting that there are some pupils who may be awkward with this approach initially. In this department

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they use the development of ICT to build that confidence and self-efficacy and as they succeed with the topic are more prepared to interact with one another. Further aspects of the reflection was concerned with the way the pupils set their own success criteria as highlighted in the previous activity, which pedagogically supports the teachers encouragement of the pupils use of higher order skills in the development of ICT capability. There was an acknowledgement that pupils with a lesser attainment may need *"pushing to a certain direction"*, this does not detract from the pedagogical style, but rather alludes to the use of dialogue and social intervention in differentiating the learning according to the pupil need. A further pedagogical tool used by the teacher is the pupil's impulsion to explore the software application tools and how these might result in possible solutions. *"kids are great explorers, you can show them the ideal way, but they will still explore software and work out how they can use it"*. This aspect of the lesson and the recognition within the teacher's reflection further supports the need for the pupils to supplement their own learning and the use of the higher order skills previously discussed in the way in which they then use their learning in the formulation of a solution to the problem.

Finally when discussing any possible need for change within their practice the teacher felt that the pedagogical approach the department was using was suited to the needs of the pupils *"we have spent a long time developing the pedagogy here and it really seems to suit the kids here"*.

Individuals / Groups. Like the initial activity of the interview, this activity the development of ICT capability within their pupils.

Rules / Codes of Behaviour. The rules and codes of behaviour set within this pedagogical reflection are, like previous activity settings focused clearly on the use of the pupils in the control and furtherance of their own learning. The use of buddy systems *"They like to interact with each other"*; *"most times if they helped design what they need to do – learning ladders, they have a better understanding of what they need to do"* and *"It works for them."*. These comments show that the teacher has a clear insight into the methods of teaching which work for the pupils in his care and their needs.

Community / Organisational Structures. The focus for this mediating factor is again the reinforcement of the need to build a trusting relationship not only within the classroom but also within the school environment and the effect that relationship has on the pedagogical approach and the development of the pupils within the school; *"Trust is an important part of teaching in this school, the pupils need to trust you to respond"*. There was also reflection on the external changing environment with a concern regarding those changes taking place and a genuine concern as to the suitability of the proposed changes to the curriculum and the needs of the pupils within the school. *"I am a little concerned at the changes which might be imposed on us"; "I don't see a need to introduce computer science at KS3, I don't think it would help our kids"*. The teacher goes on to say that *"There is so much specialism they need a good basis and then they can explore different routes later"*, implying that they believe that there is a need amongst his pupils for the development of any capability in stages. This support an earlier view expressed in the initial interview where they describes the development of ICT capability as being dependent on firstly an understanding and knowledge of the "tools" of the applications used, the associated terminology and finally the ability to use that in a problem solving environment or situation.

Roles / Divisions of Labour. The reflection discussed the use of the buddy system, how the pupils get a sense of achievement and enjoyment out of helping each other and also about the level of ICT capability amongst the staff developing ICT capability at KS3 and the impact that may have on the capability of the pupils. The teacher took the idea of exploration of software and went on to reflect how pupils are generally very good at recognising those members of the class who are the best source of help and information, and that it is partly this instinct for their peers expertise and the ability to share that knowledge which inspires the collaborative learning. *"They are also really good at working out those other kids who may be able to help them when they get stuck. They instinctively know when someone is good at something"*.

Another focus for reflection was the ICT capability of the staff and the impact that that capability may have on the development of ICT capability within the pupils. Given that the School has a policy that ICT capability is developed through discrete ICT sessions

taught by specialist ICT teachers, this most likely refers to the use of ICT on a cross curricular basis in other subjects. The implication was that the capability of many of the staff was good, *"The ICT capability of the teachers can definitely have an impact, but I would say that most of them are fairly good"* (Appendix IV School C PRD:12). The inference here is that whilst ICT capability is developed through specialist teaching, this is also supported within the other subjects on a cross curricular basis.

Second Observation Activity Setting
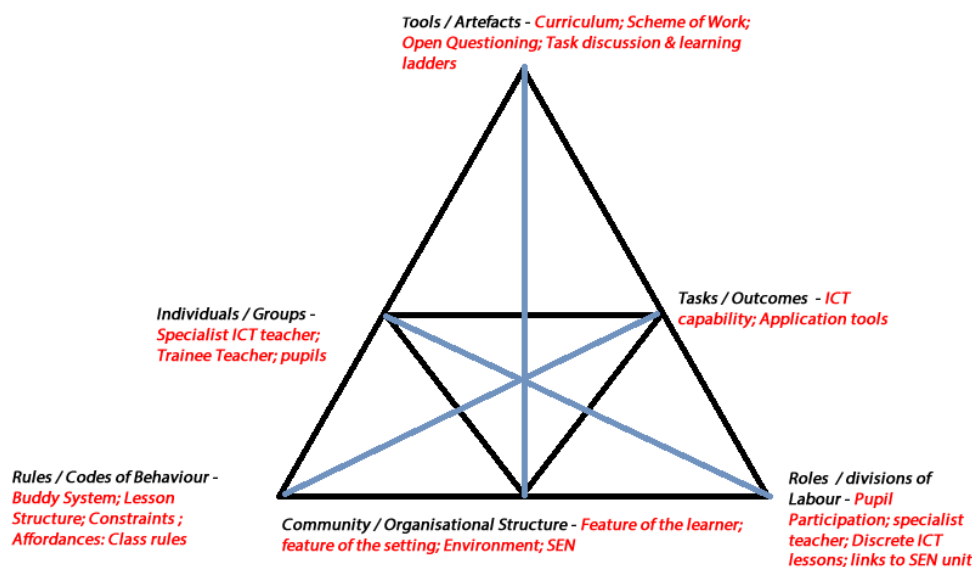
Figure 21 - Final Observation

Tasks/ Outcomes. As with the previous observation of classroom activity the task had a twofold approach, the first being the use of the tools of Adobe Photoshop to re-model one picture from another and to manipulate graphics using the application, the other was an appreciation by the pupils when this application may be used. The key point here was appropriate use, which meant that the pupils had to decide when such photo manipulation was appropriate. This was evidenced by a discussion between the class and the teacher regarding the possible over use of 'air-brushing' in celebrity media. The main learning however, was focused on the use of the tools associated with the application. When compared to the definition of ICT capability as given in the initial interview the concentration on the 'tools' rather than the terminology or the later progression of the use of the higher order skills would imply that this class was at a lower level of learning with this application than previously had been witnessed in the

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other class, where they were required to use their metacognitive skills in the production of the website.

Tools /Artefacts. The tools used in the development of the activity, that of teaching ICT and the development of ICT capability was again the curriculum and scheme of work, these had been designed with the needs of the pupils and the pedagogical strategy as a focus and linked to the National curriculum at KS3. The use of discussion was apparent throughout, with particular emphasis on the use of 'air-brushing' and photo manipulation in the media. The task was explained and the pupils were supported in their design of the success criteria in the form of a learning ladder. In this instance there was a need to prompt the group, through further discussion and questioning. This was carried out to expand the learning ladder and develop a greater understanding amongst the class regarding the application of the tools of the software under exploration. There was a demonstration of the software in addition to the exposition and discussion of the use of the software, where the focus was on the tools of the software, but beginning an introduction into some of the concepts behind the software's use.

Individuals / Groups. The class involved the pupils, who were a low attaining year eight class, the specialist ICT teacher and a trainee teacher who was circulating the classroom taking on the role of assistant. The impact of this additional member within the activity meant that there was additional help for the pupils. This added availability may encourage the pupils to ask the teacher or trainee rather than the peers.

Rules / Codes of Behaviour. The constraints here were limited to the parameters of the task in that there was a specific end result required, however, although a perceived constraint this structure enabled the group to explore the software tools in greater depth than had the focus of the task been less structured. This supports the focus of the lesson which was set at a lower stage of development than had been observed previously. This staging of development of ICT capability may be due to the class being less able, although their ICT ability and confidence within the class belied the setting of a low attaining group. It may also be in accordance with the belief stated in the initial interview that ICT capability is primarily developed in stages and this group are

currently at a lower stage in the development of capability with this particular software. The key affordances for learning took the form of the buddy system, with peer assistance where necessary, the involvement of the pupils in designing their own success criteria can also be seen as an affordance as they would develop a better understanding of the learning expected of them, however, it may be debatable as to the depth of that independent construction of knowledge given the level of structure and expectation from the task. The seating plan and peer assistance ethos within the classroom was the same as in previous classroom activity.

Community / Organisational Structures. The features of the learner were different to the previous class room activity in as much as they were lower attaining, this would place a higher level of importance on the setting and the environment in which they were working in order to develop a dialogic approach to the teaching. The setting, that of their regular classroom afforded a sense of security and an environment in which confidence of the pupil could be nurtured. This was also evident by the relationship with the teacher; *"When the teacher became aware of the disruption it was rectified with a look followed up by a quiet comment. No sanctions were necessary"* (Appendix IV School C FO:2) indicating a respect for the teacher and a relationship allowing classroom control emanating from the teacher.

Roles / Divisions of Labour. This aspect of the activity setting, again was very similar to the previous classroom activity observation, in that the production of the lesson and associated resources were the responsibility of the specialist ICT teacher, enabling the pupils to create a level of affordance and construction of knowledge albeit at an operational level. The pupils' had a role in orchestrating their own learning through exploration of the application tools, as they did in the use of the peer support. It became apparent that they enjoyed this aspect of the lesson and this will lead to greater motivation and self-confidence, which in discussion with the teacher is part of the 'hidden' curriculum of the school. This was evidenced in particular in the way the pupils discussed how they used the tools and how they had found alternative ways of carrying out the task. The questioning an prompting were carried out by the teacher, however the use of open questioning and prompting for greater depth of answer from

the pupils was also evidence of reflection on action, and this coupled with the pupils personal reflection on how they were utilising the software resulted in the construction of knowledge.

Final Interview
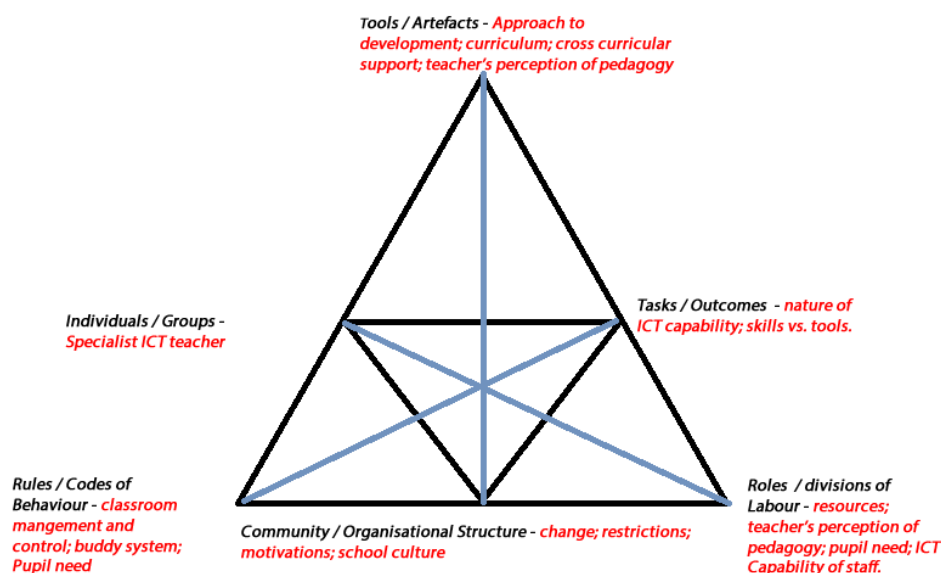
Figure 22 - Final interview Specialist ICT teacher

Tasks/ Outcomes. The object of the final interview refocuses on the original question of what the nature of ICT capability is, it evaluates the its components by examining a number of factors such as the pedagogy involved in its development; the needs of the pupils; the curriculum, both that which is in existence and the proposed changes at time of interview. Pedagogy also plays a large part of the discussion. There is evidence of how they will look at a variety of related software applications so that the pupils need to use those higher order metacognitive skills in a decision, of which application to use to solve an ultimate problem.

Tools /Artefacts. Key themes emerging are the way in which the teacher, indeed the department within the institution develops ICT capability through the use of peer assistance, the differentiation put into place within the classroom and use of pupil engagement through dialogue and discussion. There is a discussion about how the different abilities are catered for, the need to ensure that all levels have the opportunity to succeed whilst maintain the challenge *"It is the extremes of ability that you need to be careful of and it is not about simplifying work but to enable there to still*

be a push, so that you can push the others". The pedagogical approach was recognised as being different for different abilities, ICT capability was still developed with the same components including the use of problem solving, however the approach and scaffolding was different for different groups, *"It's the approach you take with them it may be the exercises that are different or it may be the time"* and *"the tops might take one lesson to do something whereas with the unit kids you may take two or three sessions, don't rush them that's the main thing and we've had some fantastic results with it especially you can see this with the year nine kids when they're taking the Essential Skills Wales tests."*.

One of the key pedagogical tool used within the classroom and by the specialist ICT teachers is the use of "learning ladders", whereby the pupils develop their own success criteria for the topic under study, this method enables the pupils to take control of their own learning and to use their metacognitive skills which the teacher believes are part of ICT capability and problem solving. This is developed within all the groups regardless of the ability, ensuring that all the pupils are able to use ICT appropriately, rather than carrying out a tool based task by rote. To enable this there is again a variation of approach, in that there is greater scaffolding put into place for the lower attaining pupils, *"It may be that we create a collective one rather than individual learning ladders each of them"* and *"cannot fit the profile or plan that you may use for the higher ability"*. All these points support a pedagogical and curricular approach where all pupils are given the support and opportunity to develop ICT capability in such a way that it involves both the "tools" of the application and the metacognitive skills required to use ICT appropriately to solve problems. This shows no contradiction to the teacher's original perceptions of ICT capability being composed of elements including, firstly the tools of the application, the terminology which supports the applications use, and the ultimate use of metacognitive skills in the ability to use the ICT appropriately to solve problems.

There was a further discussion explaining how the team within the ICT department use opportunities which exist on a cross curricular basis in order to support the development of ICT development, this is particularly the case for year nine, where there may be similar work being carried out in English and ICT with the Essential skills

Wales qualifications. This cross curricular liaison has meant that pupils in year nine have had the opportunity of combining work from English and ICT, and not had to repeat work in the two differing subject areas and this mode of study has had a positive impact on pupil attitude. However, there is also recognition that some cross curricular work is on a one off basis whereby there is a requirement within a different discrete subject area for the use of particular software. The tools of the software are then introduced within the discrete ICT lessons where the pupils will explore the use of these tools and the effects they may have, so that when they are exposed to the software in another curricular subject they are proficient in its use for the purpose that other subject requires. There may not be the development of the associated terminology or the subsequent problem solving development occurring because the subsequent tasks are carried out in the non-ICT subject area. *"Links tend to be on a one-off basis so that we can introduce them to an application and they can then produce something that is required within their different subject areas."*, this is in distinct contradiction with previous assumptions and statements that ICT capability is best developed by specialist ICT teachers, within discrete ICT lessons. Given that the specialist's viewpoint is that ICT capability is a combination of the tools of the application, the associated terminology and the metacognitive ability to use said application appropriately to solve problems, then it could be argued that only the first component is being developed within discrete ICT lessons by ICT specialist teachers

Individuals / Groups. The individuals and groups involved in the activity, also referred to as the subject of the activity is the specialist ICT teacher, who is the focus of the case study.

Rules / Codes of Behaviour. This mediating factor has remained fairly consistent throughout the case study and once again focuses on the use of the buddy system and, the need of the pupils, however in this instance there was a discussion, concerning how the 'Buddy' system could be used not only as peer support and pupil engagement but also as a means of classroom management and control. The teacher explained that the seating plans, the pairing and often the overall teams were changed regularly, usually every half term, which enabled the teacher to manipulate the system to suit the needs of the pupils in individual classes. This requirement within the department

to change or adapt the pairings and teams, gave opportunity to move pupils into more productive settings from a classroom management and attainment perspective. This manipulation can also be construed as supporting the differentiation for the extremes of attainment within the mixed ability groups.

Community / Organisational Structures. Differentiation was a theme within the culture of the school supporting the aspects within the Tools and Artefact mediating factor, discussed above, *"As a whole school differentiation is highlighted"*. There are also close links within the department and the SEN unit within the school. There is evidence that there has been a change in culture regarding ICT and SEN over recent years within the organisation. This change in culture may be partly attributed to the scaffolding and differentiated focus within the departmental pedagogy. *"the unit pupils have only come back into mainstream IT within the last five years problem that we had in the past was that IT may not be best for them because the LSA's were doing the work for the pupils so the pupils were not learning anything. But they've now come back in and we will teach them the same exactly the same skills and knowledge as mainstream as a set one would be taught."; "It's the approach you take with them it may be the exercises that are different or it may be the time"*, and, *"But they've all been achieving a level I which speaks volumes that were doing something right otherwise they'd be struggling"*.

Roles / Divisions of Labour. The teacher's perception of pedagogy and how this is matched to the needs of the pupils, indeed the curriculum and how that is matched to the needs of the pupils, were the key focus in this element. There was an addition of the use of resources and the way in which they were adapted to best bring about the development of ICT capability, not just for the "more able and talented" pupils but also for the less able and talented was also an emerging theme here. This may have been due to the focus on the role of differentiation with the development of ICT capability, which has become a key theme throughout the activity setting. The pupil need emerged not only from the need to adapt resources, but also with the effect of any proposed changes to the national curriculum, and any possible effect this may have on practice within the school. The over-riding impression was that any introduction of aspects of computing or computer science would have an impact here

and this may not be beneficial to the pupils, at least not in the KS3 programme of study. This can be construed as having an effect on the way in which ICT and ICT capability is viewed in that the introduction or greater emphasis on computing would perhaps imply that ICT capability is more tools based than having a metacognitive component. However there was reference to a need to introduce certain skills at an earlier phase of education, *"more about expanding the range of understanding, greater inject at an early age more of the IT aspects, there may be a greater broader result."* but a confirmation that this new "inject" of material should be a broad based rather than confined to "programming" for example, *"There needs to be greater emphasis on the wider aspects of IT rather than going down a narrow route of programming"*.

In discussing the use of the buddy system as a means of peer support, there was a recognition of a danger that the pupils are able to quickly recognise those members of their peers with expertise and that once recognised it is those pupils who are bombarded with pleas for assistance, *"kids will know who are the more able and talented and who they can turn to fix problem",* and *"there are times though that you think hold a minute everyone is going to that one person and they are not benefiting at all",* however, later in the interview there are comment highlighting the learning going on between pairs of pupils with paired working. *"And you'll see learning going on between those two people and the partner leading it"*

ICT capability of teachers and the effect that that may have on pupils was also touched upon, in that there was a reference to the development of ICT capability on a cross curricular level, and whilst in the initial interview the specialist ICT teacher had voiced an opinion that the capability of the teacher had a definite impact on the development of ICT capability within the pupils, the discussion here was connected with the way in which teachers from non ICT areas where improving their skills by having access to the ICT rooms and software they may not normally use, and from benefitting from the ICT department introducing the pupils to the tools of an application which may be used at a later stage in a different subjects lesson. (Appendix IV School C FI:31) and *"And this increased ICT capability (of) staff has had an impact on improving the ICT capability of the kids."*.

School C Scheme of Work

The scheme of work supplied by School C have a number of interesting points of note, the first is that it is a scheme of work which details not just KS3 but also KS4, whilst the focus of the study is limited to KS3, the combination of the two stages within the same documents strongly indicated a progression from one stage to the next. Secondly there are clear links to the 14-19 skills framework, which includes the use of communication and thinking skills. This inclusion, particularly of thinking skills further supports the perception of ICT capability having metacognitive components to it as was outlined in the initial interview. Further evidence of this definition can be found in the detail, where throughout there are indications of the need to *"Discuss"* highlighting clear intent to develop ICT capability in a dialogic manner and links to socio-constructivist approach in its development.

Contradictions

There are a number of key contradictions which exist between the varieties of activity settings outlined above. These mainly exist between the two interviews, the practices observed on both occasion together with the scheme of work substantiate the view of the teacher outlined in the initial interview that ICT capability exists as an amalgamation of the ability to use the tools of a given software application, the associated terminology and ultimately the ability to use the application appropriately to solve a problem. The table below outlines the key contradictions which exist within and between the activity settings.

Activity Triangle	Type of contradiction	Mediating factors	Location of Contradiction
Initial Initerview	Secondary	Task / outcomes & Tools / artefacts	Possible contradiction between the definition of ICT capability as being developed in linear approach in stages and the use of discourse and dialogue with links to development which is more holistic in nature
Initial interview	Primary	Tools and artefacts	Possible contradiction between the NC orders and the perception that communication strand is more important.
Initial Inierview	Secondary	Object & tools / artefacts & community / Organisation	Perception of ICT curriculum, and the national curiculum, VS possible changes to the NC Orders and perceived reasons for those changes
Initial interview and final interview	Tertiary	Tools / artefacts	Contradiction between developemnt of ICT capability by specialist teachers in discrete lessons and on a cross curricular basis.
Initial interview and Final Interview	Tertiary	Roles divisions of labour	Impact of Non-specialist ICT teachers' capability and the development of ICT capability in the pupils
Initial interview and Final Interview	Tertiary	Rules and codes of behaviour	Use of buddy system as an aid to developing more able and talented and the danger of overburdening the peers doing the assisting.
Final Interview	Primary	Roles and Divisions of labour	Peers' assistance in that the use of the peer assistance and the buddy sytem is beneficial to the learners and the opportunity for over use of particular more able and talented learners within this system.

Table 5.3 - Summary of Contradictions of Activity Settings Case Study C

Discussion of Case C

When discussing the nature of ICT capability with the specialist ICT teacher being interviewed there were a number of key themes which emerged, one was the passion for the subject of ICT together with clear beliefs concerning the development of ICT capability, another was the pedagogy of the subject in relation to his cohort of pupils, the *"according to their abilities and according to their needs."*(Appendix IV School C 1 FI:18)*,* and how the current curriculum suited their needs. There is a strong theme that

ICT Capability is multi-faceted in that it is not just concerned with the use of the tools of an application, but also has an element concerned with the ability to discern appropriate use; *"not simply about acquiring and retaining knowledge or information, but also knowing how to use it appropriately",* (Appendix IV School C FI:18).

In trying to establish the specialist ICT teacher's perceptions of ICT capability, and whether the classroom practices observed supported their personal constructs there were a number of key contradictions which emerged. The first was twofold in that both a primary and a secondary contradiction emerged within the initial interview activity. A primary contradiction is one where there is discord between the same mediating artefact within the same activity setting, in this case the "Tools and Artefacts" element of the triangle, whereas, a secondary contradiction is a contradiction between two differing mediating factors within the same activity setting. In this case it exists between the mediating factors of "Task and Outcomes" and "Tools and Artefacts". Within the task and outcomes, or as it is sometimes referred to as the object of the activity setting there is a clear perception that ICT capability exists as a combination of the tools of the application, the associated terminology and ultimately the ability to use the tools and terminology appropriately in the problem solving process, there is also an implication that this is developed in a linear way, with the pupils firstly mastering the tools aspect before moving on to the use of terminology and finally developing the capacity to use it in a problem solving way. This development in clear and defined stages implies that the ICT capability is best developed using a linear philosophy in that they first have to master one aspect before they are able to move on to the next stage of learning. However when discussing the tools and artefacts used to develop ICT capability there is a reliance on the use of discussion and dialogue, this dialogue exists on two levels, dialogue between the teacher and the pupils through the use of discussion and question and answer, and the production of the use of learning ladders, and secondly as a method of peer assistance within the "buddy" system. This method of development implies more of a holistic, approach where different aspects of ICT capability are developed concurrently, in the use of discourse and social inter action between both pupils and teacher and pupils and pupils. In this instance the contradiction can be argued that in order to use dialogue and discourse within the development of ICT capability there is a need for an

understanding of the associated terminology and a degree of developing understanding of appropriate use of the software to be in place in order that there is successful use of a dialogue between pupil and teacher in the development of ICT capability. This concept means that ICT capability, whilst having the components discussed is likely to be more holistic in nature than linear in its makeup.

There was a further contradiction, primary in nature, within the initial interview and again this existed within the "Tools and Artefacts" element of the setting. However, in this instance it was concerned with the nature of the NCO for Information Communication Technology (ACCAC, 2008a) and teacher's perception of how that fitted with the curriculum within the school. The NCO for Information Communication Technology (AACAC, 2008a) consists of two equal strands that of Analysing and Handling Data, including modelling which used to exist as an independent strand, and Finding and Communication Information, which includes the use of the internet and the inherent safety required for responsible use of the Internet and child safety. These two strands are considered equal, though Analysing and Handling Data appears before Finding and Communication Information within the document. At no point in the document is there an inference that one strand has more relevance or is more important than the other. However, within the initial interview there is a statement implying that the understanding of the orders by the teacher is such that they believe that the orders give a higher level of importance to the Analysing and Handling Data strand. The teacher goes on to state that they believe that there should be a greater status given to the Finding and Communication Information strand. This tends to imply that ICT capability is more about communicating than the use of analysing and handling data regardless of how that data exists, be it text, numerical, or indeed graphics or multimedia. Whilst there is evidence that the teacher believes that the subject should be developed in such a way that is innovative using all aspects of emerging technology, there is an implication that ICT capability is also confined with a greater status being given to the communication aspect of the subject. This also has implications for the appropriate use aspect of the teacher's definition of ICT capability, in that if the analytical aspect of ICT is diminished in any way, then how are pupils able to define appropriate use indiscriminately?

Furthermore, a second contradiction or discord emerged between the Object, the tools and artefacts and the Community and Organisation, particularly when considering the externality of the political situation and proposed changes taking place in England, which many of the profession here in Wales felt would follow. The teacher felt that the National Curriculum (2008) within Wales was fit for purpose, with the possible exception of the perceived status of the two strands as discussed in the previous paragraph. When discussing the changes proposed for England the teacher was vehement in his opposition, expressing views that those proposed changes were not suitable for KS3 and that it was not the subject which needed alteration, but that many teachers needed to take responsibility for their approach to the subject and to make the development of ICT capability more innovative and exciting. This exhibited a reluctance to change, however, recognised that ICT capability should grow with the growth in technology and its use.

As shown in the table of contradictions, the contradictions recognised within this analysis existed either within the interviews or between the interviews the following contradictions have emerged from analysing the settings of the initial and final interview and their comparisons.

There are three contradictions arising between the two interviews all tertiary in nature, a tertiary contradiction is that which exists between two historical activity settings. The first exists within the tools and artefact elements of the two settings. The contradiction is one concerning the development of ICT capability and the pedagogical approach to the subject. The case study shows that the school develop ICT within discrete ICT lessons and employs specialist teachers to do this, this in itself bestows a particular status on the subject in that it is regarded by the senior management to be of sufficient importance to have its own department with its own specialised staff. The teacher agrees that this is the way to develop ICT capability, in fact goes as far as to state that he believes that ICT capability cannot be adequately developed using "polyfilla" teachers (Appendix IV School C II:41), meaning that it cannot be developed using non-specialist teachers who have ICT lessons to fill their timetable. This view supports his definition of ICT capability, the appropriate status afforded it by the school and the pedagogical strategy for its development, however in the final

interview he discusses the use of cross curricular development where the tools aspect of the application are developed in the discrete ICT lessons, however the appropriate use aspect or the problem solving aspect seem to be developed in the non-ICT subject using the tools. This is in discord in that you need to have the pedagogical knowledge in order to adequately develop the subject. This is also evident as another tertiary contradiction between the two interviews in the mediating factor of roles in division of labour, where there is a clear conviction that the capability of the teacher has a direct impact on the development of ICT capability in the pupil. However this way of developing that part of ICT capability associated with the higher order metacognitive skills within another subject in school, appears to reduce the status of the discrete ICT lessons to a tools based discipline rather than one with higher order skills. Furthermore, the cross curricular subject in which the ICT is used is likely to be concentrating on the development of the concepts associated with their specialist subject not those associated within ICT and ICT capability. Therefore, the level to which the capability of the pupils can be developed will be limited by the capability of the non-specialist teacher.

The final tertiary contradiction observed as existing between the two interviews exists in the Rules and Codes of behaviour and is concerned with the use of the buddy system developed as a method of using peer assistance to empower the pupils to take control of their learning and to use their metacognitive skills in the development of ICT capability. In the earlier interview and indeed within the observed classroom activities there was evidence of good interaction between paired working and when necessary pupils taking their need for assistance further up the code from their 'paired' working to another member of the team for assistance. The implication was one of mutual benefit; on the one hand the pupil was receiving assistance from a peer who could develop a discourse using the language appropriate to their fellow pupil's ability and understanding, and on the other hand the pupil providing the support was able to further develop their capability by the use of metacognitive skills in re-synthesising their learning to impart to a fellow pupil. However, within the final interview there is an acknowledgement that because pupils are easily able to determine those pupils who are developing excellence within their peers, there is a tendency to always approach these high attaining pupils in order to seek assistance, and in turn this over

reliance on a smaller group of pupils is not entirely beneficial to the development of those more able pupils. This is further confirmed by a primary contradiction in the roles and divisions of labour element of the final interview highlighting the same evidence.

On the whole the evidence discussed shows that the ICT teacher perceives ICT capability to be multifaceted and that it comprises of application tools, associated terminology and the use of metacognition to support problem solving, this is further supported in the way in which the teacher develops the capability in his pupils. There are minor contradictions which have emerged throughout the analysis of the various activities; however these are not of sufficient depth to greatly impact on the teachers' perceptions or their practice.

Summary

Having used activity settings to analyse the data from the three independent case studies there is a need to establish any commonality or difference between the constructs of ICT capability and the supporting classroom practice. Furthermore, there are also other themes which emerged from the data which were outside the scope of the analytical tool used within activity theory. A discussion in the form of a cross case analysis will allow these themes and any commonalities or difference in the data to be evaluated. Once this cross case analysis has been carried out the data will be discussed in the final chapter.

Chapter Six - Cross case analysis, and additional themes.

Within this chapter there is an evaluation of the three case studies and how these may relate to each other and with the findings highlighted in the previous chapter. There was also a discussion of additional themes which arose from the coding of the qualitative data as has been described within the methodology section. A summary of the various themes can be found at the end of the chapter. It is also worth noting that in the analysis of this data the concept of pedagogical tools and pedagogical strategies arose and needed some definition. For the purpose of this discussion a pedagogical strategy is the method of approach of each school used in their development of ICT capability, whereas the pedagogical tool is a specific instrument used within that development which is particular to the school. For example, in School A the use of master-classes followed by the workshops might be considered a pedagogical strategy with the outcome or product of the master-class being a pedagogical tool for use by the pupils in the subsequent workshop. Similarly in School B the pedagogical strategy is the method of facilitation used, with the peer support and production of help guides, videos available online, or indeed the resultant resource produced by the pupils to aid the learning of other pupils being the pedagogical tools. Finally in School C the pedagogical strategy observed was the use of a "buddy" system with "buddy" as the pedagogical tool.

Cross Case analysis

The cases have been evaluated to find any similarities and any key differences. It is important that the conclusions from each of the individual case studies are established in their own right as an interpretation of the perception of the individual specialist ICT teacher, their emerging personal constructs of ICT capability and their development of that capability within their pupils. However in establishing any similarities or noting any differences, which have emerged, it may be possible to derive further interpretations within the data. In addition to any key differences or indeed similarities between the contradictions highlighted using cultural historical activity theory, there were also additional themes which emerged when coding qualitative data from each of the case studies, which did not readily fit into activity setting. Within this chapter the contradictions from the individual case studies will be discussed as they relate across

the cases. Any additional themes which were highlighted from qualitative data will also be discussed. Finally there will be analysis and discussion of the quantitative data which emerged from the cross Wales questionnaire.

It is worth noting is that all three schools have primary contradictions arising within the tools and artefacts in the activity setting of their initial interview. This primary contradiction is concerned with the teachers' perception of the National Curriculum and their interpretation of it in relation to ICT Capability. In School A, this contradiction is concerned with the way in which ICT capability is taught through the use of masterclasses and intense study over the period of one week for every year group throughout the school year. However, the National Curriculum suggests that the development of ICT capability should exist either through a cross curricular route or through discrete ICT lessons, usually amounting to approximately an hour a week. Contradictions in schools B and C also exist within tools and artefacts within the initial interview. However in both these cases the contradiction was concerned with the elements of ICT capability within the National Curriculum not with the approach to its development. Both teachers from schools B and C felt that their perception of ICT capability differed to that published within the National Curriculum.

All three teachers in their initial interview claimed that they believed ICT capability was built up through a combined use of the software tools, and higher order metacognitive skills in order to use ICT appropriately. Similarly, all three ICT teachers also described their approach to development of ICT capability in such a way that this development of metacognitive skills was included. In School A, this took the form of discussing how the pupils evaluated their completion of the task and the use of peer assessment to highlight further improvement. This aspect was also stipulated within the scheme of work supplied by School A. In school B this was discussed as being the way in which pupils were encouraged to use their higher order metacognitive skills in the selection of tools used to complete the task and the production of help guides for their peers, whilst in School C it was the verbalisation and discussion of the success criteria and learning ladders together with the "buddy system" used amongst the pupils of the class when seeking help with the task.

When the observations of schools B and C were compared to their initial and final interviews there were no concrete contradictions between their practice and their perceptions of ICT capability. Within the classroom the teachers used pedagogical tools and teaching strategies which allowed their pupils to develop metacognitive skills through the use of software applications in problem-solving. However, when the practice of school A was compared to the initial interview it was noted that, whilst the teacher claimed that ICT capability included those metacognitive skills, the practice only supported superficial use of any higher-order skills. However, as the cycle of data collection continued, there was little change exhibited by schools B and C and contradictions particularly in school C existed between the initial and final interviews.

In contrast, there was a distinct change in perception within school A. Whilst initially ICT capability was described as containing both lower order tools based skills and higher-based metacognitive skills after reflection on practice, within the final interview the perception of ICT capability appears to have changed. The skills associated with ICT capability, previously recognised as including higher order metacognitive skills such as the use of thinking skills and evaluation were now reduced in status and were defined as being synonymous with the tools learnt in order to manipulate the particular software application in that the higher order skills previously mentioned were ignored.

Perhaps the key difference emerging amongst the case studies is the difference in perception between the specialist teachers about the nature of ICT capability. In schools B and C it is clear throughout that they believe ICT capability to be about the development of not only the tools associated with particular software, but also in the development of associated metacognition in order that the pupil can justify their use of software and to be able to use ICT capability in a problem solving situation. The teachers in schools B and C indicate in their interviews that they believe the ability to justify the use of a particular software tool is of importance together with the ability to use the language of the subject to articulate why and how their use of ICT is appropriate, this perception is further supported within the classroom observation data with the pedagogical tools used in the development of ICT Capability. However, whilst the teacher in School A initially appears to perceive ICT capability as being composed of both the tools of the application and the higher order metacognitive skills

associated with problem solving, their practice and subsequent perception changes to reduce the capability to a 'tools-only' component.

Furthermore, there are clear differences between the schools in relation to how they develop their pupils' ICT capability. On one hand school A's practice is one of a tools based low-level skill approach, with only a superficial opportunity for the pupils to use the higher order metacognitive skills such as evaluation and justification, on the other end of the continuum of practice is School B where the development exists within a framework of facilitation, with the teacher offering support but with much of the development taking place through exploration of the software in use. In this instance there is support documentation to scaffold the learner in their use ICT. However, the development of the metacognitive aspect is on a strictly problem solving basis where the teacher expects the learner to find their own opportunities to construct knowledge and use their metacognitive skills together with their newly found tools knowledge to solve the problem presented to them. Between these two extremes lies the practice observed in school C. The practice observed here is closer along the continuum to School B than to School A, in that the development again relies heavily on the ability to use ICT to solve problems, and there is evidence of the development of metacognitive skills, however in this instance there is greater scaffolding in place to assist the pupils than was in place in school B, but not as tools based as in school A. However the perception of the way in which ICT capability was developed in School C was of an almost linear progression, in which the tools of the application were developed first, then this was built upon to include the associated terminology, and then ultimately the scheme of work led to the use of metacognition and problem solving.

Whilst there appear to be greater similarities between schools B and C, in that both teachers are developing the use of metacognition amongst their pupils, albeit in different ways. In School B the role of the teacher is as a facilitator. For this style to work adequately, there is a need for engagement and involvement on the part of the pupils. Another similarity between the teaching styles was the use of pupil talk in the construction of knowledge. In school A this was only a superficial feature of the approach, whilst in Schools B and C this use of pupil discussion was made greater use of and to greater effect in developing those higher order skills. However the

motivation and engagement encountered through the use of the "Buddy System" appeared to be more consistent across the class being observed than in School B. This may be due to the greater degree of scaffolding put in place in this instance than when the teacher just takes on the role of facilitator. In the case of school C the teacher was able to scaffold the work through the use of discussion according to the needs of the class, furthermore the peer assistance given by the pupils to one another was in response to the success criteria they had themselves formulated for the tasks. This appeared to generate greater engagement with the process on the part of the pupils. However the style of facilitation employed by the teacher in school B depended heavily on the pupils self-motivation and if for any reason that was absent there was not the same degree of involvement as had been observed in school C.

Further interesting anomalies emerged from the teachers' perceptions of change particularly in relation to the possible changes to the curriculum and the possible introduction of computer science to the KS3 curriculum. Two of the teachers, those from School A and B, regarded the changes that had been proposed in England as positive. The teacher from School A viewing the changes as needing an increase in resources and thus positive to her situation and possibly to an increase in the status of her subject, however this is in discord with her perceptions of ICT capability and her development of the subject. The teacher in School B indicated that the changes proposed did not go far enough and in addition to the inclusion of coding and "Computational Thinking" as has been suggested that there should also be the links between hardware and computer design and maintenance included. Conversely the teacher from School C took exception to the need for change and felt that any introduction of any aspects of computer science would be detrimental to the subject. There was a suggestion that perhaps other teachers should examine how they are teaching the subject if they consider the subject to be in need to change.

The final emergent themes which warrant discussion are the viewpoint of the status of the subject in the schools and the use of non-specialist teachers together with the impact this may or may not have on the development of ICT capability within the pupils.

On the question of status, the cultures of schools B and C afforded a higher status to the subject than that afforded in School A, in that in both Schools B and C the subject was taught within a discrete timetable using mostly subject specialist teachers. In contrast, in School A ICT was developed largely on a cross-curricular basis within other core subjects. The development was backed up by each class within KS3 being afforded a week a year of specialist ICT each year. This was developed through a system of "Master-classes" and followed by workshops throughout the week. The scheme of work for these ICT weeks were designed by the specialist ICT teacher and the "Master-classes" were delivered by the ICT specialist, however the workshops were delivered by the non-ICT specialist teachers. This suggests that there is a belief that the ICT capability of the teachers does not have an impact on the development of the ICT capability of the pupil. This was not a view shared in the other schools, in which not only was a greater status afforded to the subject, but the development by specialist teachers meant that meant that development of ICT capability could be adapted according to the needs of the pupils in any given situation.

As stated previously, in School A the scheme of work was developed by the specialist teacher as was the differentiation, however because she only taught the pupils of each year group in KS3 for one week each of the year, the needs of the individual pupils may not have been catered for as the teacher designing the work had no real substantial knowledge of the pupils' individual ICT capabilities. Furthermore the weaker pupils had their ICT capability developed through the non-ICT specialist teachers, who had the lesser capability themselves. This is a considerable difference in the attitude of the three case studies to the development of ICT capability and the use of non-specialist teachers. In both the other schools there was a stated belief that the capability of the teacher has a direct link with the development of the capability of the pupil. In schools B and C there appears to be only a small usage of non-specialists in the development of ICT capability at KS3, with School C having cross curricular development in certain instances where non-ICT teachers require their pupils to be proficient in the use of a particular software to support the teaching of their subject. Furthermore it could be argued that School B has an even greater regard to the need to match pedagogical subject knowledge to the needs of the pupils, as in the course of the study they withdrew the specialist ICT teacher involved in this case study in order to make greater use of his knowledge at KS4 and KS5 making him unavailable to continue in this study.

The pedagogical tools and strategies used by the teachers involved warrants further discussion. In the case of school A, the main pedagogical strategy was the use of master - class, which on observation emerged as a way of allowing the specialist ICT teacher to demonstrate the use of the software application to all the students within a year group at one time within a lecture theatre type environment. This was then followed up by workshops allowing different ability groups opportunities to engage with the task and achieve the outcomes required. As inferred previously, this pedagogical strategy was based on development of the tools associated with application software. The class that was observed was one of high attainment, with pupils who were confident and able to construct their own knowledge, however the opportunities within the workshop for them to apply that knowledge and use metacognitive skills were limited. In contrast, in both schools B and C, the main pedagogical tools employed, were designed in such a way that the pupils were able to both use and develop metacognitive skills to some extent

In school B the main pedagogical strategy was one of facilitation by the teacher, allowing pupils the discretion to use prepared videos and help sheets in order to construct firstly the knowledge of the software used and the tools therein, and secondly to explore the best way in which those tools can be used. Further, part of that task was to prepare a form of help guide for their peers. They were able to use their metacognitive skills to decide the most appropriate form that this help would take. It may be through the production of an on-screen video, showing their peers how to use a particular tool in a particular scenario to gain best effect. Or it may be to the production of the word-based help guide. Either way the pupils were required to use metacognitive skills to evaluate the work they were carrying out, and to reproduce the method used and explaining why, thus using those metacognitive skills to further their own learning. The one pitfall within this pedagogical tool which was observed during the classroom practice was that it relied heavily on the individual motivation of the pupils, their mindfulness and their desire to learn.

Finally the main pedagogical strategy used in school C was a system which allowed peer assistance whereby when the pupils required help or assistance they were able to

discuss their dilemma firstly with their partner then a member of their team, and finally if they were not available, their teacher. This allowed the pupils who were struggling with the task to articulate their problem, which required the use of higher-order skills in order to discern exactly where their quandary existed, and for those pupils assisting to articulate how that problem can be solved. Another pedagogical tool was one of discussion, and this existed throughout the classroom practice. It was present when discussing the learning objectives and when the pupils were enabled to develop their own success criteria for any subsequent task. This use of discussion amongst pupils to develop their own success criteria again enabled them to both articulate and solve the problem and doing so use their metacognitive skills to break down the problem and find ways to bring about its solution.

It is possible to conclude that in this instance, as with the issue of teaching styles and perception of ICT capability, there appears to be a continuum developing with school A and a general development style of a cross curricular nature and the use of non-ICT specialists in the development of ICT capability, coupled with a perception of ICT capability as consisting of the tools of the software applications at one end. And school B with the use of discrete ICT lessons, a facilitatory teaching style requiring a high degree of specialist knowledge of the subject and the belief that the subject involves both the tools of the software, metacognitive skills and the ability to problem solve at the other end of the continuum. The teacher in school B also has a perception that the subject should include a greater degree of computer science than is currently the case.

In summary there is some commonality across the cases in that there are similarities existing between contradictions in number of areas, however those contradictions differ mainly between the perceptions in School A and Schools B and C. Tables 6.1 and 6.2 outlining these similarities and contradictions can be seen below. The perceptions and practice between the schools form a continuum with School A lying at one end, perceiving ICT capability as being predominately tools based and using a pedagogical strategy, which is heavily reliant on the use of software specific tools in developing ICT capability. Whilst at the other end of the continuum lies School B, believing that ICT capability is closely linked to the use of metacognitive skills, and developing ICT capability in a facilitatory way, to enable pupils to develop those metacognitive skills

alongside those relating to software tools. Within the continuum lies School C, where there is a belief that ICT capability involves software tools and higher order metacognitive skills. The development in school C allows the development of those skills together with the tools of the software, but contains greater scaffolding than the pedagogical strategies used in School A.

Despite the belief that there is a difference in approach to both the perception of ICT capability and its development as proposed by Schools A and B, and from anecdotal evidence within the field, when the cross Wales questionnaire was analysed there was little evidence to support this. However, the length of experience and the position of the respondent within the school or department did appear to have a small influence on the manner of perception of ICT capability.

There were a number of additional themes which were discussed and all of these appeared to arise from changes to the curriculum which were taking place in England and which had been proposed but not implemented within Wales. These additional themes concentrated on the teachers' perceptions of how these possible changes may affect their practice, their available resources and the needs of the particular pupils within their establishments.

Contradiction	Evidence	Location of contradiction
Contradiction between the teachers perception of the development of ICT capability and their perception of the National Curriculum	Existing within the analysis of all three case studies	Contradiction with the tools and artefact mediating factor within the initial interview
Contradictions between the need for specialist ICT teachers and the way in which the teaching strategies are used.	Primarily within the case studies of Schools A and B, though to a lesser extent in School C	Contradictions between the tools and artefacts; roles and divisions of Labour and the task and outcome within the interviews and the observations
The change in perception of ICT capability	Existence of change in the Schools in particular School A, and possible lack of change in perception in Schools B and C	Change in the outcome and the perception of tools and skills in the development of ICT capability in School A

Table 6.1– Summary of Cross Case contradictions

	Location	Additional Theme
External influence and curriculum change in relation to pupil need	Existing within the analysis of all three case studies primarily in the initial and final interviews	Individual teacher's perceptions of pupil need in terms of proposed curriculum change.
Change in required resourcing	Existing within the analysis of all three case studies	The need for change in resourcing to provide adequate development particularly in light of possible future curriculum developments
Teacher's perception of ICT capability development	Existing within the analysis of all three case studies	The way in which ICT capability is developed and the role of the pedagogical tool in its development
Status of the subject within the school	Existing primarily within the Case study of School A	The need for increased specialist teachers and increased curriculum time thus increasing the perception of status within the community.
Pedagogical approach	Existing within the analysis of all three case studies	Differences between the pedagogical tools used in the development of ICT capability and the resources perceived as being required.

Table 6.2 – Summary of Additional Themes

Chapter Seven - Conclusion and Recommendations

The purpose of this final chapter is to discuss and outline the findings of the research, to present how those findings relate to the research objectives and the conclusions which can be drawn from them, and ultimately, to draw recommendations from those findings and to discuss the implications of those findings for the future whilst recognising the limitations of the study.

In order to fulfil this purpose, the research objectives will be addressed, leading to discussions of the implications for the future, and recommendations drawn from the study. There is also a reflection on the use of Cultural Historical Activity Theory (CHAT), evaluating how the use of this as an analytical framework has added to the study and considering how it might be refined for future use in the analysis of pedagogy in educational research. Finally the limitations will be discussed and areas for future research will be evaluated.

Achievement of Research Objectives

The aim, which the research set out to address, was to explore teachers' perceptions of ICT capability and whether their practices in the classroom matched their personal constructs. As discussed in previous chapters, this is particularly pertinent given the current environment of curriculum change in Wales.

To facilitate this aim the following research objectives have been addressed.

1. To investigate teachers' constructs of ICT capability at KS3 in Wales;

2. To investigate the relationship between individual teachers' personal constructs of ICT capability and their classroom practices;

3. To identify changes in individual teachers' perceptions during a period of curriculum review;

4. To investigate how individual teachers' changing perceptions are mediated by their environment.

In order to achieve the first research objective, a questionnaire was issued to all schools in Wales in both paper and electronic format using the mediums of English and

Welsh. The subsequent analysis showed that there was a consensus that ICT capability consisted of both higher order metacognitive skills and the ability to use appropriately the tools of the software applications, employed to develop that ICT capability. This consensus was interesting given the lack of specificity within the NCO (DCELLS, 2008). However the orders link with the key skills framework, which explicitly states the need for development of thinking skills within all subjects of the curriculum. This being the case it is fair to suppose that this development of thinking skills should link with the appropriate and justified use of software. This would support the definition of the use of software and metacognitive thinking skills which has emerged through this questionnaire. Analysis was also carried out to determine if this understanding of ICT capability differed depending on whether or not the respondent had been teaching for more than 10 years, whether they held a more senior position in school, or indeed whether having a subject specialism in ICT had any impact.

According to Shulman (1987), the degree of efficacy in the teaching of any subject can be dependent on different categories of knowledge (Content Knowledge; Pedagogical Knowledge and Technical Knowledge; and in Conjunction, Pedagogical Content Knowledge). Shulman also emphasizes the need to understand the classroom environment, the characteristics of the pupils, their knowledge and understanding and how they develop that knowledge and understanding. Finally he recognises the need to acknowledge those parts of the subject which are not easily assessed within the curriculum. Within these categories of knowledge that of subject knowledge plays an important role, and it may have been that the lack of an ICT specialism would have impacted on the understanding and perception of ICT capability. In this study lack of specialism in ICT capability appears not to have had a major influence on the way the teachers perceived ICT. However, one aspect which was not determined was how long those teachers who indicated they were not specialists had been teaching ICT. One supposition to explain this anomaly is that they had been teaching ICT for some time and as such developed a specialist knowledge of the subject and how best to teach it.

However, when the years teaching was taken into account there was a difference in the way in which teachers perceived ICT. The disagreements which occurred indicated that if ICT capability were placed on a continuum with it being defined as a tool in

order to support learning in other subjects at one end, and as a subject requiring the development of higher order metacognitive skills together with the ability to apply software tools at the other end, then those teachers with under ten years' experience, as opposed to those with more than ten years' experience, teaching the subject tended to regard ICT capability as sitting closer to the end of the continuum including metacognitive skills than the end concerned with tools. However, when the responses concerning the development of ICT capability (and particularly the inclusion of problem solving as a teaching strategy) was evaluated, the cross-Wales questionnaire suggested a definition of ICT capability as having metacognitive thinking skills at its core, regardless of the years teaching.

The other research objectives were related and are concerned with individual teacher's personal constructs of ICT capability, and how they relate to their classroom practice, and whether their classroom practice supports their view of the subject or whether there is discord between practice and personal constructs. These include any impact of changes in the present environment of political change and whether that change has an impact on teachers' perceptions and classroom practices. Investigation of these research objectives involved the formulation of three specific case studies.

The main findings from the case studies and cross-case analysis are that similarly to the cross-Wales questionnaire, a continuum of perception of ICT capability emerged, as did another when evaluating practice. The case studies were initially in agreement with regard to their perception of ICT capability, in that they included higher order metacognitive skills as part of their explanation of their understanding. This supports the ethos of the national curriculum, (ACCAC, 2000) (ACCAC, 2008a) and indeed the definitions of ICT Capability (Kennewell, et al., 2003a). The NCO clearly refer to the use of 'Thinking Skills' within the teaching of the subject, whilst Kennewell describes ICT capability as being a non-linear process involving the development of "routines, techniques, key concepts, processes and higher order skills" (Kennewell, et al., 2003, p. 7). However after a cycle of observation, reflection, further observation and a final interview the perception of the teacher in School A changed and they described the skills which had previously been associated with higher order metacognition as now being "synonymous" with the application tools. Thus this moved the perception of that

teacher along the continuum towards a tool-based subject, which would be more in line with the support of other subjects rather than a subject with its own conceptual framework. The analysis of the classroom practice of this teacher highlighted that the approach used to develop ICT capability in the school and the strategies from a teaching perspective were in greater accordance with the development of a tool-based subject. The practice concentrated on the development of the tools of a software application and their use, with only superficial opportunities to activate higher order skills or metacognitive processes. Furthermore, the subject was not held in high status within the school community as it was not afforded regular discrete lessons within the curriculum.

In not adequately addressing the concepts and contextual aspects of the subject, the teacher is failing to develop the 'powerful knowledge' of the subject (Young ,1971; 2013a; 2013b).The notion of powerful knowledge links knowledge and its importance to the sociological arena at the time, and though Young has since refined the idea of powerful knowledge acknowledging that some subjects posess knowledge are more powerful than others, this distinction has not moved the formation of knowledge out of a sociological aspect. It could be argued that the lack of status of ICT in the school has meant that any powerful knowlwdge associated with ICT capability is not deemed as powerful as the knowledges associated with those other subjects with higher status. Furthermore, the reliance on teaching the subject as a tool in order to support learning in other subjects, fails to address the propositional knowledge and relies more heavily on that form of knowledge associates with experience (Winch, 2013). This failure to develop the contextual and conceptual areas of the subject would mean that limitations are placed on the pupils and in turn their progression from novice to expert in the field, as described by Winch (ibid) would be reduced, if not halted at experience only.

It is possible that the initial interview process encouraged the teacher to reflect that their classroom practice was not supporting their construct of ICT capability and that they modified their constructs to match their practice and the practice within the school. However, rather than solving the problem of a contradiction within practice and perception, there now lies a contradiction between their practice and perception

and that stated within the NCO. This change in perception is related to Engeström's links between activity settings and expansive learning, particularly the role of historicity, where the contradictions of an activity setting are recognised by the subject of the activity setting, resulting in a permanent change in perception, cognition or behaviour (Engeström, 2007; Virkkunen & Kuutti, 2000). In this case the teacher in school A recognised the contradiction between their original perceptions of ICT capability having the use of metacognition as one of its componants, and their classroom practice where ICT capability was taught in a tool-based mechanistic process. In expansive learning one would expect that a transformation of the activity takes place in order to resolve the contradiction (Engeström, 2004; Engeström & Sannino, 2010). In this case the transformation resulted in a redesign of the activity setting, concerned with the teacher's perceptions of ICT capability, changing the ICT capbility to having a single tools- based component. However, the very redesign of the perception of ICT capability resulted in the formation of a new contradiction which now exists between the teacher's perception and practice and the NCOs.

A further aspect that became apparent within this case study is that their pedagogical strategy was to develop ICT capability largely on a cross curricular basis, with the bulk of the tool's development occurring over a concentrated week for the entire year group by a single specialist ICT teacher, supported by a team of ICT "Champions". The scheme of work and the differentiation of the work were designed by the ICT specialist, and attainment groups or sets formed using generic cognitive ability scores. The rationale is that the specialist ICT teacher teaches and develops ICT capability with the 'top' set whilst the lowest attaining set is taught by the ICT champion with the least ICT Capability. However, a contradiction here is that the ICT teacher who is designing the work is the teacher who has the least knowledge of the pupils and their capabilities. However, if one adheres to the hypothesis that the capability being developed, particularly any digital capability, can be directly related to the capability of the teacher (Lankshear, 2010; Webb, 2002) then one might expect that those groups who were less able and possibly in need of greater support in the development of ICT capability might be associated with the teachers having the greatest ICT capability. The rationale for this is that a teacher possessing a high standard of ICT capability would be able to support those in need to a greater extent, whereas those pupils capable of

directing their own learning are more likely to create those opportunities needed to develop their own capability. Furthermore, the school's practice is also in dissonance with the model of pedagogical reasoning (Shulman, 1987), which links the effective teaching of any subject with a series of different types of knowledge concerned with the teaching of that subject. One such category is that of knowledge of the pupils and their characteristics which argues that the teacher designing the way in which the scheme of work or programme of study should be taught, should be aware not only of the capabilities of the pupils in their care, but also the way in which they would react to differing teaching strategies or tools. One possible explanation for this may be that the school appears to subscribe to a belief of a fixed general ability and as such those pupils who are considered to be capable of a lower attainment are taught with more restrictions and rigidity in the programmes of study. This would suggest a mechanistic rationale for the development of ICT capability. However a further argument may be one of resourcing and that by operating in this way the school is reducing the need for a greater number of ICT specialist staff with the specialist ICT teacher, managing this strategy, having a preference for teaching high attaining groups. The prescribed nature of the Scheme of Work in School A and the limited opportunities for the development of metacognitive and higher order skills, reduced the likelihood that non-specialist ICT teachers would feel able to introduce them in "lower ability" groups. The reasoning given for associating the high attaining groups with the more capable teachers was that the higher attaining groups would require greater challenge, however the opposite could also be argued in that those pupils with higher cognitive abilities are more likely create opportunities to construct their own knowledge as they explore the learning taking place. Conversely, the lower attaining groups are likely to require far greater scaffolding to achieve their potential and may need those teachers with more specialist knowledge who are able to perceive ways to differentiate the work and support the tasks to enable this to occur.

The contradictions which emerged in Schools B and C were not between their perceptions of ICT capability and their classroom practice. Both defined ICT capability as having a tools based component, where there was a need to be able to operate a variety of software applications, but also highlighted the need to be able to use higher order metacognitive skills to be able to discuss the subject, using the language and

terminology of the subject, and to use the software applications in an appropriate and effective way to solve problems. Where differences did emerge, it was in the way the teachers interpreted the National Curriculum, and in particular the proposed changes to include computer architecture and programming. Some teachers perceived the changes as being purely of a programming and coding nature, whilst others included the need to understand the architecture and how that related to the operation of the computer. The teacher in School B felt that the proposed changes did not go far enough and that there was a need to teach aspects of hardware and computer and network engineering, whilst the teacher in School C felt that the curriculum did not require change at all but that those teachers teaching the curriculum need to be more innovative and motivational in their approach to the development of ICT capability. Their classroom practices both supported their personal constructs of ICT capability with the development of the higher order metacognitive skills alongside the tools of the applications. However, there was a difference in the pedagogical strategies and pedagogical tools used to develop ICT capability. In school B there was an ethos of facilitation and ICT capability, the metacognitive skills associated with it and the language of the subject were taught in a holistic way. In School C this took a more linear format, with the belief that first you had to teach the tools, then develop the language associated with the subject and finally the higher order skills associated with the appropriate use and problem solving aspects of the capability. They also used a system of learning ladders and peer support through a 'buddy' system as a form of pedagogical tool, enabling the pupils to generate discussion and verbalisation of and about their learning. Whilst the teacher in School B used a system of facilitation, he presented the pupils with a problem to be solved and informed them of the available help sheets, supportive videos and tutorials to enable them to solve the problem. This enabled the pupils to take control of their own learning, and in addition developing tutorials of their learning for their peers.

These two case studies demonstrated both Powerful Knowledge in that the teachers' pedagogical approaches and their perception of the subject promoted a development of the concepts inherent to ICT capability, differentiating between mere use of the subject tools and incorporating the higher order metacognitive skills required to develop that Powerful Knowledge. Further there is also evidence of Epistemic Ascent

in that the case studies of Schools B and C did not limit the development of the subject to the Knowledge How (KH) but also supported the development of the Knowledge That (KT) in the design of the curriculum. This use of KH and KT allows for the distinction between knowledge and the experience, which is deemed necessary in the development of powerful knowledge. This distinction is also vital for progression within the subject, allowing the learner to progress to expertise (Winch 2013). This is in contrast to School A, where the curriculum design and pedagogical strategies focused on the KH and only gave superficial attention to the KT of the subject, resulting in the development of experience rather than knowledge (Young 1971; 2013a; 2013b; Winch 2013). The teacher's perception of ICT Capability was that there was a need to develop thinking and metacognitive skills, and furthermore, that there was a conceptual knowledge associated with the subject.

Thus this examination of the practice in the three case studies highlighted another continuum concerned with the development of ICT capability, where at one end the scheme of work is rigid, tends to be mechanistic in nature and is concerned with the development of the tools within the software application under study in that lesson. On the other end of the continuum there is a method of development which involves accessing the metacognitive skills of the pupils using strategies such as facilitation and problem solving. School A resides at one end of the continuum, where ICT is developed as a subject which is a cross curricular tool or aid for other discrete subjects, developed through a series of tasks with only superficial opportunities for evaluation or the use of higher order skills. At the other end of this continuum lies School B, where the development of ICT capability is one of a facilitation of learning by the teacher. The pupils have control over their own learning and are using their higher order metacognitive skills to define their learning and how they are going to solve the problem in hand. Lying within this continuum is school C, where ICT capability is developed using metacognitive skills, but with more scaffolding and teacher support. The scaffolding places its practice between Schools A and B, however the use of verbalisation in developing the learning ladders and the formulation of the success criteria by the pupils with varying degrees of guidance by the teacher pushes this school closer along the continuum to School B than School A.

Reflections on Cultural Historical Activity Theory

The last focus of the study is the use of Activity Theory (Daniels, Edwards, Engeström, Gallagher, & Ludvigsen, 2010; Engeström,2000; Engeström, 2007) in assisting the analysis of practice and perception. For this reason every key piece of research data: the interviews, the classroom observations and the reflective dialogues were analysed within their own activity settings, and then contradictions between mediating factors of the setting were explored. These contradictions may exist on a number of different levels; they may exist within a single mediating factor; between different mediating factors of the same activity or between different activity settings. Part of the rationale behind the use of Activity theory in this way is to determine whether there is any change within the perception and practice of the teacher over a period of time. Any changes which took place might have been as a result of recognition of any contradictions that existed. The teachers' subsequent reactions to those contradictions usually fall into two categories: either accepting and nullifying that contradiction by changing perception or practice and thus learning from that contradiction; or ignoring any contradiction, whereby there is no learning from the experience taking place. Activity theory was chosen as an analytical tool and framework within this study as it enables the researcher to focus on a number of areas at once. As with other forms of ethnographical study the use of CHAT has allowed the exploration of the relationships between, not only practice of the individual teachers and their perceptions of ICT capability, but also wider societal relationships. One of the mediating factors is termed "Community and Organisational Structure" and it is the inclusion of this together with the mediating factor of "Roles and Divisions of labour", which allows the researcher to probe the relationships with the environment outside of the classroom. The relationships between factors such as the National Curriculum, the way in which ICT as a subject is viewed by the schools within the case studies and the national environment of change have had a huge impact on the teachers involved, their perceptions of the subject, how it should be taught and their practice. Activity theory, with the concept of mediating factors impacting on each other, has allowed an exploration of the contradictions which have emerged as a consequence of the impact of the change occurring in this external political, cultural and social environment. Rather than confining the analysis to a theme-based narration of what has been observed, use of activity settings has facilitated the analysis of individual interviews as

one activity setting and individual observations as other activities, which has allowed for a direct and rigorous comparison of the mediating factors within each setting. It enables a framework to investigate and analyse a variety of themes which in turn allows and facilitates a comparison between two activities which may not be alike in any other aspect than that they are activities e.g. observation of practice and individual interview. This has also enabled the analysis to focus on elements at a deeper level, for example the drilling down to the differences between the pedagogical strategies and the application of the pedagogical tools within those strategies used in each case study, and how those approaches may or may not impact on learning.

There is a multi-dimensional nature to this tool, in that it is possible to use activity settings to investigate different levels of relationships, those occurring within an individual's learning activity, within the classroom as whole and the larger picture of the way in which the school policies and political arena may also impact on the focus of investigation. This can be represented by the relationships between the different mediating factors at different levels of analysis, for example the mediating factor, communities and organisational structure of the political external environment will impact on the same mediating factor of the school. At the same time that mediating factor, community and organisational structure, is likely to contain the same themes in the settings for both the school and the classroom. This relationship and similarity results in a 3-dimensional structure In effect depending on the activity settings used and the relationship of those activity settings to one another a picture of the micro, meso and macro levels of the activity can be built. In addition to this 3-dimensional property of combined activity settings, when one uses this over time a fourth dimension acknowledging the effect of how change can impact on that activity becomes apparent. Similarly there are differing levels of contradiction which may be identified, with some contradictions being more obvious than other more subtle differences.
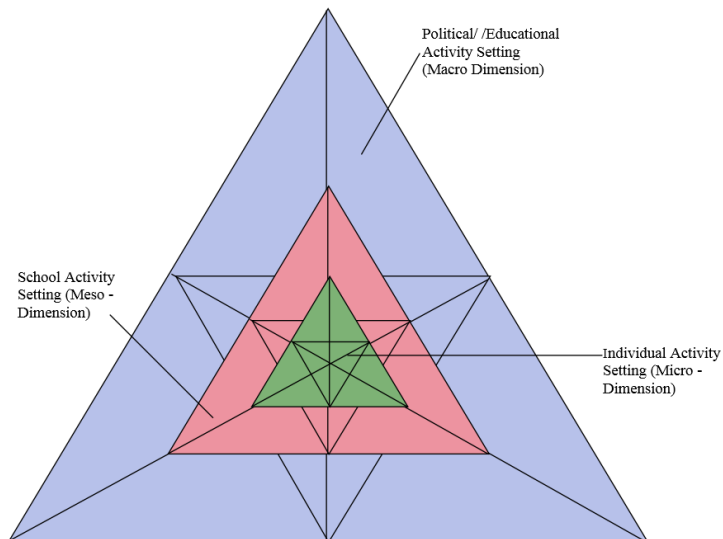
Figure 23 – 3 – D relationship between activity settings

This analysis has further highlighted factors which have influenced changes in behaviour amongst the teachers within the case studies. These changes in behaviour relate to expansive learning (Engestrom, 2007; Hill, et al., 2007) and the concept of acceptance or rejection of the contradictions whereby there is an acknowledgement of a need for change and new activities are formed in light of this recognition. Conversely, where there is no acknowledgement of any contradiction which has emerged, no such change takes place. This is particularly true of the teacher in School A, who recognised the contradiction between their perception of ICT capability being composed of software application tools and metacognitive skills and the practice which fostered the development of the software tools, giving only superficial opportunities for any metacognitive development. The acceptance of the contradiction brought about an aspect of learning termed "Adjustable Exploitation" (Engeström, 2007). The realisation of the emerging contradiction between perception and practice resulted in a change to the teacher's current perceptions of ICT capability, and that change brought about a stable activity setting in the attainment of the 'Object'. In doing this however, this activity setting brings about a further contradiction, this time between the teachers' perceptions and practice and the NCO in Wales.

The links between activity settings, the use of CHAT as a pedagogical analytical framework and expansive learning become important for managing change. It

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becomes a method for identifying how that recognition of contradiction existing between various mediating factors at different levels of analysis within a variety of activity settings is dealt with. With the onset of change within the external political and socio-cultural environment in Wales and the possible introduction of computing to the curriculum, the ability of the teachers to recognise any contradiction which may exist between curriculum and practice and how they relate to it may indicate how successful a change in pedagogy is likely to be. For those teachers who are resistant to change, it may be entirely possible that their existing constructs of the subject will change to accommodate contradictions, however, these changes may not bring about new activity settings in the form that the external political change might indicate. Those teachers open to change are likely to recognise the contradictions in a positive manner and change their constructs and practices to bring about entirely new activity settings through a form of radical exploration in a context of transformation resulting in a successful change in curriculum.

There are however, limitations to the use of Cultural Historical Activity Theory in this way and that is primarily that not all the aspects or themes which emerged from the coding could be aligned to the mediating factors within the activity setting. Certainly the themes which this included were aspects such as the need for resourcing due to the possible curriculum change and the perceived future needs of the pupils in light of that possible curriculum change. Should the activity systems be re-analysed at a later date it is entirely possible that these themes would have been accommodated within the activity setting. However at the time of the analysis because they were referenced to the future and to activities which at that point did not exist, it was necessary to also conduct a separate analysis of those additional themes. A further limitation which may be considered is that there is at present a lack of differentiation between the levels of complexity of the contradictions. If this tool is to be used as a tool for management of pedagogical practice as well as an analytical tool, it would be useful to categorise the depth of complexity of the contradictions, so that the management of any subsequent change can be prioritised.

Implications and recommendations

The recognition of a continuum of perception of ICT capability and indeed a continuum of practice in the teaching of ICT Capability may have implications for the development of the subject. The variation in perception between a tool based and a metacognitive based ICT capability implies that learners across Wales are likely to experience different foci within ICT lessons. Those teachers who may perceive ICT capability as being tool based are likely to use a more mechanistic and systematic approach to their teaching whilst those who perceive ICT capability as being closely linked to the use of metacognitive skills are more likely to teach ICT capability with an approach that allows for the development of those skills including problem solving. From a teaching perspective this may mean that some pupils will require greater instructions and 'spoon-feeding', because this is the way they have become used to being taught the subject. Furthermore, pupils taught in this way are likely to perceive ICT capability as simply a tool. In contrast, other pupils who have experienced a more problem solving approach to the development of ICT capability are more likely to be able to use it as a means for solving problems and generating answers within the work place. From a knowledge and curriculum design basis, those teachers who are more mechanistic in their approach are not engaging with the relationship to knowledge that the pupils are likely to develop (Young 1013b). This lack of engagement in turn will mean that the curriculum designed for study will not distinguish between experience and knowledge and as such the epistemic ascent will be reduced. The implications of this are that the KS3 pupils in Wales will be experiencing a different preparation in terms of knowledge and skills for further development within KS4 and KS5. This in turn has implications for employability and the creation of a work force with sufficient ICT capability. One of the key arguments which support the need for a change in curriculum is that the present curriculum is not creating sufficient skills in problem solving and metacognition at the end of KS5 in order to build an economic workforce capable of assisting Wales to compete in a digital world.

Interestingly, in Estyn's (2014) evaluation of the development of ICT at KS3, it was suggested that there should be changes made to allow for an improvement in the teaching and assessment of ICT skills, both on a discrete level and across the curriculum, to allow pupils to develop independently. Further suggestions included the

need to improve connections between the ICT department and those other subjects where ICT capability is being developed and to provide relevant and sufficient professional development for all the teachers. In previous reports there has been no recognition of the need to develop ICT capability in any from other than on a cross-curricular basis (ESTYN, 2003; Estyn, 2007). Further recognition of the need for change within the subject can be found in the recommendation that the Welsh Government "implement a relevant statutory framework for ICT from Foundation Phase to post-16 and review the National Curriculum subject orders to reflect current developments in technology" (Estyn, 2014, p. 5)

Such is the reasoning from the government and employers that the education system in Wales and particularly that of ICT curriculum now exists in an arena of change. Changes within the curriculum have already taken place in England and whilst it has been shown that since the devolvement of Education to Wales the curricula in the two countries have diverged, the impact of the changes in England, particularly the abolition of the National Curriculum for ICT and speculation concerning its replacement, can be seen to have had an impact on teachers in Wales. This is particularly true of the perceptions of ICT capability. Amongst the respondents to the all-Wales questionnaire, there has been a higher than expected credence given to the inclusion of programming, whilst in the case studies there has been dispute about the need for change and the validity of that change. The teacher in School A reacted to the changes as being a requirement for increased resources both at a tangible level, including equipment and an increase in teaching staff and at an intangible level relating to specialist knowledge. In opposition to this was the teacher for School C who did not believe that there was any requirement for a change in the curriculum, but that there was a need for greater divergence in creativity in teaching the present curriculum to bring about greater development of metacognitive skills. That teacher also felt that the inclusion of aspects such as algorithms, abstraction, logic and the use of different programming languages would possibly be detrimental to the needs of his pupils, whereas the teacher in School B wholeheartedly supported the proposed changes to the curriculum, and indeed showed enthusiasm for opportunities to teach those aspects of computer science at KS3. Interestingly, this variation in opinion might be explained by examining the degree backgrounds of the teachers involved which are

varied with the teacher in School A having a background in business information systems, the teacher in School B a background in computer science and the teacher in School C in ICT. The implications of this are that within ICT departments there are a variety of backgrounds, even amongst the specialist ICT teachers, and these variations may be encourage a resistance to change in one instance with a clear support of change in another depending on where their knowledge base lies.

The proposals for change in Wales include re-branding the subject, developing digital literacy and introducing elements of computer science to be taught alongside aspects of a more traditional ICT curriculum. There is also a recommendation that metacognition to support problem solving skills is explicit in this new subject area. This is crucial if this subject is to be taught on a conceptual level and not just in a mechanistic format. This study has shown that despite the inclusion and emphasis of the development of thinking skills as part of the ICT curriculum orders (ACCAC, 2008b), there is evidence that the subject is taught in a variety of ways and there is a possible continuum of perceptions of the subject, with a definition of ICT capability as being a tool to support learning in other subjects at one end, and a subject driven by metacognitive skills, creating appropriate applications to support problem solving at the other.

The proposed rejection of ICT as a worthwhile subject in Wales and its replacement with a rebranded 'computing' may be related to the desirability of 'powerful knowledge' (Young 1971;2013a; 2013b) together with perceptions that by introducing aspects of Computer Science constitutes such knowledge in a computing context whereas ICT does not. However, the ICT Capability, as originally conceived by the authors of the national curriculum in 1989 and amplified in Kennewell et al., (2000), does satisfy Young's criteria for powerful knowledge; ICT taught in a mechanistic fashion as was seen in school A, does not. This may be partly blamed on the vague specification of the ICT curriculum and its failure to identify the 'knowing that' (KT) of the subject in addition to the 'knowing how' (KH), this failure in identifying the KT has led to a subject which can be developed in a superficial way. The aspects of 'Modelling' and 'Control' existent in the original curriculum, may have been another contributing factor in the perceived 'Dumbing' down of the subject. Had these aspects been

identified as algorithms and coding the subject may have been afforded the status it deserved. Lastly the expectation, supported by Estyn until recently (Estyn 2014), that ICT could be 'delivered across the curriculum', rather than explicitly taught by specialist teachers like all other subjects, further decreased its status within some schools. Young (1971;2013a;2013b) states that it is vital when discussing powerful knowledge to make the distinction between the knowledge and experience. The mechanistic approach to teaching ICT capability in some schools relates more to an experience of the subject. However if we include the conceptualisation which is inherent to the subject, the knowledge of appropriate use, and the ability of pupils to justify and explain this appropriate use according to context then all the elements Young espouses as necessary in the development of knowledge are present. Furthermore, he clearly places the role of curriculum design as being sociological in its purpose and that powerful knowledge is formed as a result of sociological need (Young 1971). Thus, if the role of ICT in society is established, and the need for its continued use and further development within society supported, then there is a sociological impetus for the subject to have developed its own form of powerful knowledge. Indeed some of the debate and political argument for the rebranding of the subject is linked to this need to aid the growth of ICT / Computing within society from a political, economic and industrial standpoint.

Whilst the ICT curriculum's 'epistemic ascent' (Winch2013) was set out in the level descriptions, these broad statements concerning what learners would be able to do at different levels obscured the progression in understanding, which is key to developing powerful knowledge. The proposed curriculum may have avoided this error, but seems highly optimistic concerning the epistemic ascent which is feasible. Consequently, ICT teachers without sufficient specialist knowledge of computer science may pick out the KH and teach that aspect as mechanical techniques in isolation from KT with the result that learners will be left with 'powerless knowledge' which is only applicable in limited contexts. The focus on 'coding' in media discussions of the new curriculum may have reinforced this response.

It should be acknowledged that this analysis is limited, as it is based on the analysis of three case studies, and a larger study would help to increase the reliability of the

conclusions. However, if the new subject as proposed is to have an impact on the development of metacognition as part of the curriculum, then those curriculum orders are likely to require a degree of explicit explanation as this has not necessarily been obvious to all teachers in the past. In the unlikely event that the proposals are dismissed and the curriculum remains as a variation of its present form, there will still be a necessity that the subject is more adequately defined. There is a danger that if there is a continuum of understanding of the subject, and an accompanying continuum of practice then at the two different ends of that continuum the variation in the learning and product of the subject will be pronounced.

As has been pointed out in the review of literature, Creighton et al.,(2006) refers to the evolution from 'computer literacy to information literacy', as does Moore (2005) in his references to the movement from the terminology of 'ICT Literacy' to 'ICT Capability'. However, the implications of these texts are that the evolution they discuss involves little more than a change in nomenclature and without precise definition of the subject it is entirely possible that a similar result will arise from these proposals. It is possible to teach these suggested aspects of computer science in a mechanistic way. Without opportunities for the pupils to engage with their metacognitive skills through the pedagogy of the subject, then ICT or Computing will continue to be susceptible to accusations of being not 'fit for purpose', as it has recently been labelled by both government and industry.

Within School C there was adamant denial of any need for change, which may be illustrative of a resistance to change within the subject as a whole. As previously indicated, this resistance may be due to the background of the teacher involved. According to Shulman (1987) to teach any given subject effectively, there is a need to be knowledgeable in a variety of areas, including the pedagogy of that subject. School A case study showed that the subject was largely developed mechanistically and that there was high use of non-specialist ICT teachers employed to do this. The scheme of work was designed by the specialist ICT teacher and there may be an argument that the lack of opportunities for the pupils to engage with metacognitive processes substantially may in some part be due to a mismatch between the teacher's practice and perception of the subject, but may also in part be to accommodate the capabilities

of the non-specialist ICT teachers assisting the teaching of the subject. Should the subject change in nature and include the need for the use of metacognitive engagement, together with aspects of computer science such as algorithms, logic, abstraction and coding as previously outlined, there are a number of implications for schools. The ability of schools to use non-specialised teachers in the teaching of computing will be greatly reduced, because not only is the pedagogy of the subject likely to change, but also if the specifications of the subject are to be taught in a non-mechanistic way there will be a need for a greater specialised knowledge of the subject. This specialised knowledge is likely to require training for existing teachers and the attraction of teachers with that specialised knowledge to schools. This form of specialised knowledge would be difficult to teach within a cross curricular model. The pedagogy for the teaching of the subject and the ability for the teachers to use problem solving techniques to allow pupils to access their metacognitive skills would need careful design. A philosophy describing the progression of pupils through the computing curriculum in England describes the core concept of the new curriculum as being the development of the "Computational Thinking Concept", further breaking this down into Abstraction, Decomposition, Algorithmic Thinking, Evaluation and Generalisation (Dorling & Rouse, 2014, p. viii). This program of study emphasises the need for a rigorous development of the subject which is likely to reduce the teacher's freedom in the way they teach the new subject.

Further evidence for this need for the professional development of teachers can be found within the quantitative analysis, where the greatest difference in perception was between teachers who had been teaching for over 10 years and those who had been teaching for less than 10 years. The results indicated that those teachers who had been teaching for less time placed ICT capability on the continuum closer to the end which contained higher order skills and developed this subject through access to those metacognitive skills, whereas those teachers with greater experience tended to indicate that ICT capability was developed though a more mechanistic pedagogical approach. If this were applied to a computing curriculum then teachers may be unable to effectively develop this subject using a mechanistic pedagogical approach and would require continued professional learning and development. However, it could be hypothesized that the length of time teaching ICT may have the effect of de-sensitising

them to their original subject knowledge. Furthermore, even those teachers who had originally studied computer science, had developed their knowledge of ICT capability over a substantial period with only minor changes within the curriculum and it may be that those teachers have developed a greater knowledge of the teaching of ICT capability than that of teaching computer science or computing, and thus these teachers may still require additional knowledge in order to teach the new curriculum.

The New Curriculum and the Case studies

In order to further describe possible implications for teachers and schools at a classroom level it may be opportune to model the teaching of computing using current practices in each of the case studies. Using CHAT to carry out this modelling will enable the identification of contradictions within the current practice of the schools and further to identify changes which may need to be made in order to resolve contradictions arising with the introduction of a new curriculum subject.

This brief analysis highlights the implications of the continuation of the pedagogical strategies used in the case studies in the event of a change in the curriculum. It should also be noted that there are assumptions that in the event of curriculum change, first that the change in curriculum incorporates all the recommendations as laid out in the steering document (Arthur, et al., 2013) and that secondly the case study school continues to employ the pedagogical strategies and tools identified in the course of this research.

In order illustrate the likely implications, which the introduction of a new computing curriculum would have on the schools, it is useful to model activity settings based on computing as the subject. Using the findings from the research to populate the mediating artefacts within the activity settings, whilst changing the task and outcomes to from ICT capability to one of a computing curriculum, it is possible to model the effect of change on the practices within each case study. This model allows for the identification of contradictions which would emerge using current practice and would allow recommendations to be made to allow the transition from one curriculum to another to be more effective.

With all the activity settings the task or outcome would be the development of computing and the inclusion of metacognitive problem solving skills and key aspects of computer science such as algorithms, logic, abstraction and programming languages or coding. Essentially it is the same activity setting which is being analysed but with a different 'Object' and for this reason it is practicable to focus the subsequent discussions of the case study practices on the remaining mediating artefacts.

Case study A

Tools and artefacts for school A using the current pedagogical strategies and pedagogical tools, would comprise a strategy of a centrally taught master - class where the acquisition of knowledge is orchestrated by one specialist teacher. This is taught in a lecture format with little opportunity for teacher-pupil interaction or dialogue. Where dialogue does exist through question and answer, it is in the form of closed questioning and appears to check understanding on a relatively superficial nature. During the workshop the pupils are given a task using the knowledge that has been taught in the master - class. This resulting knowledge forms the basis for the activity in the subsequent workshop; the master - class becomes a pedagogical tool to enable the pupils to complete the given task.

The individuals and groups within this model are the specialist ICT teacher and the accompanying non-specialist ICT champions. These champions are teachers of other key subjects and have an interest and ability to use ICT effectively in the teaching of their specialist subject.

Rules and codes of behaviour include the attitude of the school to technology. Pupils are encouraged to use technology not only in the support of other subjects but are also allowed to use mobile phones for accessing social networks and gaming in breaks and over lunch.

The Community and organisational structure is that the subject is developed mainly on a cross curricular basis within other subject areas. The exception to this is that for one

week in the academic year each year group is taken off timetable for a week and delivered intense master – classes and workshops in the subject. During this time the pupils are expected to achieve the required targets for that subject.

Roles and divisions of labour. The system for development of the subject has been designed by the specialist ICT teachers and the model necessitates the support of non-specialist teachers in the development and teaching of the subject. The scheme of work has also been designed by the specialist teacher and the year is split by that specialist teacher into attainment groups. The basis for the formation of the attainment groups is the use of cognitive ability tests which are not necessarily relevant for the assessment of ability in this subject. However there may be relevance for the development of higher order metacognitive skills. The roles of the teachers are dependent upon their capability within the subject in that those teachers with the least capability are linked to those classes who have the least attainment levels.

Contradictions

There are a number of contradictions within this model of development and they are entirely of a secondary nature and are as follows

Task / Outcomes and Tools / Artefacts. The contradiction which arises here is one between the Curriculum and the 'pedagogical strategy'. According to the steering report for the proposed changes and transformation of an ICT curriculum to a computing curriculum, the subject should exist as a discrete subject, with a status of its own, indeed one that would equate to a fourth science. However, the teaching of this subject using this pedagogical strategy is one where it is developed not within the curriculum and timetable as designed by the school, but over a week a year per year group involving an intense course of cramming the 'tools' and little engagement with the metacognitive problem solving which has been highlighted as imperative to the subject.

Task / Outcomes and Individuals / groups. The pedagogical strategy highlights another contradiction in that it is being taught by only one specialist teacher and supported by ICT champions. The identification of such champions has been through their ability to

use ICT in the support of their teaching. Whilst this may equate to digital literacy on some levels, it is unlikely to equate to computing as a subject. It is clear that computing is unlikely to be developed on a cross curricular basis but would require specialist knowledge, which it is questionable that these champions are would possess.

Task / outcomes and Community/ Organisational practice. The present community within school A does not give the status to the subject that is afforded within the other case studies, nor does it allow the subject a similar status which has been provided to other curriculum subjects. If it did there would be discrete weekly lessons for its development throughout KS3. However, this is in direct contradiction with the proposals where there is a recommendation that the subject of Computing be afforded a similar status as a fourth science.

Task / outcomes and Roles / divisions of labour. Currently the whole system of teaching, scheme of work and the provision of the lecture within the master - classes is the responsibility of the specialist teacher. That teacher also has the responsibility of assigning pupils to ability groups and designing the differentiation for those groups. However, because this teacher does not teach the pupils on a regular basis, they do not possess knowledge of those pupils regarding their preferred methods of learning and what are the best pedagogical tools to employ to bring about effective learning in ICT as suggested by Shulman (1987).

Furthermore, those teachers with the least capability in the subject teach those groups deemed to be of a lesser attainment . Given the change in the nature of the subject then the capability of the champions used as part of this pedagogical strategy is likely to be even less than at the present time.

It would appear from these contradictions that the impact of the introduction of computing to this school is likely to be great if it is to be developed as suggested by the steering group. There are a number of recommendations which can be made. The first would be an increase in the number of specialist staff; this would enable a different pedagogical strategy to be employed where discrete specialist lessons could be used to develop the conceptual and metacognitive aspects of computing. It would still be

possible to develop the digital literacy aspect of the curriculum using the pedagogical strategy of master - classes and workshops if that were still the wish of the school. The addition of further subject specialist teachers to the department and the initiation of discrete lessons would eliminate the remaining contradictions, in that the subject would be afforded a greater status as a result of regular lessons taught by specialist teachers. There would be less need to use 'Champions' and any classes deemed as being of a lesser attainment would receive the specialist teaching they required. Furthermore, the implementation of regular timetabled lessons would allow the specialist teachers to develop their knowledge of the pupils and their needs and enable a more effective teaching of the subject.

Case study B

The tools and artefacts are the curriculum and orchestration of learning. The pedagogical strategy used in School B was one of facilitation and the pedagogical tool is the use of online help and media to enable the pupils to solve problems.

The individuals and groups in this case comprise the single specialist teacher involved within the case study, not only because it was the teacher from school B who was observed and the focus of the case study, but also in the interview informed me that though this method of teaching was designed by the department, they were the only teacher using this approach. The teacher also felt that the reason for this may have been that for this approach to be successful there was a need for a secure and deep level of subject knowledge on the part of the teacher and that they needed to be confident in their knowledge of the subject. The teacher in this instance has a background in computer science and as such has a strong pedagogical knowledge.

The rules and codes of behaviour are that of facilitation by the teacher, within this pedagogical strategy and is such that the main input is from the learner, with the learner using the pedagogical tools of the help sheets, podcasts and videos to explore software applications. In doing this, the learners are creating their own opportunities to further their learning and to use their metacognitive skills in deciding how to solve

the particular problem. In addition they are required to design their own form of help guide to assist their peers in the solving of the same problem.

The community and organisational structure mediating artefact, has the status of the subject positioned reasonably high, with the majority of lessons being taught by specialist teachers with a limited number of non-specialist teachers assisting in this process. In addition the subject is timetabled for a discrete one hour lesson per week throughout KS3.

The roles and divisions of labour. This is one of teacher facilitation promoting independent learning. The teacher has a responsibility of designing the problems for the pupils to solve and the production of many of the help guides, be they in video format or as online text. Pupils also design help guides for their peers as part of the process and this links to the use of metacognitive skills, as they re-synthesise their knowledge in the production of these. However, the core of the materials is produced by the teacher to reduce the formation of any misconceptions on the part of the pupils.

Contradictions

The contradictions which exist in this case study are fewer than in case study A for the transition to the new curriculum.

Tasks/ outcomes and Tools / Artefacts The contradiction here may be one between the pedagogical strategy of facilitation and the need within the subject to teach the concepts of computing, specifically those arising from the use or development of algorithms and their relationships to concepts such as logic and abstraction. Further it may not be possible to master coding through exploration on its own in quite the same way as the production of a website through the exploration of a web authoring software. It is entirely possible to explore various tools within an application, and to use higher order metacognitive skills in deciding how those tools can be used to bring about an effective solution. However, to use coding to bring about the same end, the teacher would have needed to first teach the concepts and syntax associated with the language being used to carry out the coding: for example, when it may be appropriate

to use simple routines such as an 'If' statement and when it may be more appropriate to use more complex routines where the routine itself may rely on the use of variables to make that routine successful.

Tasks / Outcomes and Rules / codes of behaviour. In this instance, one would have to devise and utilise a process through which the pupils could still orchestrate their own opportunities for the construction of knowledge, but ensure that any misconceptions of the subject matter be exposed and dealt with appropriately.

Tasks / Outcomes and Roles / Divisions of labour. As described by the teacher at the focus of this case study – for the teacher using this strategy successfully to bring about the development of the subject - there is a need for secure and confident application of the subject knowledge. This teacher previously acknowledged that this pedagogical strategy is not used by any other member of the teaching staff within the department in their school and implied that this may be due to staff lacking confidence in their subject and pedagogical knowledge.

It appears that the application of computing within the activity setting associated with the pedagogical practice in school B has less of an impact than in school A. This is as might be expected as this school has made greater use and development of the metacognitive skills than had been previously noted within the practice and scheme of work in school A. However there are still contradictions between the task/ outcomes mediating artefact and the mediating artefacts of tools and artefacts; and between rules and codes of behaviour and divisions of labour. Recommendations for change in this instance would be the adjustment of the pedagogical strategy to include a slightly more structured approach so that the teacher could ensure that misconceptions did not remain unchallenged, whilst allowing for the pupils to continue accessing their metacognitive skills within their learning. The addition of structure to the teaching process would also allow for opportunities to develop the more conceptual aspects of the subject which would not respond to an exploratory approach such as programming languages and the implementation of appropriate syntax. The conceptual knowledge needed to solve problems effectively within ICT is different from that needed in computing; in ICT many of the concepts involved in the production of a web site are

already commonplace, with the notion of hyperlinking and navigation part of the pupils' existing knowledge. However the design of algorithms and the use of logic and abstraction cannot be learnt through exploration alone and would require greater scaffolding and structure than exploration alone would allow. There are software applications which would allow for the use of exploration in programming such as SCRATCH. However, they are limited in their application and usually operate using a visual interface in the production of the ultimate task; the result of this is that without a more teacher-led approach, there is a danger that the development of the skill can become mechanistic and the conceptual knowledge base upon which these applications build is ignored. Lastly it is worth acknowledging that due to timetabling the subject as an hour a week through KS3, the subject is afforded a reasonable status, however if it were to be regarded as a fourth science as the steering group recommend there may be a requirement to increase the number of hours teaching a week, this in turn will have an impact on the number of teachers and the levels of expertise required within the department. This would also impact on the time available within the timetable for the teaching of other subjects.

Case study C

Tools and artefacts took the form of the use of discussion between the teacher and the pupils within the class. The pedagogical strategy was the development of a buddy system where when a pupil was unsure of how to proceed with their learning first they had to approach a 'buddy' for assistance. The discussion focused on the production of 'learning ladders' which was a method designed to generate discussion within the class and to encourage the pupils to verbalise the learning or a success criteria needed to solve the problem at hand.

Individuals and groups. Similarly to the activity settings of the other school discussed in this scenario the individual was the specialist teacher who is the focus of the study. In this instance the background of the teacher is primarily one of ICT and as such the specialist knowledge may have limitations.

The rules and codes of behaviour of the activity consisted of the use of the 'buddy system' and the use of 'buddies' in generating the motivation within the class between the two teams of 'buddies'. The rules of the strategy dictate that the buddies are not allowed to carry out the task for the pupil they are assisting, but have to verbalise the assistance and peer support they can provide for their buddy. This verbalisation encourages the pupil to engage with the vocabulary of the subject, it also means they have to access and use the higher order metacognitive skills associated in order to re-synthesise their learning, and to apply their learning to the problem being solved.

The community and organisational structure of the subject in the school as it currently exists with the present curriculum is the timetabling of one hour a week throughout KS3, and at the time of research this was taught solely by specialist teachers. The status of the subject was further increased as teachers of other subjects were actively encouraged to liaise with the ICT department in improving their own ICT capability and where possible to use ICT within their subjects in order to improve their pupils' ICT capability on a cross-curricular basis. Whilst this would still be possible in the development of the digital literacy aspect of the curriculum, it is unlikely that other subjects need to incorporate computing unless it was linking in with the metacognitive skills associated with problem solving.

The roles and divisions of labour in this instance are concerned with the use of the buddy system as a pedagogical strategy, with the roles of the pupils as buddies. This role becomes pivotal to their participation with in the class and the learning environment. If the role of the pupils as knowledgeable peers is derived solely from the learning which has taken place in the classroom, this is likely to be a strong pedagogical tool, especially in motivating pupils in their own learning and the development of independent learning. If, however, it is also reliant on capability derived outside the classroom environment using a knowledge base that has been constructed either through cross-curricular use of the subject or through exploration of the subject independently using technology such as social networking, then this knowledge base may be of lesser value in the transition to computing as a subject, limiting the benefits of this form of pedagogical strategy.

Contradictions

Task / Outcomes and Individuals / Groups. The contradiction here lies in the amount of specialist knowledge teachers may have of computing. As such to remedy this there may be need of continual professional learning and development in order to ensure that their subject knowledge and pedagogical skills are able to adapt to the new subject. Whilst this teacher, and indeed the other teachers teaching the subject, are specialist ICT teachers who have been teaching the subject for a number years and are used to the pedagogical strategies associated with the development of ICT capability, the pedagogical tools required for the development and teaching of computing are likely to be different. Having noted this, part of their pedagogical strategy is the use of discussion which can be used to develop the concepts of the subject.

Task / outcomes and Rules / codes of behaviour and Roles / divisions of labour. It is appropriate to discuss these contradictions together as they are closely related both being related to the use of buddies and the buddy system employed as a pedagogical strategy. The pupils' acquired knowledge of ICT is used as a means of peer support, which encourages the pupils to develop verbalisation of the subject and also the use of their metacognitive skills as a step to independent learning. However the changes within the subject, with the inclusion of algorithm, logic and abstraction limit the amount of knowledge the pupils can gain through external exploration of the subject. It is possible that the knowledge acquired by the pupils about the subject and the concepts associated with it are likely to be reliant on the learning taking place within the classroom. There will be a number of pupils who are able to use exploration and trial and error as a way of developing further knowledge outside the classroom, however the number is not likely to be as great as is possible with ICT purely because the opportunities to interact with ICT outside of the classroom are greater than the opportunities available for computing at this time.

The implications which can be drawn concerning the transition from ICT capability to Computing in School C is likely to involve professional learning and development for teachers to improve their subject knowledge and pedagogical knowledge. Even if these teachers were computer science specialists, such is the time that they have been teaching ICT as a subject that they may be entrenched in the subject and its

curriculum. However, the degree of discussion which is present in the pedagogical strategy use by the teacher observed indicates that the transition to teaching computing may not be as different as in the facilitation strategy from School B or the master - class strategies used in School A. There would be limited opportunities to work with other subjects in the development of computing; however these opportunities would be suitable to enhance the development of a digital literacy. Similarly, the way in which other subject teachers are encouraged to develop their ICT capability would remain, particularly as this change to digital literacy appears to be little more than a nomenclature change at this stage. Like School B the subject has been traditionally taught through weekly lessons in KS3, and as such there would be little need to alter the status of this subject, unless the recommendation is accepted that the subject of computing be considered a fourth science in which case there may be a need for increased timetabling and increased resources.

At a national level within Wales, in order to minimise or resolve these contradictions with a computing curriculum, there is a need for a defined subject. If the curriculum is written in such a way that there is room for a varied perception as is the case of the present ICT curriculum then there is the likelihood that there will be a difference of perception across Wales. In order that a shared perception, and thus a shared practice of development of the new curriculum is developed, there is going to be a need for professional development, not just within individual schools but nationally. Should this curriculum follow the way in which the curriculum is being implemented within England, then this professional development should include not only the technical and conceptual aspects of the curriculum, but also the pedagogical means by which it can be effectively taught.

The research has highlighted a variety of pedagogical strategies used in different ways within the schools to develop ICT capability, this variation and the resulting variation in experience and hence preparation of the pupils for future employment has already been discussed. However, a possible continuum of practice for the development of computing would also imply that there would be a variation of experience and a variation in possible outcomes resulting from this continuum. In order to improve the quality and standard of these computing skills it would be favourable to encourage less

variation in the learning experience. To this end there may be a need for new pedagogical strategies employed by the schools and new or adapted pedagogical tools employed within the classroom by the teachers. This may involve analysis of the pedagogical strategies and tools used by the teachers and evaluating how these strategies inform their classroom practice. Having recognised any existing contradictions, it would be beneficial to employ a system of expansive learning to transform the existing activity settings in order to bring about new knowledge in relation to the subject and pedagogical practices. From a governmental perspective in order to achieve these aims nationally a bespoke system of continued professional development available for all schools would be feasible. This bespoke development would by necessity need to include subject knowledge and pedagogical tools as previously implied. With this being a new subject, based on an amalgam of both computer science and ICT there may need to be further research in order to establish or design new pedagogical tools specific to the new curriculum.

Limitations of the study

There are a range of limitations which have emerged throughout the course of this research. As discussed in the introduction, when deciding initially on the feasibility of the research it was found that there was very little literature connected with a study of the perceptions and pedagogy of ICT within the UK and particularly within Wales. Research has been carried out concerning pedagogy and practice in a variety of other subjects, but not in ICT. This has meant then when using literature as a basis for this research there has by necessity been reliance on curriculum orders and literature concerning the acquisition of knowledge and effective development of pedagogy. The result of this is that in order to maintain the focus of the research, key aspects connected to the development and perception of ICT have had to remain outside the scope of the study, notably the role of assessment in the development of ICT.

Another limitation, whilst not as great or with the same impact as the one concerning assessment, is the absence of pupil voice within the research. With the availability of ICT in support of other subjects and outside the learning environment in the form of gaming and social media, it is likely that additional engagement with ICT other than in

discrete ICT lessons would have an impact in the development of ICT capability. However, pupil voice in this instance was not available.

The sample of schools for the case study was established firstly by asking teachers via the questionnaire if they were interested in further participation in the research and then, out of those teachers which indicated that they would be interested, using local knowledge of the schools in order to select three schools with different styles to study. Any claims to knowledge or awareness of the study of pedagogy concerned with ICT capability is reliant predominantly on three case studies. As such the emergent data is limited and accurate only as far as those case studies are concerned. The study would have benefitted from a greater number of schools with which to build the case studies, and further the examination of a greater number of ICT teachers in each school. It would have been interesting also to incorporate non-specialist ICT teachers within the study to establish how the different teachers used the pedagogical strategies and tools which emerged in this research.

Another limitation which emerged during the course of the research was the question of specialisation. According to Shulman (1987), and indeed according to the perceptions of the teachers in case studies B and C, in order to effectively develop and teach ICT capability there is a need for a specialist subject knowledge and a specialist pedagogical knowledge. This is not being disputed, but perhaps a definition of specialism should be. Within the questionnaire respondents were asked to indicate whether they were specialist teachers of ICT or non-specialists, it would have been more beneficial to this study to ascertain what their specialist background was and how that related to the years teaching of the subject. The analysis of the questionnaire data found no significant difference in response to the perceptual statements between teachers with and without specialist background in ICT. In fact, the defining factor for a variation in response appeared to be the length of time a teacher had taught the subject and not the specialist background. In future research it may be more apt to use this association with teaching the subject as a benchmark for measuring specialism within the subject area. It is entirely possible that in teaching the subject for a number of years the teachers develop an understanding of the subject and its curriculum requirements as it is taught and that they become specialists in the subject regardless

of their background qualifications. This limitation of understanding both on the part of the questionnaire design and the respondents' answers indicates restrictions surrounding the formulation of the questions and statements within the questionnaire.

One of the foci of this research was the study of change: the change in teachers' perceptions, changes in teachers' practice and in particular the impact of external change on those perceptions and practices. However, this study of change has been limited by the timescale of the project and consequently there has been no opportunity to study longitudinal change. This further impacted on the scope of the study which was not able to evaluate the management of that change.

Areas for future research and concluding comments

Due to relative absence of a body of work in this area, and the need to focus this research on the perceptions of the teachers of ICT capability, the relationship of perception to practice of those teachers and the use of CHAT as an analytical tool, there are a number of areas which have arisen which would warrant further investigation. The discussion of these areas of further investigation will link with concluding comments in an attempt to bring the study to a close whilst further outlining possible ways forward.

An important aspect of this research has been the use of Cultural Historical Activity Theory as an analytical framework for the qualitative data. The thematic coding of the data and the alignment of those themes to the mediating artefacts within the activity settings and subsequent identification of contradictions has allowed for a rigorous and deep comparison of activities which otherwise would not be possible. This is because by analysing the data through an identification of the relationships between mediating artefacts, it is the relationships which become the focus. This focus has enabled the researcher to build otherwise unrelated collections of data such as interviews and observations as activity settings and in doing this find commonality or contradiction. Thus it has been possible compare perceptions with practice. However there were aspects of the data which were unable to be effectively included or linked to the

mediating artefacts. These additional themes were concerned with speculation and arose when the participants speculated about what might be needed in the future should the curriculum change. This is entirely logical as activities can only take place either in the present or from a historical perspective. However if those speculations are introduced to an existing activity setting, then it is entirely possible to alter the focus of the activity setting and use it as a means of modelling possible activities given a particular set of circumstances, as has been carried out above when discussing the implications of a change in curriculum.

With the possible introduction of a new curriculum in Wales there will be a need to generate a greater understanding of the pedagogy associated with this new subject. From this study it has been appropriate to surmise that there is both a continuum of practice and a continuum of perceptions surrounding the teaching of ICT capability. This suggests that there will be a need to carry out a similar study to investigate the development of teacher's perceptions and practice should computer science or computing be included in the National Curriculum in Wales. There are many research studies which could be carried out to create a better understanding of the means of developing this subject, whether this is ICT focused or computer science focused, and as suggested above, any further studies should not neglect the aspect of assessment in developing this knowledge base.

Should a new curriculum containing computer science be established within Wales, there is also the need to ascertain the question of specialism and the possible links between establishing specialist knowledge through the years associated with teaching the subject using a particular pedagogy. If such a link does exist, there may be a necessity for professional development of teachers with a computer science background who have developed as specialists within ICT as their original subject specialism may have changed.

Another possible challenging aspect of the activity system is when evaluating the contradictions. The tool easily supports the recognition of contradictions between the related factors of the triangle (Engestrom, 2000b); however the depth or significance of contradictions is not recognised. For example a contradiction between the practice

and the perception of a subject may have far greater significance than a contradiction between a subject's perception of the National curriculum and the perception of the communication strand, as was discussed in the Case Study of school C. For a contradiction of greater significance there is likely to be the need of a greater degree of change to rectify that contradiction. In contrast where that contradiction has a lesser significance the change required to rectify the system is likely to be less.

It would therefore be interesting to use variations in the depth of contradictions in a further study using Activity Theory to evaluate the development of digital literacy between specialists and non-specialists within the same environment using the same pedagogical tools. To enable this there would need to be a greater focus on what defines a specialist teacher as previously outlined. This further work in addition to developing an understanding of the pedagogy involved in the development of digital literacy would also help to validate the notion of different depths or complexities to the emergent contradictions which at present is tentative.

Lastly it is possible to better evaluate the use of CHAT as an analytical framework in educational research and to determine if there is indeed a variation of significance within the contradictions.

At the start of this study, there was a desire to ascertain if the experience of observing the teaching of ICT in Wales at KS3 suggested that the ICT curriculum and the pedagogy associated with the subject varied widely between schools in Wales. This study examined the pedagogy of ICT in that the aim which the research sought to address was to explore teacher's perceptions of ICT capability and whether their practice in the classroom matches their personal constructs. This is particularly pertinent given the current environment of curriculum change in Wales.

Whilst the limitations of the scope of the study meant that findings were mainly confined to three case studies and within those case studies to three ICT teachers, it appeared from the research that there is a variation regarding both the perceptions and the development of ICT capability.

Two continuums emerged, one where the teachers perceived ICT capability as having the use of metacognitive skills associated with it at one end and a capability which was based on the tools of specific software applications at the other. The other continuum was concerned with the pedagogy of ICT. It emerged that within the schools there were again different pedagogical strategies which in turn resulted in the use of different pedagogical tools by the teachers within the study. At one end of this pedagogical continuum was a strategy which allowed pupils to explore their learning through facilitation and exploration, with the other end of the continuum presenting as a rigid teaching strategy with only superficial opportunities for the pupils to employ their metacognitive skills.

The study has allowed for the considered speculation of how the pedagogy may have to change should a new curriculum of computing be introduced to the National curriculum in Wales. This consideration has highlighted limitations of the study and opened avenues for further research as previously discussed in this chapter.

Cultural Historical Activity Theory has been used as an analytical framework within this study. The use of this tool has enabled different dimensions within the case studies to be recognised and discussed. Not the least of these has been recognition of the difference between different pedagogical strategies at a school level and the impact that the use of those strategies has had on the use of particular pedagogical tools at a classroom level. The use of the activity settings over time has allowed a fourth dimension to be added to the analysis and to examine how the teachers in the case study, particularly how the teacher in school A has reacted to change and how those teachers have managed their recognition of the emergent contradictions. The use of the activity setting to analyse similar settings from different viewpoints has also prompted the use of CHAT as a tool to model likely contradictions which may emerge from the introduction of any new curriculum. The ability to model future changes has allowed for the implications of change to be highlighted.

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Appendices

Appendix I

Cross Wales Questionnaire

About the survey

This research aims to investigate how ICT teachers perceive the development of ICT Capability at key stage 3 and this researcher would be grateful for your participation. It is hoped that this research will ultimately lead to a better understanding of ICT capability and improved development of ICT capability at key stage 3.

This survey should take about 10-15 minutes of your time. Most questions ask you to place a tick in the box provided and/or may ask you to provide some additional information as well.

The information recorded on this questionnaire will be kept completely confidential and all information you provide will be recorded on a completely anonymous basis. It will be passed only to the researcher, who will ensure that the information you provide is kept securely stored. You are not asked to provide your name at any point during the survey. If you find the research interesting and would like to receive a copy of the results, or would like to participate in further action research on this topic please contact me at the address below or alternatively submit your email on the survey in the place provided.

If you have any problems completing the survey or would like to speak to the researcher, then please contact;

Jan Barnes
Swansea Metropolitan University
School of Education
Townhill
Swansea
SA2 0UT
01792-481000
E-mail: jan.barnes@smu.ac.uk

ICT capability perceptions

2. Educators details

1. What is your current Position in School (tick any which apply)

☐ Head of ICT

☐ ICT Co-ordinator

☐ Specialist ICT teacher

☐ Non-specialist ICT teacher

If non-specialist ICT please state main subject

2. Please indicate your Local Education Authority

LEA

3. How long have you been teaching

	Less Than 6 years	6-10 years	11-15 Years	16-20 Years	Over 20 Years
Any Subject	☐	☐	☐	☐	☐
ICT	☐	☐	☐	☐	☐

4. Do you posess a formal qualification in ICT

Yes

No

If Yes Please state

5. Please describe your first degree(s) subject

- Higher Certificate

- BA

- BA Ed

- BSc

- PGCE ICT

- PGCE (Other)

- MSc Computing

- Masters in Education

- Masters (Other)

- PhD

Please state Subject

6. At what level do you teach ICT

- Key Stage 3

- GCSE or equivalent

- A Level or equivalent

- Key skills

7. Please rate the following statements

	Strongly Agree	Agree	Unsure	Disagree	Strongly Disagree
Technical ICT skills are essential building blocks for developing ICT					
ICT concepts are often ignored when teaching ICT at KS3					
ICT skills are best taught separately					
ICT is just a tool for carrying out work in other subjects					
ICT skills develop with systematic practice					
ICT skills are best learnt through personal exploration					
ICT skills require conscious thought					
ICT capability requires knowledge of the correct software package for each task					
ICT capability has nothing to do with knowledge of hardware					
Exposure to ICT outside the classroom has limited influence on developing ICT Capability					
ICT capability is not adequately defined by the Key Stage 3 curriculum in Wales					
Teacher demonstrations are essential for the development of ICT					
ICT Capability is best developed by pupils practicing in class					
Peer assessment is relevant in the development of higher order ICT capability					
Problem solving is integral to ICT capability					
Pair / Group tasks are not relevant in the development of ICT					

capability

Parental Knowledge is important in aiding ICT capability development

Originality is a key component of ICT Capability

Graphic design skills are not part of ICT Capability

8. Please rate the following strands in order of their importance in the development of ICT capability at Key Stage 3. Where "1" is the most important and "4" the least important

	1	2	3	4	5
Modelling					
Communicating Information					
Data Handling					
E-safety					
Control					

9. How important are the learning of the following applications in the development of ICT capability at Key Stage 3

	Very Unimportant	Unimportant	Neutral	Important	Very Important
Word processing					
Spreadsheet					
Databases					
Programming					
Digital Photography / Moviemaking					
PowerPoint					
Activ / Smart					
Interactive quizes					
Internet					
Web development					
Other					

Other (please specify)

10. Are there any aspects of ICT capability that are not included in the KS3 curriculum which you believe should be and why

Aspect to be included

Why

11. May I take this opportunity in thanking you for your participation in this survey and if you would like to participate in further research or would like copies of the ultimate results please indicate and supply your Email. Thank- you

I would like to participate in further research

I would like to receive copies of the ultimate results of this research

Appendix II

Consent forms

Headteacher Consent form.

Jan Barnes

PGCE ICT Tutor

Swansea Metropolitan University/Prifysgol Fetropolitan Abertawe

Townhill Campus, Townhill Road, Swansea, SA2 0UT

E-mail/E-bost: Jan.Barnes@smu.ac.uk

Dear <Name of Head>,

I am currently undertaking research for a PhD which aims to investigate how ICT teachers perceive the development of ICT Capability at key stage 3 and I have been in touch with <Name of Teacher>, in your ICT department who has kindly agreed to be part of this research. It is hoped that this research will ultimately lead to a better understanding of ICT capability and improved development of ICT capability at key stage 3.

In line with the "Ethical Guidelines for Educational Research" (BERA 2011), I am writing to you with details of this study in order to obtain your informed consent prior to any research taking place within your establishment.

It is proposed to use case study based on three different secondary schools as a research methodology, and that case study will be built by means of two cycles of interview, observation and reflective dialogue with the teacher named above.

The initial interview aim is to ascertain the teacher's personal constructs of ICT capability. It would also be desirable to discuss methods of delivering of ICT sessions, evaluating the scheme of work in place and how this promotes the development of ICT capability. During this interview it would be a good opportunity to identify a particular teaching approach carried out by the participating teacher which they believe has a particular impact on the development of ICT capability. This would then be followed up with an observation of the lesson where that teaching approach is being used. The primary focus for this observation will be the potential for learning and the structure by which this is achieved and how this relates to the teacher's personal constructs of ICT capability established in the previous interview.

Post-observation reflective dialogue will be used to establish the teacher's thoughts on the observed lesson, how it relates to the development of ICT capability according to the personal constructs and beliefs of the teacher, and how the teacher may like to alter or adjust the teaching approach for the next cycle.

There is to be no interaction with the pupils by the researcher other than vicariously in that there will be observation of the pupils' learning.

Any findings from the study are solely for the purpose of the PhD and will be confidential; every effort will be made to ensure that neither participants nor participating schools can be recognised. Would appreciate help with this bit.

I would be grateful if you could sign and return the acknowledgement below in the envelope provided in order to give informed consent. If you have any issues regarding this research you would like to discuss please do not hesitate to contact me either by email as above or by phone (07927775713)

Yours Sincerely

Jan Barnes

PhD Research Consent

I consent to Jan Barnes of Swansea Metropolitan University undertaking research with <Name of Teacher> for the purposes of her PhD

Signature   _____

Print Name   _____

Teacher consent.

Jan Barnes

PGCE ICT Tutor

Swansea Metropolitan University/Prifysgol Fetropolitan Abertawe

Townhill Campus, Townhill Road, Swansea, SA2 0UT

E-mail/E-bost: Jan.Barnes@smu.ac.uk

Dear <Name of Teacher>,

You have recently participated in a questionnaire regarding how teachers perceive the development of ICT capability. At the end of that questionnaire you indicated that you would be interested in taking part in this research. It is hoped that this research will ultimately lead to a better understanding of ICT capability and improved development of ICT capability at key stage 3.

In line with the "Ethical Guidelines for Educational Research" (BERA 2011), I am writing to you with details of this study in order to obtain your informed consent prior to any research taking place within your establishment.

It is proposed to use case study based on three different secondary schools as a research methodology, and that case study will be built by means of two cycles of interview, observation and reflective dialogue with the teacher named above.

The initial interview aim is to ascertain the teacher's personal constructs of ICT capability. It would also be desirable to discuss methods of delivering of ICT sessions, evaluating the scheme of work in place and how this promotes the development of ICT capability. During this interview it would be a good opportunity to identify a particular teaching approach carried out by the participating teacher which they believe has a particular impact on the development of ICT capability. This would then be followed up with an observation of the lesson where that teaching approach is being used. The primary focus for this observation will be the potential for learning and the structure by which this is achieved and how this relates to the teacher's personal constructs of ICT capability established in the previous interview.

Post-observation reflective dialogue will be used to establish the teacher's thoughts on the observed lesson, how it relates to the development of ICT capability according to the personal constructs and beliefs of the teacher, and how the teacher may like to alter or adjust the teaching approach for the next cycle.

There is to be no interaction with the pupils by the researcher other than vicariously in that there will be observation of the pupils' learning.

Any findings from the study are solely for the purpose of the PhD and will be confidential; every effort will be made to ensure that neither participants nor participating schools can be recognised. Would appreciate help with this bit.

I would be grateful if you could sign and return the acknowledgement below in the envelope provided in order to give informed consent. If you have any issues regarding this research you would like to discuss please do not hesitate to contact me either by email as above or by phone (07927775713)

Yours Sincerely

Jan Barnes

PhD Research Consent

I, <Name of Teacher> consent to Jan Barnes of Swansea Metropolitan University to assist in undertaking research for the purposes of her PhD

Signature   _____

Print Name   _____

Appendix III

Perceptions of ICT capability

Within the questionnaire, there were a number of statements, which the respondents indicated their level of agreement using a Likert scale ranging from "Strongly Agree" to "Strongly Disagree". The responses to these items were analysed using the SPSS statistical analytical program and can be seen below.

There were a number of statements, to which the respondents indicated the extent of agreement. These statements were as follows:
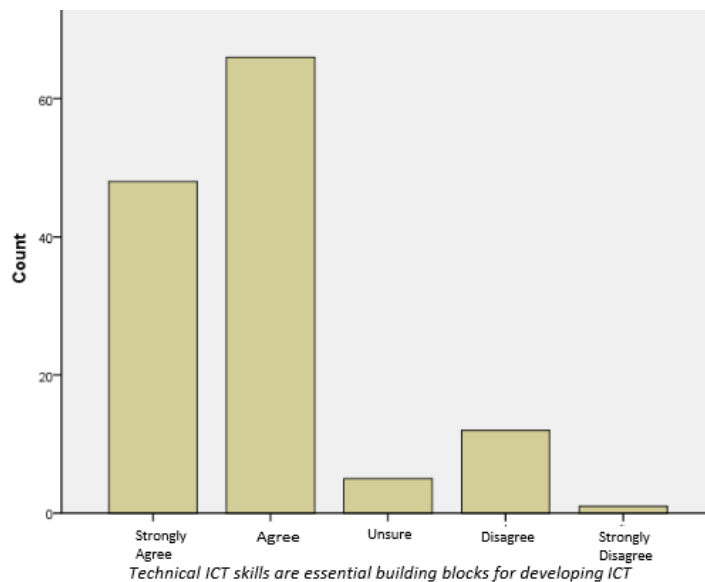
Figure 24- Technical ICT skills are essential building blocks for developing ICT

The overall opinion of those taking part in the questionnaire was one of the agreement with the statement "*Technical ICT skills are essential building blocks for developing ICT*" (Median 2.0).
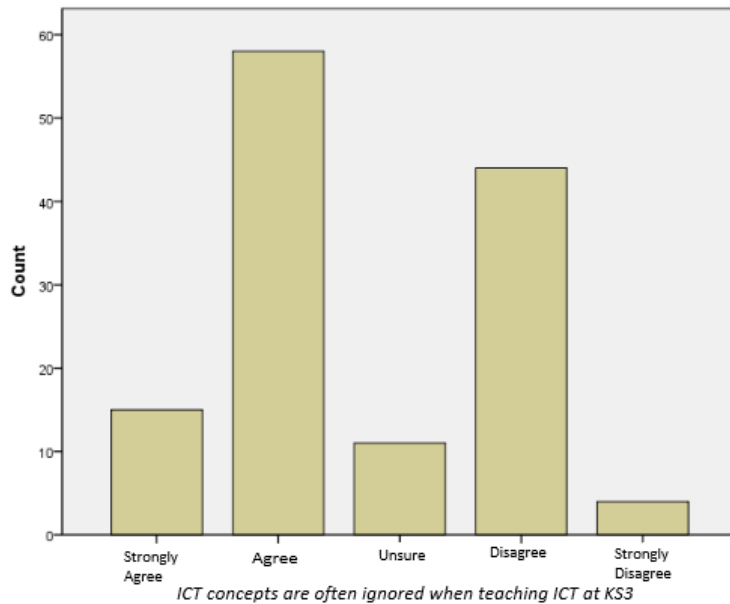
Figure 25 - ICT concepts are often ignored when teaching ICT at KS3

This statement *"ICT concepts are often ignored when teaching ICT at KS3"* the graph (median = 2.0) shows a bimodal distribution. Those agreeing with the statement imply that if concepts are ignored at KS3 then perhaps ICT at KS3 is perceived as being more of a 'tools' driven subject as discussed in previous chapters.
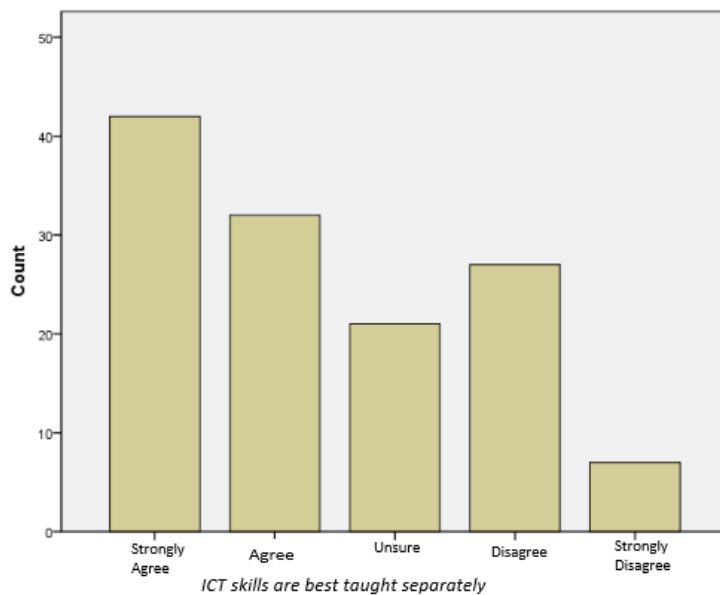
Figure 26 - ICT skills are best taught separately

Furthermore, agreement with the statement "*ICT skills are best taught separately*" (median 2.0) could be argued to be in line with this, in that the skills are best taught within the ICT sessions rather than as part of support for the other subjects. However, the answers to this statement varied. However, an alternative interpretation may also be that each individual

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skill associated with ICT capability be taught in separation from each other and not as an holistic approach, this lack of clarity may also be the reason for this varied result.

Whilst there is overall agreement, conversely there are once again a number of respondents who are either in a disagreement or unsure of this statement. A similar statement regarding the development of ICT capability as its own subject was *"ICT is just a tool for carrying out work in other subjects".* If these two statements were being perceived as being the opposite of one another in as much as some may be interpreting ICT to be a separate subject with its own skills and that they are best taught in their own right. This is in contrast with the position that ICT is just a tool for supporting other subjects, in which case opposite responses would have been expected. This was not the case. This apparent disparity further reinforces the apparent lack of clarity within this statement.
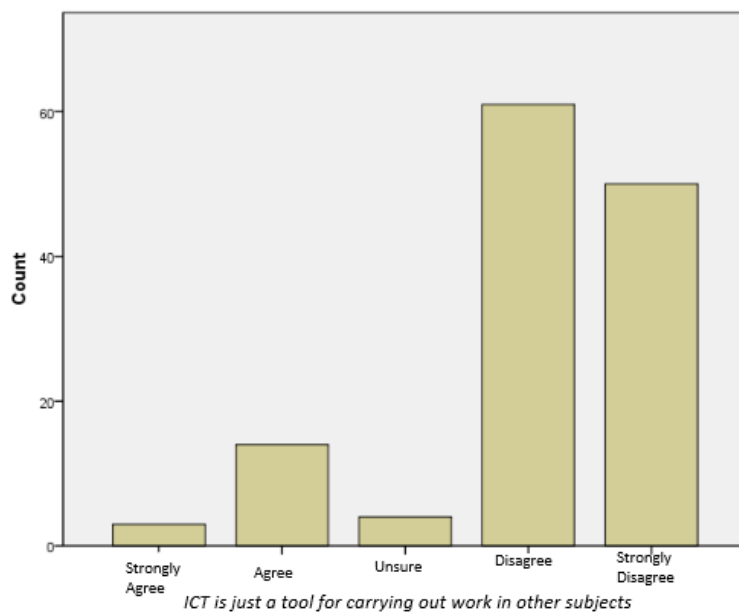
Figure 27 - ICT is just a tool for carrying out work in other subjects

The consensus was one of disagreement (Median = 4.0), with the statement *"ICT is just a tool for carrying out work in other subjects"*. The interesting aspect of this is that in disagreeing or strongly disagreeing with the statement the indication is that the majority of respondents believed that if ICT is about more than tools for other subjects then it must have a value as a subject in its own right.

This is in line with case study schools B and C, where ICT capability is developed through a series of dedicated weekly sessions, unlike school A where it is developed through a specific week per year group of master - class and workshops, as discussed in chapter 5.
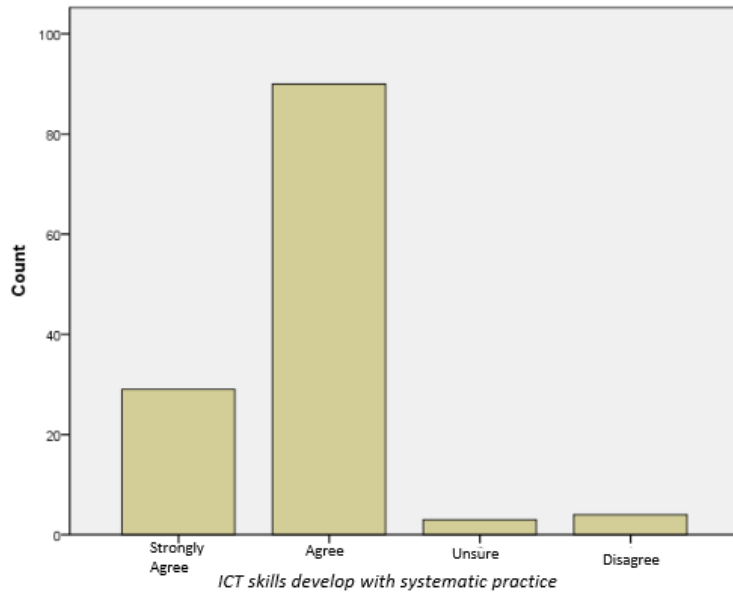
Figure 28 - ICT skills develop with systematic practice

Once again, there was agreement that ICT skills are developed with systematic practice (median 2.0), although the interest here lies perhaps in the indication that whilst the statement was agreed with this agreement was not indicated as being a strong agreement.
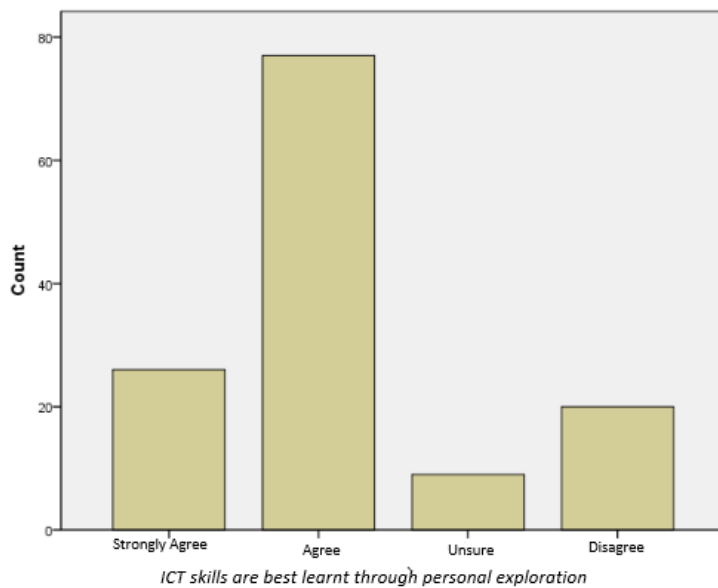
Figure 29 - ICT skills are best learnt through personal exploration

The agreement amongst the participants (median 2.0) with this statement is of interest. The implications are that exploration is an important aspect in the development of the learning of ICT. Personal exploration implies enabling pupils to be able to investigate aspects of ICT individually and to be able to successfully carry out this form of activity and hence use this strategy as a way of developing ICT the pupils are utilising higher metacognitive skills to be able to detect what may be important in their exploration. This is a technique, which has emerged in the analysis of the case studies particularly in Schools B and C.
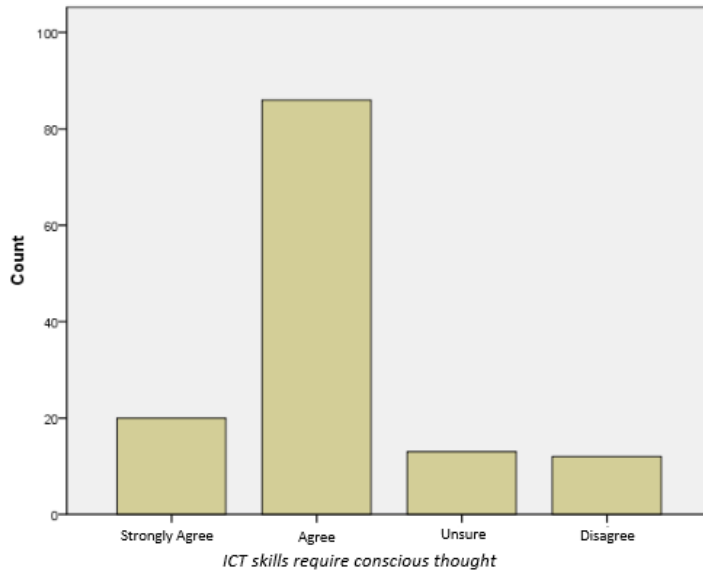
Figure 30 - ICT skills require conscious thought

Agreement with this statement (median 2.0) indicates that use of ICT requires the use of the metacognitive and thinking skills that cannot be carried out automatically.
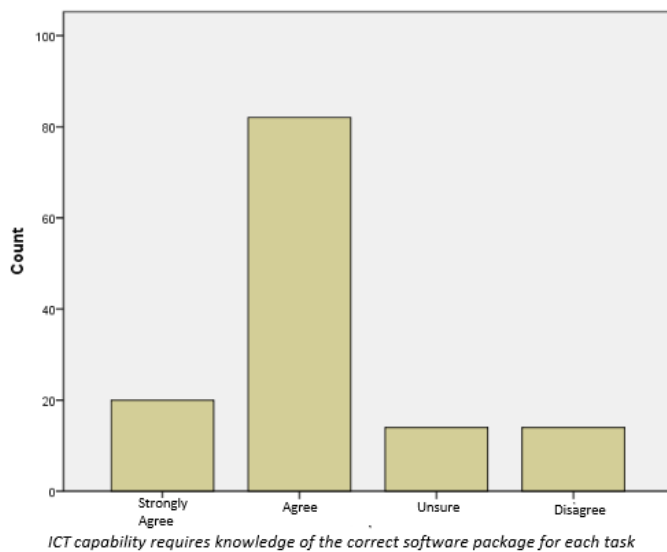
Figure 31 - ICT capability requires knowledge of the correct software package for each task

Agreement with this statement (median 2.0), states that ICT capability requires knowledge about the correct software package and the implication may be that for pupils to be ICT capable their knowledge of certain software applications becomes important. This is certainly true when, for example, there is a requirement for pupils to pick the appropriate software application in order to carry out a task.
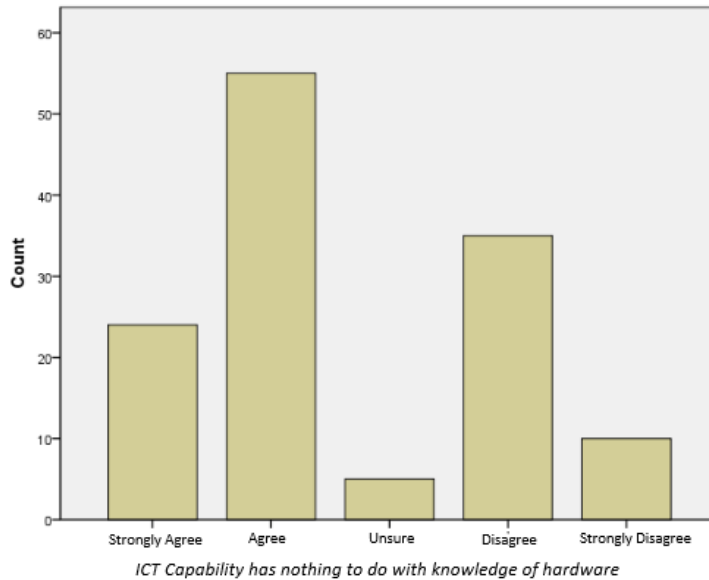
Figure 32 - ICT capability has nothing to do with knowledge of hardware

"ICT capability has nothing to do with knowledge of hardware" gives another bi-modal result (Median 2.0) showing a clear difference in opinion , however the majority view is that ICT capability is independent of any hardware knowledge often associated with the teaching of computer science.

In the case study interviews, the participant in school B indicated that they felt that the subject should also include a knowledge and understanding of the associated hardware in order that the subject can evolve. This opinion agrees with those respondents who disagree with the above statement .

Furthermore, if the lack of consensus about this statement is linked to the aspiration to evolve the subject nearer to one of computer science then it might be expected that a similar picture to the statement regarding coding would appear. However the statement *"Coding is an essential part of ICT"* produced a bimodal distribution, and although the majority opinion

is one of disagreement there is a moderate number of respondents who view coding as an integral part of the subject.
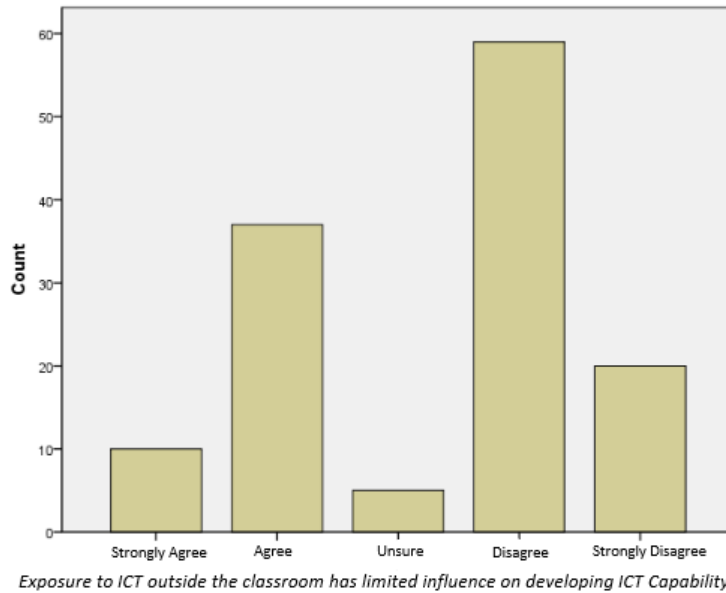
Figure 33 - Exposure to ICT outside the classroom has limited influence on developing ICT Capability

"Exposure to ICT outside the classroom has limited influence on developing ICT Capability" once again the responses show mixed opinions (median 4.0), however whilst bi-modal the median indicates that there is a stronger disagreement to the statement than there is agreement. This in itself is of interest given the amount of exposure available outside on the classroom, with Web 2.0 and interactive social media.
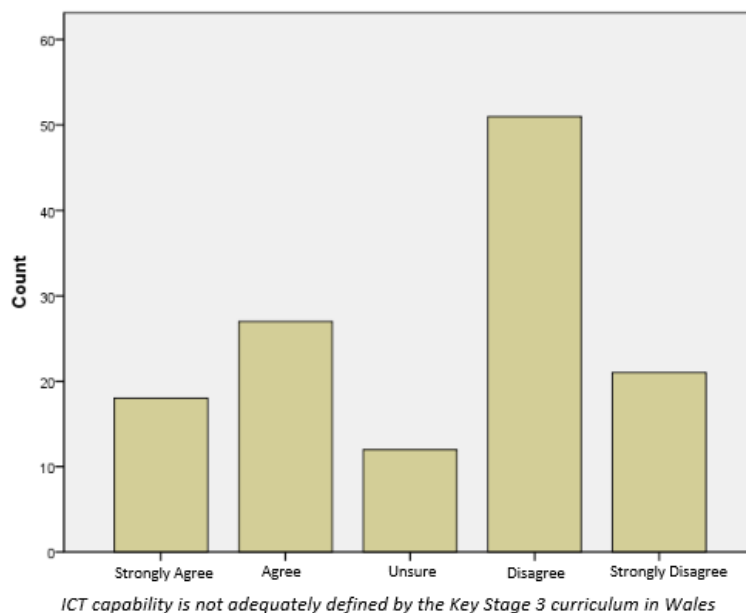
Figure 34 - ICT capability is not adequately defined by the Key Stage 3 curriculum in Wales

Once again, this shows a higher rate of disagreement than agreement with this statement (median 4.0), however the bar chart indicates that there is a number of respondents who do not agree that the curriculum adequately defines ICT capability at KS3 in Wales. Whilst relatively low, this may be of interest given the current period of change, which the subject is undertaking at the moment. It, however needs to be noted that the questionnaires where sent out to participants prior to the indication that change was likely to take place.
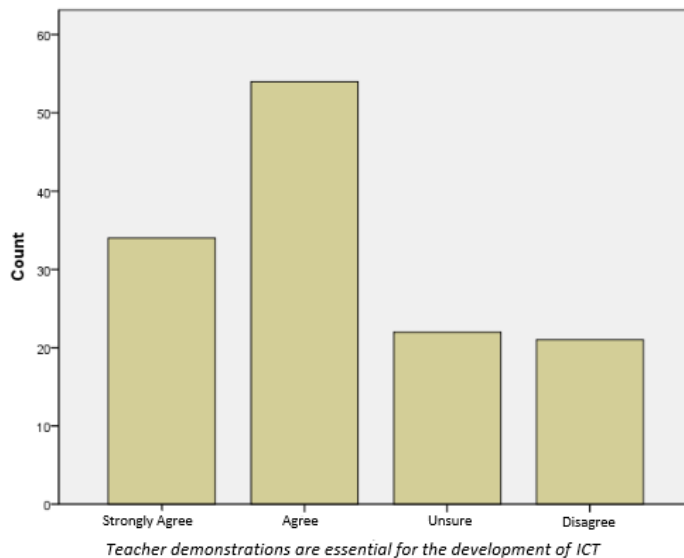
Figure 35 - Teacher demonstrations are essential for the development of ICT

The above chart indicates agreement with the statement that teacher demonstrations are important, (median 2.0), however there is some disagreement, indicating that there is some belief that alternative strategies in the development of ICT may also be of import. Analysis of the response to the statements concerning personal exploration, parental influence and external exposure to ICT might be expected to have complimentary results. However, whilst there was disagreement with the statement concerning the impact of both parental control and the impact of external exposure, both of which support the results from this statement. However the respondents also agreed with the statement that personal exploration is important in the development of ICT capability. This may indicate that the personal exploration should be within the environs of the classroom, and not influenced by external exposure to ICT.
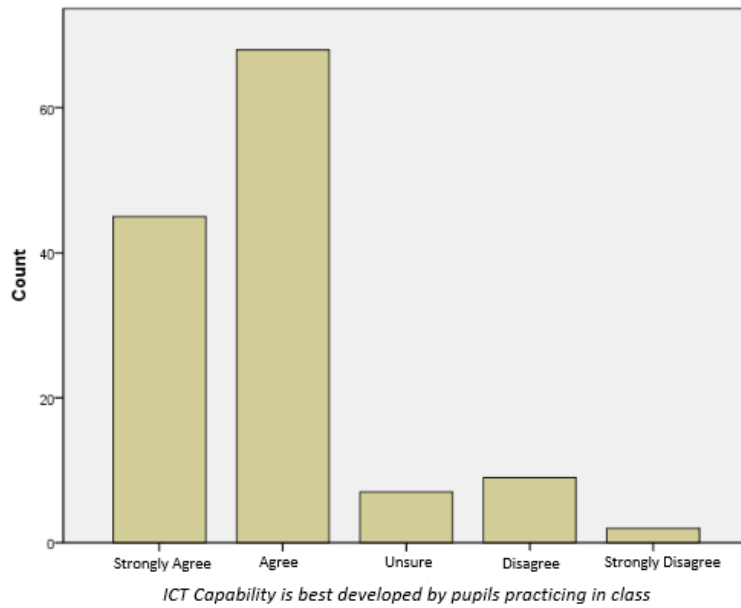
Figure 36 - ICT Capability is best developed by pupils practising in class

The agreement with this statement (median 2.0) also indicates that the respondents agree that pupils practising in class best develop ICT capability. Similarly, as with the previous statements this result may be supported by the disagreements respondents made to the statements related to parental influence and exposure to ICT external to the classroom.
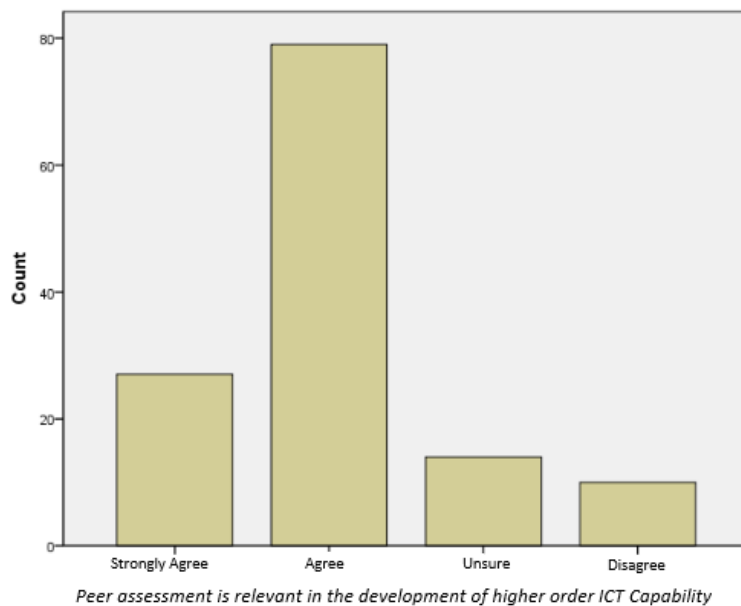
Figure 37 - Peer assessment is relevant in the development of higher order ICT capability

Respondents also agreed with this statement concerning the use of peer assessment in class (median 2.0). To be able to use peer assessment successfully in class the pupils need to be fully aware what is required; and the use of effective peer assessment is related to the use of

those higher order metacognitive and thinking skills.
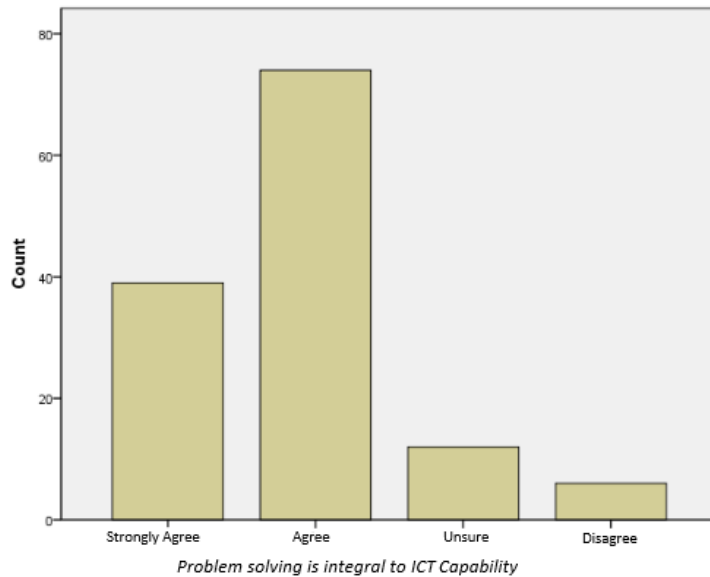
Figure 38 - Problem solving is integral to ICT capability

The respondents once again agree with the statement relating to problem solving and ICT capability (median 2.0). The recognition of problem solving as being a part of ICT capability implies that there is a need for the use of the higher order thinking skills as a part of ICT capability. Agreement with this statement is in line with the agreement to the statement that ICT is not just a tool for use in other subjects. If indeed ICT were just a tool then one would not expect to see the use of problem solving skills and the use of those thinking skills required to solve problems.
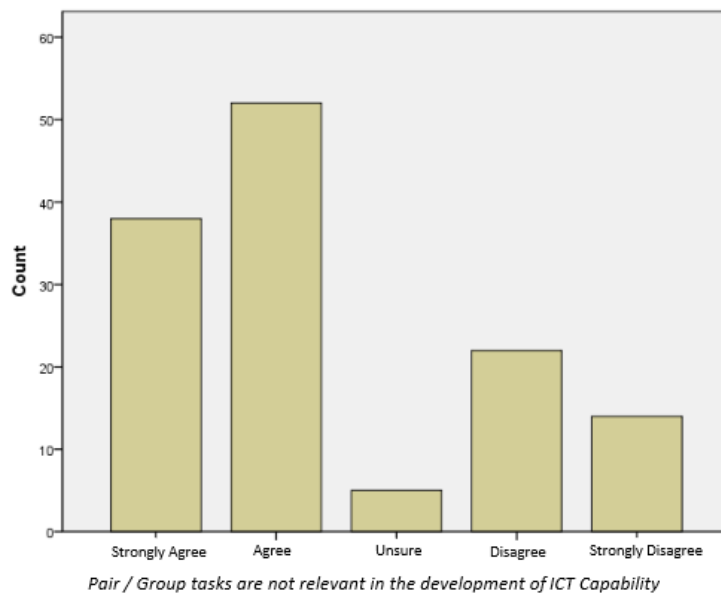
Figure 39 - Pair / Group tasks are not relevant in the development of ICT capability

Respondents agreed (median 2.0), that pair or group tasks are not relevant to ICT capability, supporting the results from the earlier statement that personal exploration is important in development of ICT capability.
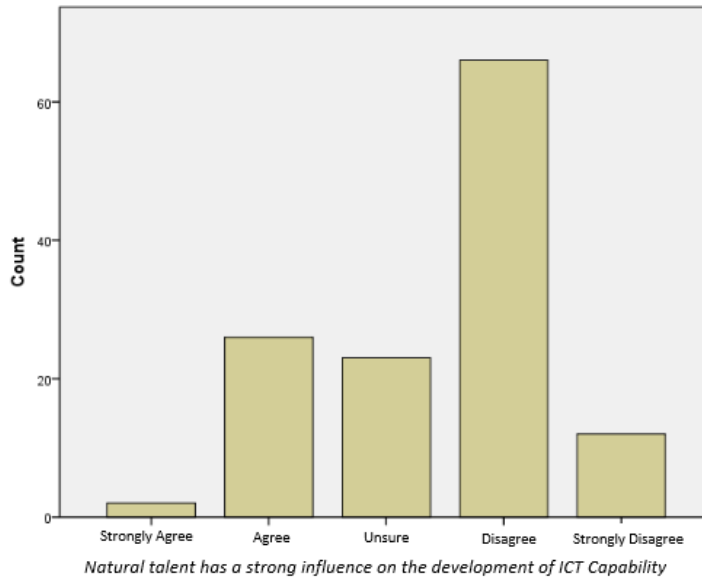
Figure 40 - Natural talent has a strong influence on the development of ICT capability

A further statement showing an overall disagreement was "Natural talent has a strong influence on the development of ICT capability" (Median 4.0). This is indicates that the teachers answering the questionnaire did not perceive natural talent to have a strong influence on the development of the subject.
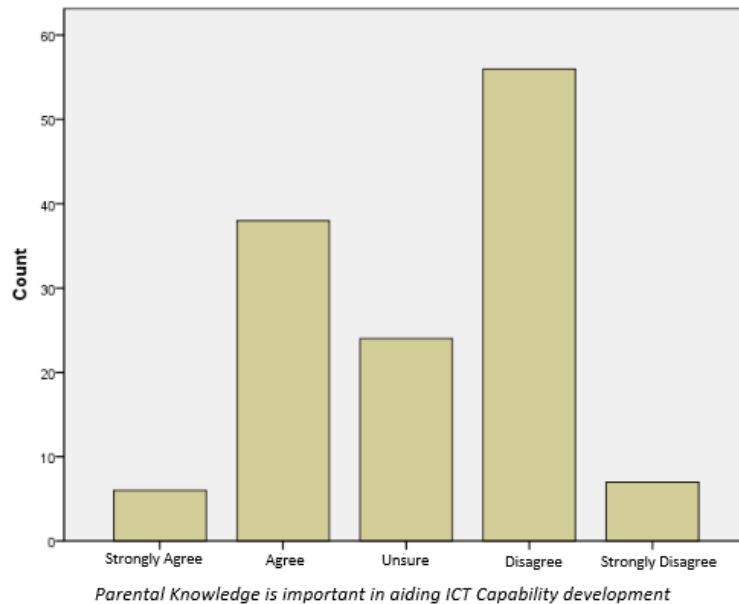
Figure 41 - Parental Knowledge is important in aiding ICT capability development

With a similar response shown for *"Parental Knowledge is important in aiding ICT capability development"* (median 3.00) as to that of exposure to ICT outside of the classroom. However the distribution indicates a bimodal response

The main variation between these two graphs is the number of respondents who are unsure about the second statement. The pattern of agreement and disagreement are very similar overall. Both statements are concerned with the ability of the pupils to develop ICT outside of the classroom, whether that be by external exposure or influence by parents. This is interesting as there is strong anecdotal evidence that pupils who use ICT through social media and games develop basic skills and techniqueswhich develop into routines in line with Kennewell et al., definition of ICT capability (Kennewell, et al., 2003). These skills, routines and techniques are largely trnsferable and easily used to support the work pupils are carrying out in classrooms.
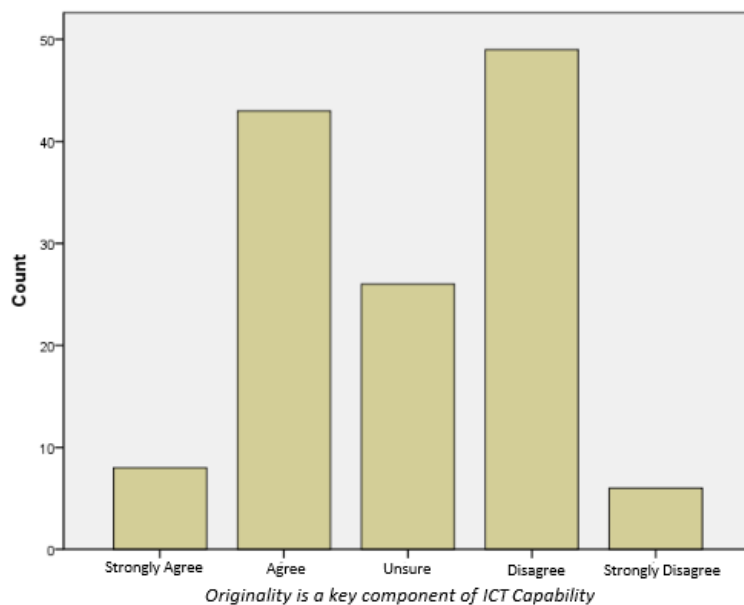
Figure 42 - Originality is a key component of ICT Capability

Another statement which might have been expected to be more positive , but was bi-modal was *"Originality is a key component of ICT Capability"* (median 3.0)*.* Within the case studies, there was a strong inclination by Schools B and C that the schools use their creative skills in the production of their work, in School C this was with learning ladders where the pupils used their own creativity with guidance from the teacher in producing their own success criteria.

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Whilst in School B the pupils used their creativity and originality to produce work sheets and training videos for their peers in the use of the tools of the software application under investigation. However, there are slightly more respondents who disagree that originality is key to ICT capability.
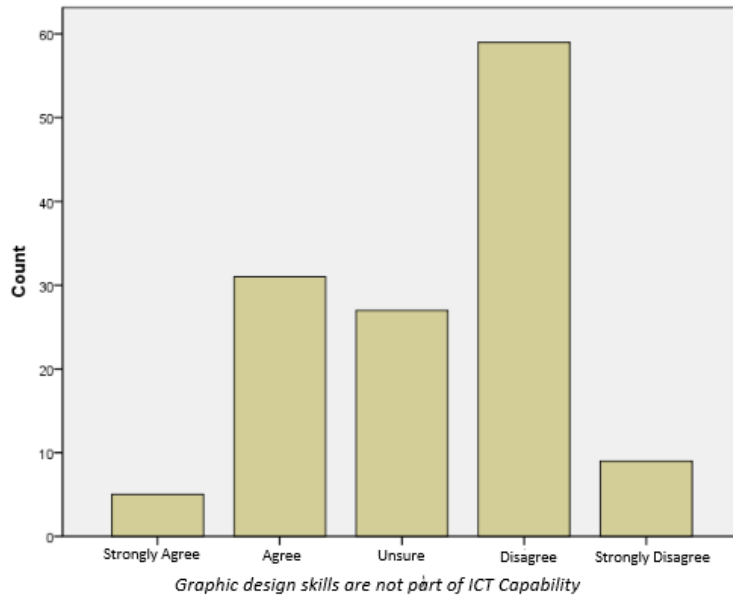
Figure 43 - Graphic design skills are not part of ICT Capability

The chart depicting the results to this statement shows responses to be varied, however the median is greater than three, (median = 4.0), implying that there is a greater disagreement with this statement than there was agreement.
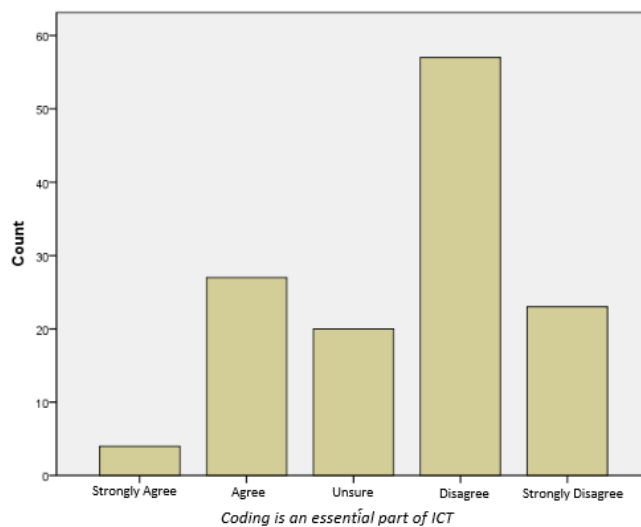
Figure 44 - Coding is an essential part of ICT

The responses for the statement concerning the role of coding as a part of ICT capability indicate disagreement with the statement (median 4.0). However, at the time of writing it

should be noted that coding is not part of the National Curriculum in Wales and as such, this level could be considered as moderately high. This response might be explained by the possible impact that the changes within the Curriculum in England are having on the perceptions in Wales.

The responses to the statements were then analysed further, comparing the responses by independent groups using non-parametric tests, specifically the Mann-Whitney U test. This test compares the responses between two independent groups on an ordinal scale based on rank ordering of the data (Hinton, 1995, p. 210). The grouping variables used were: their years of experience teaching ICT, their position within the department and whether they are specialist or non-specialist teachers of ICT.

In each case, the null hypothesis H_0 is that there is no difference between the groups and the Alternate hypothesis H_1 is that there is a difference between the groups. The 5% level of significance was used with a two-tailed test. The results, which will be discussed for each category, are those, which show there is a difference at the 5% level. Size of effect r has been calculated using the formula:

$$\text{size of effect } r = \left(\frac{z}{\sqrt{n}} \right)$$

(Connolly, 2007, p. 193)

Years teaching ICT

When carrying out the Mann-Whitney U Test for the number of years teaching ICT against the perceptual questions discussed above there are two hypotheses.

For the majority of statements there is insufficient evidence to reject the null hypothesis. Full results can be seen in Appendix IV

However, for the following statements there is sufficient evidence to support the alternative hypothesis.

ICT concepts are often ignored when teaching ICT at KS3

Differences were found between the two groups (more than ten years' experience teaching ICT/ten years or less teaching ICT) (p=0.035, Mann Whitney U=1795, Z=2.056) (Tables 7.1 and 7.2). As can be seen from Figure 22, teachers with ten years' experience or less were more likely to disagree with the statement, however, the strength of this relationship was small (r=0.184) (Cohen, 1988).

Table 7.1 Significance test for "ICT concepts are often ignored when teaching ICT at KS3" against years teaching ICT

Test Statistics[a]	
ICT concepts are often ignored when teaching ICT	
Mann Whitney U	1795
Z	-2.112
Asymp. Sig. (2-tailed)	.035

a. Grouping Variable: Years teaching ICT

Table 7.2 Comparisons of Median ranks for "ICT concepts are often ignored when teaching ICT at KS3" against years teaching ICT

Years teaching ICT	N	Median	Mean Rank
Over 10 Years	72	2.00	60.49
10 Years and under	60	3.00	73.71
Total	132	2.00	

The median values in Table 7.2 indicate that more teachers for the 10 years and under category ranked the statement using the higher rankings, which equated to a disagreement or strong disagreement with the statement. Figure 22 clearly shows that those teachers who had been teaching ICT for 10 years and under were more likely to disagree with the statement, whereas those teachers who had been teaching ICT in excess of 10 years were more likely to agree.
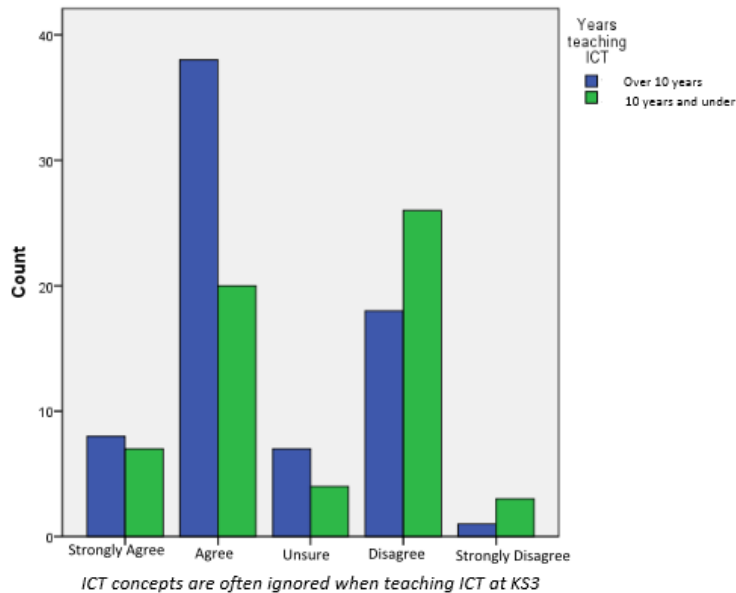
Figure 45 - "ICT concepts are often ignored when teaching ICT at KS3" Vs. Years teaching ICT

ICT capability requires knowledge of the correct software package for each task

Differences were found between the two groups (more than ten years' experience teaching ICT/ten years or less teaching ICT) (p=0.028, Mann Whitney U=1689.5, Z=-2.197) (Tables 7.3 and 7.4). As can be seen from Figure 23, both categories of teachers tended to agree with the statement, however the differences lie where teachers did not respond with the "Agree" option. Teachers with ten years' experience or less were more likely to strongly disagree with the statement, however, the strength of this relationship was small (r=-0.193) (Cohen, 1988). This indicates that those teacher with ten years or less experience were more likely to think that the concepts where not ignored when teaching ICT at KS3 implying that they are teaching concepts.

Table 7.3 "ICT capability requires knowledge of the correct software package for each task"

Test Statistics[a]	
ICT capability requires knowledge of the correct software package for each task	
Mann Whitney U	1689.500
Z	-2.197
Asymp. Sig. (2-tailed)	.028

a. Grouping Variable: Years teaching ICT

Table 7.4 Comparisons of Median ranks for "ICT capability requires knowledge of the correct software package for each task"

Years teaching ICT	N	Median	Mean Rank
Over 10 Years	71	2.00	71.20
10 Years and under	59	2.00	58.64
Total	130	2.00	
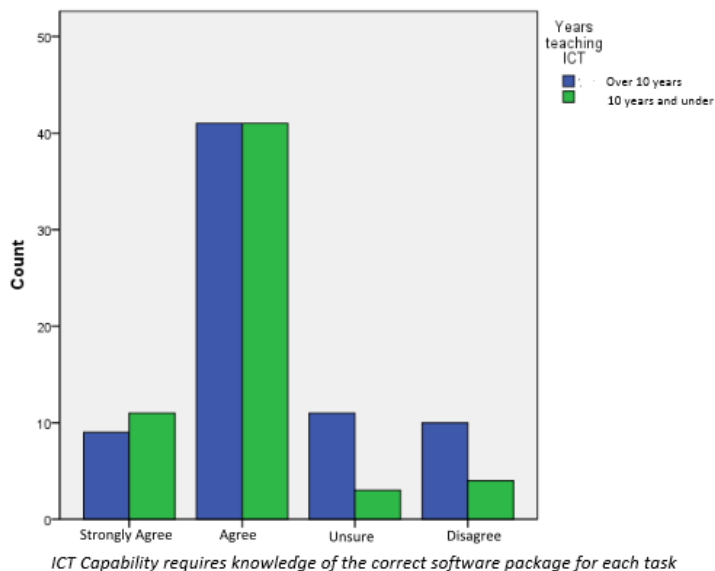
Figure 46 - ICT Capability requires knowledge of the correct software package for each task

Whilst the median does not show any distinct difference between the two groups, the graph indicates that those teachers with ten years' experience or less have a stronger agreement with the statement "ICT capability requires knowledge of the correct software package for each task". The developing knowledge of specific software applications indicates that it is possible to distinguish between packages and therefore be able to use the appropriate software for the tasks. This takes conscious thought to make that choice and as such implies that ICT capability has the higher order metacognitive skills as part of its components.

ICT capability is not adequately defined by the Key Stage 3 curriculum in Wales

Differences were found between the two groups (more than ten years' experience teaching ICT/ten years or less teaching ICT) (p=0.046, Mann Whitney U=1654, Z=-1.998) (Tables 7.5 and 7.6). As can be seen from Figure 24, both categories of teachers tended to disagree with the statement, however the differences lie where teachers did not respond with the "Disagree" option. Teachers with ten years' experience or less were more likely to "Strongly

Agree" with the statement. In all other categories, teachers with ten years' experience or less there was a lower response than teachers with over ten years' experience. However, the strength of this relationship was small (r=0.176) (Cohen, 1988).

Table 7.5 "ICT capability is not adequately defined by the Key Stage 3 curriculum in Wales"

Test Statistics[a]	
ICT capability is not adequately defined by the Key Stage 3 curriculum in Wales	
Mann Whitney U	1654
Z	-1.998
Asymp. Sig. (2-tailed)	.046

a. Grouping Variable: Years teaching ICT

Table 7.6 Comparisons of Median ranks for "ICT capability is not adequately defined by the Key Stage 3 curriculum in Wales"

Years teaching ICT	N	Median	Mean Rank
Over 10 Years	71	4.00	70.70
10 Years and under	58	3.50	58.02
Total	129	4.00	
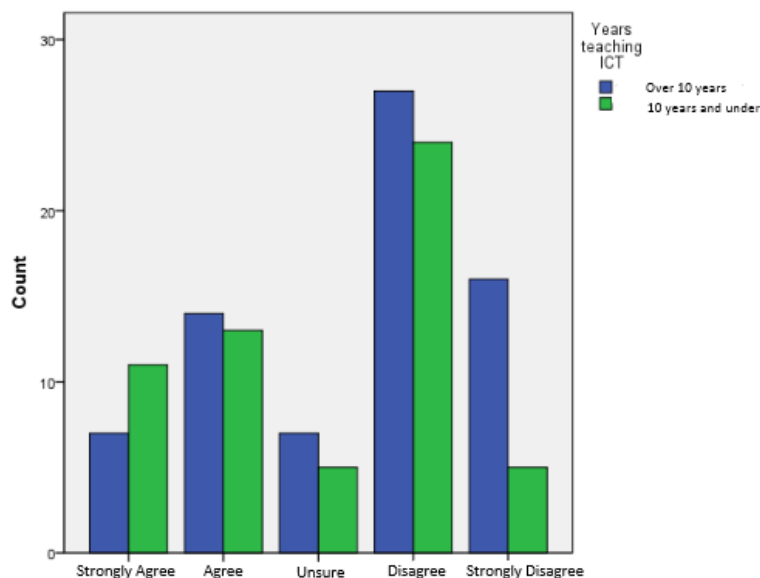
ICT Capability is not adequately defined by the Key Stage 3 curriculum in Wales

Figure 47 - ICT capability is not adequately defined by the Key Stage 3 curriculum in Wales

In this instance the implication is that those with ten years and more experience have a greater level of disagreement with the statement. This may imply that they are more used to the vagaries of the curriculum as outlined in the literature review and their experience allows them to teach the appropriate components for ICT capability.

Teacher demonstrations are essential for the development of ICT

Differences were found between the two groups (more than ten years' experience teaching ICT/ten years or less teaching ICT) (p=0.021, Mann Whitney U=1649, Z=-2.312) (Tables 7.7 and 7.8). As can be seen from Figure 25, both categories of teachers tended to agree with the statement, however the differences lie where teachers did not respond with the "Agree" option. Teachers with ten years' experience or less were more likely to "Strongly Agree" with the statement, however, the strength of this relationship was small (r=-0.202) (Cohen, 1988).

Table 7.7 "Teacher demonstrations are essential for the development of ICT"

Test Statistics[a]	
Teacher demonstrations are essential for the development of ICT	
Mann Whitney U	1649
Z	-2.312
Asymp. Sig. (2-tailed)	.021

a. Grouping Variable: Years teaching ICT

Table 7.8 Comparisons of Median ranks for "Teacher demonstrations are essential for the development of ICT"

Years teaching ICT	N	Median	Mean Rank
Over 10 Years	72	2.00	72.60
10 Years and under	59	2.00	57.95
Total	131	2.00	
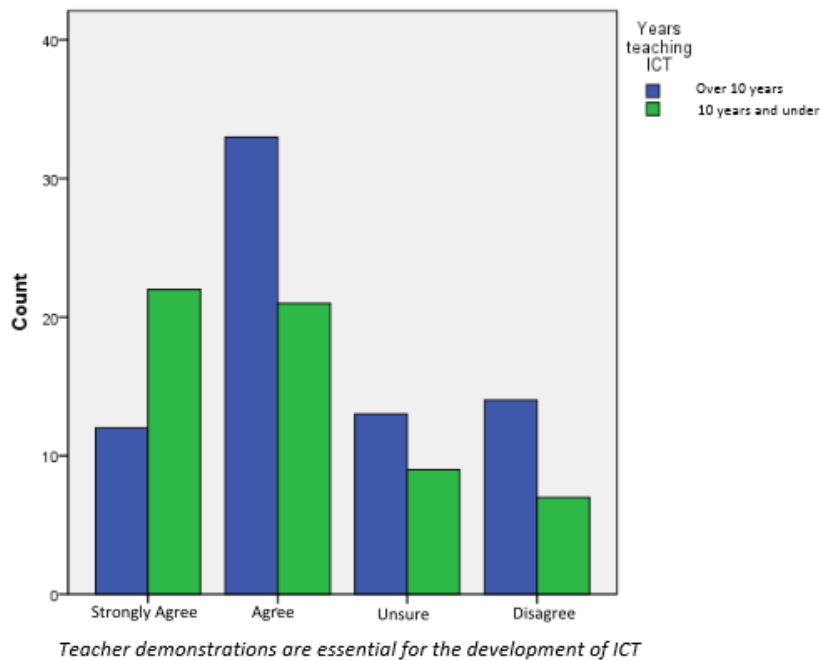
Figure 48 - Teacher demonstrations are essential for the development of ICT

The implication here is that those teachers with less than ten years' experience have a greater number expressing that they "Strongly Agree" with the statement, however those teachers with ten years or more experience have a higher level of "Agreement". This indicates that whilst agreeing with the statement the teachers are split in their level of agreement.

Problem solving is integral to ICT capability

Differences were found between the two groups (more than ten years' experience teaching ICT/ten years or less teaching ICT) (p=0.020, Mann Whitney U=1678, Z=-2.318) (Tables 7.9 and 7.10). As can be seen from Figure 26there is little difference in the responses except that teachers with over 10 years' experience are more likely to "Strongly Agree" with the statement, whilst those with 10 years or less experience are more likely to "Agree", the strength of this relationship was small (r=-0.202) (Cohen, 1988).

Table 7.9 "Problem solving is integral to ICT capability"

Test Statistics[a]	
Problem solving is integral to ICT capability	
Mann Whitney U	1678
Z	-2.318
Asymp. Sig. (2-tailed)	.020

a. Grouping Variable: Years teaching ICT

Table 7.10 Comparisons of Median ranks "Problem solving is integral to ICT capability"

Years teaching ICT	N	Median	Mean Rank
Over 10 Years	72	2.00	59.81
10 Years and under	59	2.00	73.56
Total	132	2.00	
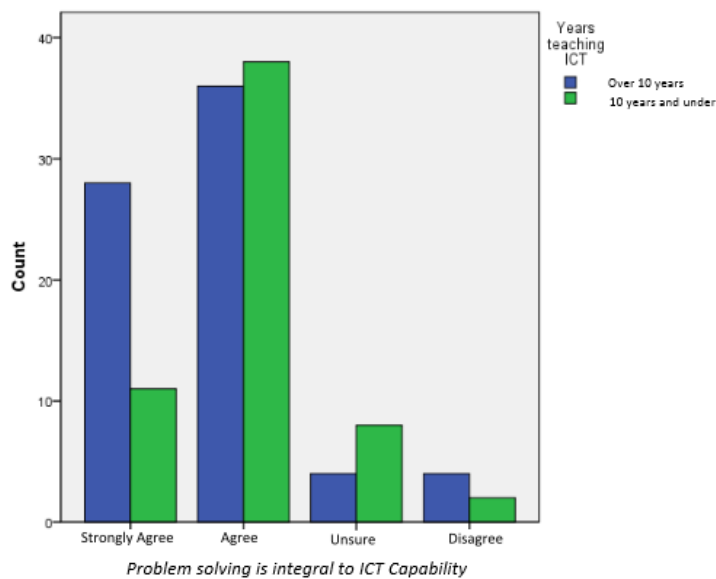
Figure 49 - Problem solving is integral to ICT capability

Similarly, to the previous statement the variation shows a split in the level of agreement, however the majority of teachers agreed or strongly agreed with this statement.

Originality is a key component of ICT Capability

Another statement showing a statistically significant disagreement with the way in which the statement was ranked was concerning the role of originality as a component of ICT capability.

Differences were found between the two groups (more than ten years' experience teaching ICT/ten years or less teaching ICT) (p=0.030, Mann Whitney U=1708, Z=-2.170) (Tables 7.11 and 7.12). As can be seen from Figure 27, teachers with ten years' experience or less were more likely to disagree with the statement, however, the strength of this relationship was small (r=-0.184) (Cohen, 1988).

Table 7.11 "Originality is a key component of ICT Capability against years teaching ICT"

Test Statistics[a]	
	Originality is a key component of ICT Capability
Mann Whitney U	1708.000
Z	-2.170
Asymp. Sig. (2-tailed)	.030

a. Grouping Variable: Years teaching ICT

Table 7.12 Comparisons of Median ranks for "Originality is a Key Component of ICT capability" against years teaching ICT

Years teaching ICT	N	Median	Mean Rank
Over 10 Years	72	2.50	60.22
10 Years and under	60	3.00	74.03
Total	132	3.00	

The median values in Table 7.11 indicate that more teachers in the 10 years and under category ranked the statement using the higher rankings, which equated to a disagreement or strong disagreement with the statement. The graph below, figure 27 clearly shows that the key difference between the two categories is the proportion of teachers who had been teaching ICT over 10 years felt that originality was important, however those teachers who

had been teaching ICT 10 years and less indicated that a higher proportion were in disagreement.
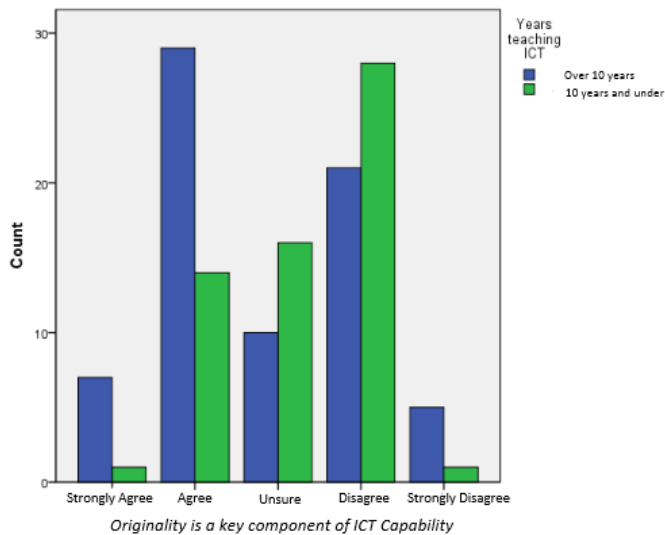
Figure 50 – "Originality is a key component of ICT Capability" Vs. Years teaching ICT

Specialist ICT teachers

When carrying out the Mann-Whitney U Test for the specialist ICT teacher against the perceptual questions discussed there are two hypotheses. The Null hypothesis H_0 is that there is no difference using a two-tailed test, between the ways in which the two categories rate the perceptual statements. The alternative hypothesis H_1 is that there is a difference between the groups using a two-tailed test in the way the two categories will rate the perceptual statements.

For all of the statements, there is insufficient evidence to reject the null hypothesis. (See Appendix V)

Position in School

When carrying out the Mann-Whitney U Test for the position held in school against the perceptual questions discussed above there are two hypotheses. The Null hypothesis H_0 was that there is no significant statistical difference using a two-tailed test, between the ways in which the two categories rate the perceptual statements. The alternative hypothesis H_1 is that there is a difference using a two-tailed test, in the way the two categories will rate the perceptual statements.

For most statements, there is insufficient evidence to reject the null hypothesis (see appendix VI), however for the following statement there is sufficient evidence to support the alternative hypothesis

ICT capability requires knowledge of the correct software package for each task

Differences were found between the two groups (Head of ICT or ICT co-ordinator/teacher) (p=0.015, Mann Whitney U=1786, Z=-2.487) (Tables 7.13 and 7.14). As can be seen from Figure 28, both categories of teachers tended to agree with the statement, however those teachers whose position was that of ICT co-ordinator or Head of department tended to have a much stronger response than those whose position was that of teacher. The strength of this relationship was small (r=0.218) (Cohen, 1988).

Table 7.13 ICT capability requires knowledge of the correct software package for each task

Test Statistics[a]	
ICT capability requires knowledge of the correct software package for each task	
Mann Whitney U	1786
Z	-2.487
Asymp. Sig. (2-tailed)	.015

a. Grouping Variable: Position in school

Table 7.14 Comparisons of Median ranks for ICT capability requires knowledge of the correct software package for each task

Position in school	N	Median	Mean Rank
Head of ICT/ ICT co-ordinator	78	2.00	59.83
Teacher	52	2.00	74.00
Total	130	2.00	
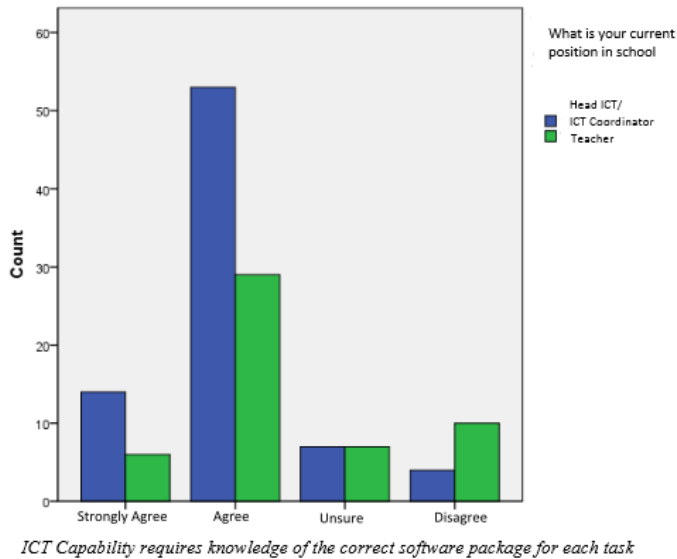
Figure 51 - ICT capability requires knowledge of the correct software package for each task.

ICT Capability Strands and software applications

Further aspects within the questionnaire were the importance that respondents gave to both different strands within ICT capability and different software applications, which may be used in the teaching and development of ICT capability.
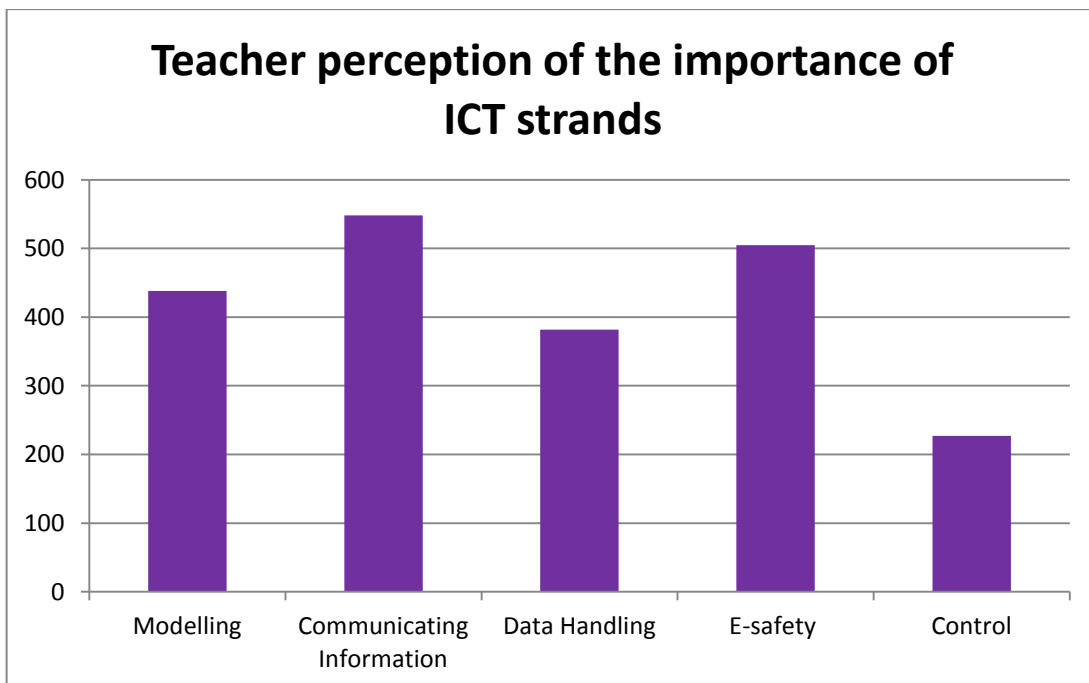
Figure 52 - Teacher perception of the importance of ICT strands

In the analysis of the responses to this question it was necessary to see which of the various strands or aspects of ICT was considered the most important. In order to do this the responses were weighted with the response indicating most important weighted as 5, important as 4, unsure as 3, unimportant as 2 and very unimportant as 1. This was in order to recognise there was a greater contribution of a strand if it was considered the more important than others. The weighted results were then totalled to give an overall result to establish which aspects of ICT were considered more important than others. That is, rather than each variable in the data contributing equally to the final result, some data are adjusted to contribute more than others.

From this data, it can be seen that the most important strand indicated within the results of the questionnaire was that of Communicating Information. This is in line with the opinions expressed within the interviews in School C, where the teacher indicated that he felt that there was too much emphasis within the curriculum on data analysis and handling and not enough on communication. The teacher in the school C case study considered that, with the growth of the communications industry, there was a greater need for pupils to have the ability to operate the digital communication systems effectively and safely within the 21st century. Interestingly although there has been much publishing regarding the use of programming and particularly coding within the education environment during this study, the element of "Control" which is where programming with Logo and SCRATCH would be associated shows the least importance.

The respondents' responses regarding the importance of a variety of software applications can be seen in Figure 52:
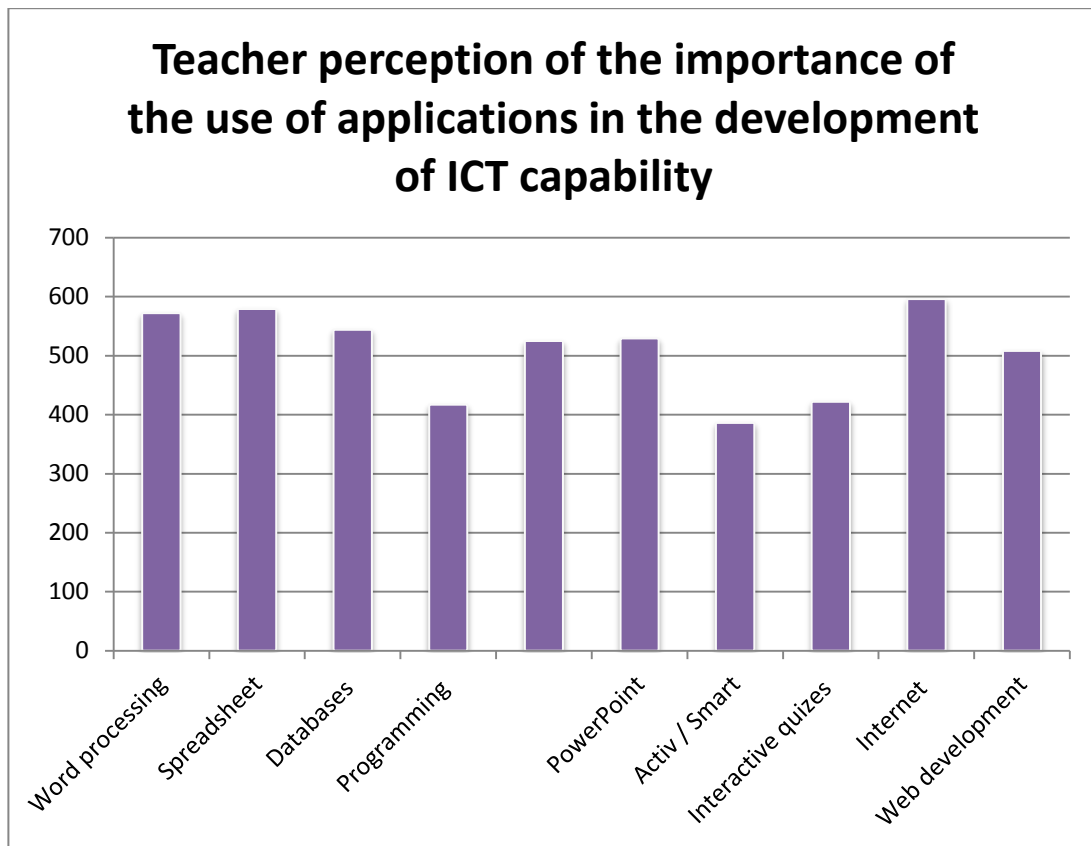
Figure 53 - Teacher perception of the importance of the use of applications in the development of ICT capability

The highest scoring application within this data is the ability to use the Internet; this might be explained by the growth in the internet over recent years. The need to understand and use the internet, for production of material, through for example google docs, the increased popularity of the cloud storage, social networking and Web 2.0 technology may also be factors in this. This has been closely followed by many of the "communication" type applications, Word processing; PowerPoint; Digital Photography/moviemaking, all supporting the previous results that communication may be the perceived as being the most important strand of ICT capability. The data handling applications, with the exception of Spreadsheets are all ranked marginally lower recognising the importance of the manipulation and analysis of data.

Given the present political environment within this subject specialism, it is interesting that programming is considered to be relatively less important, however at the time of writing it should be noted that programming is not part of the National Curriculum in Wales and as

such, this level could be considered as reasonably high. This response may be explained by the possible impact that the changes within the Curriculum in England are having on the perceptions in Wales. It is worth noting, that in this instance programming and coding are considered as having two different contexts, with programming being a component of the curriculum, and coding a tool within that component to bring about the solution to a given problem. However, the way in which the question was originally designed may be flawed. Questions relating to programming may have been better served by including it as a strand in the rating of the strands within the curriculum. The aspect of coding could then have been questioned alongside the applications and contexts ICT capability.   Mann Whitney U, analysis on this data was carried out to see if the position within school, years teaching, and subject specialism had any influence on the way this question was answered and there was no statistically significant outcome at the 5% level on any of these factors. This is in contrast to the theme, which began to emerge within the case studies where there was a growing perception that there should be a greater amount of computer science within the curriculum as a whole.

One final piece of data which may be of interest is the specialist degree of the teachers who responded to this questionnaire, and this can be seen in the following graph.
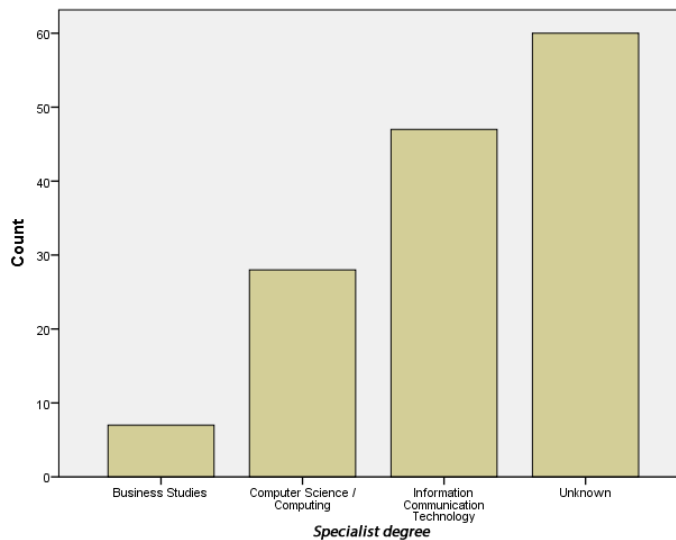
Figure 54 - Graph depicting degree subject of respondents.

The graph shows that the highest level of respondents have not stated their specialist degree, this may be because it is unrelated to ICT, or indeed it may be because they have simply neglected to answer the question. The respondents who have stated their degree specialism, the majority are ICT specialisms, followed by computer science specialisms and lastly less than ten respondents have a business studies specialism. This was also compared to the years teaching as can be seen below.
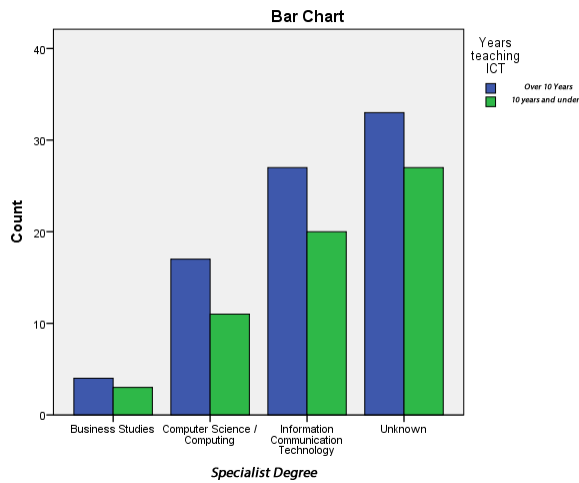
Figure 55 - Specialist degree vs years teaching.

As can be seen for every subject stated the majority of teachers had been teaching ICT for over 10 years.

Significance – Years teaching in schools

Statement	N	Std. Deviation	Minimum	Maximum	Significance
Q7.1	132	.908	1	5	.992
Q7.2	132	1.133	1	5	.035
Q7.3	129	1.285	1	5	.066
Q7.4	132	1.020	1	5	.889
Q7.5	126	.603	1	4	.235
Q7.6	132	.920	1	4	.473
Q7.7	131	.779	1	4	.054
Q7.8	130	.818	1	4	.028
Q7.9	129	1.275	1	5	.895
Q7.10	131	1.248	1	5	.908
Q7.11	129	1.332	1	5	.046
Q7.12	131	1.012	1	4	.021
Q7.13	131	.897	1	5	.140
Q7.14	130	.791	1	4	.979
Q7.15	131	.751	1	4	.020
Q7.16	131	1.346	1	5	.431
Q7.17	129	.969	1	5	.982
Q7.18	131	1.049	1	5	.700
Q7.19	132	1.063	1	5	.030
Q7.20	131	1.023	1	5	. 479
Q7.21	131	1.098	1	5	.280
Years teaching ICT	132	.500	1	2	

Significance – Specialist ICT teacher

Statement	N	Std. Deviation	Minimum	Maximum	Significance
Q7.1	132	.908	1	5	.678
Q7.2	132	1.133	1	5	.109
Q7.3	129	1.285	1	5	.112
Q7.4	132	1.020	1	5	.509
Q7.5	126	.603	1	4	.562
Q7.6	132	.920	1	4	.734
Q7.7	131	.779	1	4	.563
Q7.8	130	.818	1	4	.312
Q7.9	129	1.275	1	5	.795
Q7.10	131	1.248	1	5	.674
Q7.11	129	1.332	1	5	.213
Q7.12	131	1.012	1	4	.589
Q7.13	131	.897	1	5	.785
Q7.14	130	.791	1	4	.598
Q7.15	131	.751	1	4	.958
Q7.16	131	1.346	1	5	.870
Q7.17	129	.969	1	5	.844
Q7.18	131	1.049	1	5	.896
Q7.19	132	1.063	1	5	.153
Q7.20	131	1.023	1	5	.887
Q7.21	131	1.098	1	5	.556
SpecialistICTteacher	132	.487	1	2	

Significance – Position in School

Statement	N	Std. Deviation	Minimum	Maximum	Significance
Q7.1	132	.908	1	5	.542
Q7.2	132	1.133	1	5	.259
Q7.3	129	1.285	1	5	.808
Q7.4	132	1.020	1	5	.414
Q7.5	126	.603	1	4	.970
Q7.6	132	.920	1	4	.786
Q7.7	131	.779	1	4	.944
Q7.8	130	.818	1	4	.015
Q7.9	129	1.275	1	5	.364
Q7.10	131	1.248	1	5	.804
Q7.11	129	1.332	1	5	.815
Q7.12	131	1.012	1	4	.556
Q7.13	131	.897	1	5	.571
Q7.14	130	.791	1	4	.761
Q7.15	131	.751	1	4	.369
Q7.16	131	1.346	1	5	.543
Q7.17	129	.969	1	5	.376
Q7.18	131	1.049	1	5	.418
Q7.19	132	1.063	1	5	.982
Q7.20	131	1.023	1	5	.354
Q7.21	131	1.098	1	5	.095
What is your current position in school	132	.492	1	2	

Appendix IV

The following appendix contains the qualitative information transcribed for School A the tables have the line number added to enable the identification of the comments in the main body of text and are split into the following sections

Data reference	Data
II	Initial interview
IO	Initial Observation
PRD	Post reflective Dialogue
FO	Final Observation
FI	Final Interview

School A Data

Initial interview (II)

1. ICT capability is a term that is often used in the curriculum to describe what we want pupils to learn, what do you feel influences the development of ICT capability?
   a. What in your opinion is the most crucial aspect of ICT capability?
   b. How does this definition relate to ICT at Key stage three?
   c. How does this relate to society?
   d. What do you think the term digital literacy refers to?
   e. What is the difference between that and ICT capability?

Line No.	Dialogue
1	Work v closely with looking at how to increase capability by working at higher order skills and teaching not just skills but the content behind it
2	Very strong skill based curriculum
3	Different approach focus on constantly bombarding them with skills where they have to repeat those skills through ICT & cross curricular
4	Crucial aspect
5	Development behind everything not skill based
6	How they do it
7	How they approach it
8	Problem solving that goes with it
9	All crucial
10	Definition and development is about Progression throughout KS3, from Ks2 through KS4
11	Feeder schools with skills, then yr7 given questionnaires
12	Development then adjusted to their needs
13	If they knew less about databases the curriculum for the focus weeks would be focussed on that
14	Most get jobs
15	Either into FE
16	It students go into IT Fe
17	What they do here is important and how they relate it to in work
18	Development with Michael Gove and wanting extra skills in industry
19	Greater programming so we get better industry
20	Obviously we have a recession so we build skills that they need to get better industry

	rather this Microsoft application process that we're going down in our current curriculum
21	Need to look at what skills they need in the wider world to know what they will need at schools
22	Games design, new technologies, multimedia developing their own apps, crucial for going into an office job or into an industry job all relative to what they are actually doing in schools, I believe in what they are doing in Bishop Gore anyway
23	We do a lot but not enough
24	No difference between digital literacy and ICT capability, well maybe ooh I don't know
25	I haven't researched into it I think it's just a term

2. The national curriculum in Wales relates ICT capability to two key strands that of Finding and analysing information and creating and communicating information, in today's world of emerging technology how do these strands relate to your thinking about ICT capability
   a. Are there any aspects of technology, emergent or indeed traditional should be included?
   b. Is this a change conceptually or are these new skills that need to be learnt?

Line No.	Dialogue
26	ICT is changing because we came from a sense where we were very computing based
27	We lost that to go to a skills based curriculum
28	Focused just on skills we lost a lot of content and you can see when kids from our school when they have just done skill based and they go to FE and are expected to know the content, the grades drop
29	Not just skills need to focus on the computing aspect as well
30	Needs to develop both on knowledge base and conceptually
31	Still need the skills communicating information often is posters and PowerPoint the kids have the skills they get those skills in primary school we don't need to spend the time developing that skill we need to be looking at the concepts behind it
32	Like to see control back – key aspect
33	Go back to logo and the logicator type programs, where they understand the concepts behind programming
34	How computer works – need to develop those skills
35	Need to understand not just the ICT but the computing aspect as well
36	Like to see the skills based left to cross curricular and the conceptual side and computing to the discrete ICT
37	Nice to see ICT growing to become more of the computing subject that it used to be
38	Think we are harming our kids because of that.
39	Subject = Cisco, networking, computing, how it works, the running the theory behind it using things like SCRATCH still need to have some skills based like learning about databases, because I don't think that subject areas can do that on their own and would like to see what we class as ICT now moved to the cross curricular areas. E.g. databases in geography, spreadsheet in maths and the ICT in key skills because in KS3 will still have to do the Essential skills
40	Computing back in the ICT subject area - good thing for the subject area because as ICT teachers are being pushed away it has all been integrated into non-specialist, we get control back

3. The national curriculum also talks about progression in ICT capability, how do you believe this comes about
    a. What do you think progression is?
    b. What is it that helps some kids to succeed with ICT easily and others not so well?
    c. What are you looking for to progress pupils through the subject?

Line No.	Dialogue
41	Don't know how we can progress that with computing at KS3
42	Maybe tiers because some kids want different routes
43	Maybe ICT nationals and multimedia, but also the computing side as well, so at KS3, we would have to have all that in KS3 so that they can move into KS4 and then progress to doing the ICT qualification which I think will change in the next few years and the computing qualification if the kids choose to go down that route
44	Different routes for different progression – but what they would do in yr. 7, 8, &9 – don't know
45	Subject so up in the air
46	If you ask an ICT teacher if they like teaching ICT I bet most would say monotonous, to be honest I like the week we do because we only touch each aspect once, but other schools using spreadsheet in 7r & spreadsheet in year 8 and year 9. What is the excitement in the subject, where are these kids being enthused

4. There is evidence to suggest that at the end of KS2 Pupils are invigorated and excited about ICT, and yet it often appears that there is disillusionment with ICT at the end of KS3,
    a. What is your reaction to this
    b. Why would you say this is the case?

Line No.	Dialogue
47	I think in primary schools they get a lot of funding in IT and in secondary schools we get hardly any capitation at all – we don't have hardware to buy we don't have software to buy.
48	They use exciting programs the technologies they use, they've got apple they've got iPad ,itouches digicams lots of aspects of technology, new technology
49	What we buy in secondary is usually free source software and it's very Microsoft based whereas the other software is not so Microsoft because there is more money funded to the primaries than the secondary
50	Can't even find the money for raspberry pi at £29

5. What are your thoughts on the following text? (Extract from Gove's speech – BETT 2012)
    a. Do you agree
    b. Is it your opinion that the same can be said for the curriculum in Wales?

Line No.	Dialogue
51	I agree, I do agree that the current ICT is demotivating for the kids
52	Off putting
53	I think it's the same for wales definitely
54	I welcome that speech
55	Maybe not a lot of heads and I would say our head does as he is very pro ICT he puts a lot of money towards some aspects

56	In secondary schools generally it would need more money, for example to have specialist teachers, I mean at the moment I am a department of one
57	as a teacher myself it would give a lot more freedom
58	We could teach what we wanted, we would not be stuck by the curriculum and I think that is what Michael Gove said through-out
59	He does not want a strict input he wants them to go and use the new technologies
60	Many schools do not use the technologies that are out there, for example in communicating information as a moderator I see very few podcasts.
61	It's there in the criteria – txt and media, but it is coming over in many instances as text and image
62	Not exploring sound development or the multimedia aspect of new technologies

6. Within the NC orders for ICT (Wales 2008) it is recognised that ICT is a key component of education and entitlements for the provision of ICT are established, however, the way in which that entitlement is organised either on a cross-curricular basis or as discrete ICT lessons is left up to the policy of the individual schools. Do you believe this has an impact on the development of ICT Capability and if so in what way and how?

Line No.	Dialogue
63	I do I believe that yes
64	I believe out pupils are much more enthused doing the subject how we do it than they would through normal discrete teaching.(master - class - each year is pulled off curriculum for a week and there is a themed week of ICT attacking one of the strands of ICT, depending on the year this is supported throughput the year cross curricularly but there are no discrete lessons at KS3)
65	Can do it this way because of our current curriculum
66	We may need to go back to the classroom environment due to the demands of resourcing and things like that
67	Don't believe it has an impact in the end, whether it is discrete or cross curricular they need to show progression throughout
68	Pupils do not get the highest levels in KS3 with non- specialist teachers. The level of the teachers ICT capability does affect the level

7. Can you identify an element or elements of your practice which you believe target the development of ICT capability in a particular way?
    a. Why do you think that this is so effective in the teaching of ICT capability
    b. Is there anything in this practice that you would like to investigate or experiment with?

Line No.	Dialogue
69	We started to develop it in this way because of our resourcing.
70	It works very well here because the curriculum is the way it is and it enables us to use non-specialist.
71	The kids that actually do it with the non-specialists are not disadvantaged the work is differentiated as such
72	Different approaches - for us it works
73	In the top Quartile
74	I would like to see more new technologies

75	The approach is still fundamentally a 4-stage lesson
76	Still fundamentally focussing on the skills the kids need to learn
77	The kids mange to target set, we do a lot of target setting and improve during that week
78	It also gets them to look at what they're doing and enthuse them just before they are going into KS4 and carry on with the subject
79	To push ICT capability at each and every pupil we need to develop a strategy to get every single pupil to use their higher order skills
80	To show their progression

Initial Observation (IO)

The analysis of the initial classroom observation can be seen in the table below.

Line no	School A class room observations		
1	Intra-Action	Features of Learner	The learners are the whole of year 9. These are set in attainment groups; however there is still a degree of mixed ability within each set. The degree of autonomy of learning is dependent on the overall ability of the group and the confidence that this ability brings. Therefore this autonomy is likely to decrease as the needs of the learner increase in the less able groups. The observed group was 'top set' and as such high ability; this group had the confidence to explore the tools of the software independently and had developed clear ideas about how they wished their finished product to appear.
2		Features of the setting	There are two distinct features to the settings, the first that of the main hall and the assembly style seating arrangements. The hall was large and the group felt a little isolated within the space. The main presentation was set up in the centre, with seating set out in a herring bone fashion radiating from it, this enabled all students to be able to view the presentation, though there was some craning of necks from those sat further back at the sides.

The second is a more traditionally based classroom setting, with a space for the teacher's exposition, and computers in groups, and along the left hand side and back. Other groups were in a more traditional ICT classroom setting. |
| 3 | | Product | The product here was task based, with task criteria and expected outcomes shared and reinforced with the group. During both 'master-class' and the class based recap and exposition there was an absence of the higher order skills in that there was little dialogue with the pupil's and any questioning was closed and functioned to check understanding of the task success criteria rather than any evaluation or analysis, the sessions were based on the use of the tools of the software, as such the likely outcome is going to be tool based. It may be quite polished, with some advanced tools being used depending on the individual skills and creativity of the pupil; however evaluation and reflection is likely to be absent. |

4	Interactions	Orchestration by Teachers and others	In the assembly / 'master-class' portion of the teaching and learning experience, the orchestration of the learning is in the hands of the teacher, there is no opportunity for interaction other than in a superficial way checking the recall of the instructions given. However, in the workshop setting, the recap and exposition allowed for reinforcement of the objectives of the day. There was also opportunity for greater questioning regarding the workings of the software under investigation. Differentiation was designed for all the groups by the Specialist ICT teacher, and was a combination of electronic resources and worksheets; however this was delivered by a non-specialist ICT teacher. Whilst the ICT specialist prepared those non-specialists who required support, the teacher with the lowest level of ICT capability interacted with the least able group whilst the workshops were conducted.. On the contrary at the moment the specialist teacher is orchestrating opportunities for the highest ability group in the supposition that this group requires greater challenge and extension. This was evidenced by the teacher circulating the class and offering advice and targets to individuals and small groups, however, there was also evidence of discussion of the task amongst the pupils themselves and setting themselves targets for improvement.
5		Orchestration by Learners	The first session, that of the 'master-class' as has been previously stated was predominantly didactic in nature and as such there was little opportunity for any self-directed learning, however, when on task in the workshop, the learners in the group had a greater control over how they organised the learning of the software, there was evidence of exploration as a strategy, that is clicking on icons and seeing what happened. If the effect was favourable, they discussed this with those sitting close by. In this way the learning was shared. Whether this was evident throughout the different ability groups cannot be ascertained as there was only opportunity to observe the one group in the workshop setting.
6		Perceived Constraints	A constraint was that due to the size of the audience and the fact that they were in an assembly –like setting, there was little chance for interaction with the teacher. This is probably more suited to the more-able of the group, as there was little opportunity for personal reinforcement or interaction. Furthermore there was not the opportunity for individuals' to check their own understanding because due to the size and nature of the setting there was by necessity a didactic as opposed to a dialogic approach. Further constraints to the learning process were the use of non-specialist teachers and the way in which they were assigned the groups by ability. Because the ICT teacher only has the ability to teach these pupils once a year, it is difficult to attain an awareness of the capabilities of each of the groups, or indeed of the differentiation required to bring about success, and yet as the ICT specialist it is this teacher who is required, not only to design the teaching,

			activities and challenge, but also the differentiation.
7		Perceived Affordances	The affordances in this setting was that the theme appealed to the year 9 pupils, although with the last Harry Potter film released in 2011 this may not always be the case, and the feeling of assembly, with the pupils sitting with their friends in form groups led to a relaxed atmosphere. The setting, allowed pupils to work in their chosen groups or with their chosen friends. This setting is likely to assist the less-able pupils as they can get assistance from their peers as well as from their teacher. There is access across the network to resources, which again will assist the less-able, especially if they do not have clear ideas of how they wish their product to evolve. There is also the opportunity for the teacher to circulate the group, offering advice and targets for improvement. All this will assist the less-able, and can also be applied to the more able if necessary. Both of the settings can be beneficial to the more-able, however it is only the classroom setting which is likely to assist the less-able. The task was clearly defined and structured with clear expectations and criteria. This meant that the pupils had an element of choice regarding how this was to be achieved and allowed for creativity in individuals. This creativity can be a very motivating factor. There were a variety of resources supplied on the school network including music, images and video clips, however the pupils were not confined to these resources thus not constraining those with greater creativity. Internet browsing form material was organised in that there were search criteria used to select sites from which material such as images could be saved or downloaded. However these searches did not appear to be complex. Search Criteria such as "Hogwarts" were used within for example Google images and then the pupils would browse to select the image they required. Appropriate images appeared to match the contest of the purpose for which they were downloaded. As stated previously there was also a number of resources existent on the school network from which they could choose. These were mainly in video and music format, though images were also present. The pupils were given instructions concerning the location of the materials and pupils were then able to browse the resources for appropriate material and format when they required. In order for this to be possible pupils would be required to understand how to successfully navigate the network, both independently from the application, e.g. students knew to go to "My Computer" and find the appropriate network drive and browse for the correct folder to view the resources and then copy and paste,
8		Goal Directed Activity	This appeared to be exploration and use of a video editing software
9	Evaluation of product	Reflection in Action	There was reflection in action present with in the second learning environment and this was evidenced by the discussions

	and process		taking place between the pupils having explored a particular tool within the software interface.
			This was also evidenced and orchestrated by the teacher when circulating and giving appropriate guidance to individual pupils as required where the by discussions within the peer sand with the teacher focused on how individuals had addressed certain criteria with questions such as "how did you do that?" "What happens if you use this tool?"
10		Reflection on action	In contrast there was little evidence of reflection on action, however that does not mean it did not occur, just that it did not occur at a time where it could be observed.
			The nature of this style of pedagogical approach is that there is a week of so termed 'master-classes' followed by a day of workshops, completing a particular objective. The plenary necessary for this form of reflection, did not take place at the break when my observation ended, however I am assured that this took place later in the day and occurs again at the end of the Week, however I was unable to observe this.
11		Knowledge construction	There was evidence of a construction of knowledge to a degree, certainly by the end of the morning break, the pupils I observed were more competent in the use of the particular software under investigation, however, this must also be viewed in light of the fact that they were top ability set and as such it would be expected that by year 9 they take some responsibility form their own learning and are able to orchestrate their own affordances and constraints in the pursuit of the learning objectives.
			Whilst knowledge construction may have taken place, given the nature of the week long workshops to achieve an overall goal and a likening to cramming for exams, it would be interesting to revisit the group at a later date and reflect to establish whether this knowledge is superficial and likely to disappear or whether Vygotsky's zone of proximal development has truly been bridged.

Post reflective dialogue - 07/03/2012 (PRD)

What are your key reflections of this lesson?	
1	This sort of style really suits our pupils here,
2	They really engage with the fun of it all.
3	Something different not being bombarded with skills all the time.
4	They can get to grips with something that they enjoy.
5	Teaching ICT as the curriculum is in most schools can be boring, have to teach the same things year I year out, but with this you concentrate it all into 1 week of the year
6	It becomes more relevant and they can see how the skills link to each other
How about the development of ICT is this retained?	
7	Yes I believe yes they can use the skills they learn in this week and use them in other subjects
8	They know how to make a spreadsheet, or video and present information.
9	We get good results with their levels, I see that when I assess them.

How about the level of ICT capability amongst the teachers	
10	Well I design all the worksheets and the scheme of work and we use ICT champions within the school to deliver the workshops over the week.
12	I run the workshops for the MAT, so that I can extend their learning
13	The rest of the groups are formed by using data like test scores to work out which ability group they should be in.
14	Those other groups are looked after by the other teachers all of them use ICT a lot in their lessons and we know then that they will continue the development cross curricularly.
Is there anything you might like to change	
15	I think this suits the kids really well they are motivated by it and they engage because it is so different.
16	We let them dress in their own clothes or Harry Potter dress and they get really involved so learning is better
17	You mean what we are teaching, well I don't know, I suppose Harry potter is getting a little dated now, I mean all the films have been made and watched so we might need to think of something else.
18	But at the moment they are really enjoying it.
19	We do another session with year 8 about healthy eating, but that is not as engaging as this one.
20	We cover the whole of the curriculum in the week so it is intense and full on. There is so much for the students to do they don't have time for bad behaviour, we really do cram a lot into the days on this week
21	At the end they have awards and things as well

Final Observation (FO)

Line No	School A class room observations		
1	Intra-Action	Features of Learner	The learners like the previous observation were the whole of year 9 and these pupils were set in ability groups. These groups were defined by the specialist ICT teacher who determined these groups from the data retrieved from their performance in other areas of the curriculum. This data was supported by the results of their performance from the previous year. When the cohort were part of year 8 previously they experienced a KS3 ICT week in a similar way but with a different degree of complexity and a different theme. Although the pupils are set by ability and previous performance there is still a degree of capability within the group. The set observed during the follow up classes were again Top Set as these were the pupils that the teacher under observation was assigned. During the master - class" there was opportunity to observe the whole of the year group. The group were confident and literate, able to discuss the task and ways of fulfilling the success criteria
2		Features of the setting	The master class took place in the School theatre, where there were rows of seats set in ascending order from the stage backwards, the advantage of this setting was that all students were able to see the instruction which took place on the stage. There was enough room for the year group within the Drama theatre, though there was little room left over. The space was more intimate than had previously been noted in the main hall.

			The surroundings also lent themselves to the 'special' atmosphere of a different form of learning which the teacher hopes to use to motivate the students. However, the lighting within the drama theatre was a little dim and the acoustics a little echoey which could be a little distracting. Accompanying teachers who were selected by their ability to use ICT well in their teaching and who the observed teacher referred to as "ICT Champions" were positioned around the perimeter of the theatre. The follow up session for the top set took place in the library, where there were desktop PC's, these were set out with approximately half set up across the rear of the assigned area and down the left hand side and the remaining half in circular areas within the centre of the room. This enabled good circulation within the group. There was the observed teacher and a student specialist ICT teacher present. The setting had an atmosphere of movement, being placed within the library there was a lot of coming and going and ambient background noise. This offered opportunities for distraction.
3		Product	The product of the observation will differ depending on the perspective from which it is observed. Form a pupil's perspective the product was the successful completion of the task using the software application that they were directed to use. The teacher's product was task based and was situated within the "communicating information" strand of the curricular this was also linked to the Essential Skills Wales program with the success criteria linking specifically to this program. The task was the production of a presentation, with specific task success criteria; these were given on a basic and advanced level. However, whilst the teacher desired the successful completion of the task in order to prove the skills the students had acquired, there was also the matter of the skills themselves.
4	Interactions	Orchestration by Teachers and others	During the master- class the orchestration of the learning is in the hands of the specialist ICT teacher who designed the program. The exposition is given from the stage, by the means of a presentation containing hyperlinks and screen shots of demonstrations. There are no opportunities for real time demonstration of the tools used within the applications due to the lack of ICT within the room. The session was started by a greeting and a reminder to the whole year group of work and behavioural expectations. There was an implication that there had been a series of unacceptable behaviour previously in the week. This was delivered by the head of year. Aims and objectives together with the success criteria were shared and the detailed presentation containing screen shots and text descriptions of how to operate the tools of the software in order to complete the task was gone through. This exposition lasted about 30 minutes. The presentation was

			didactic in nature with any interactions with the students limited to closed questions, which checked the understanding of the task and the required success criteria. Pupils where then asked to proceed to their assigned class with their assigned teacher. As previously mentioned the year group were split into groups according to ability and this ability had been determined by the specialist ICT teacher and this was based on the pupils' performance in other subjects and their performance from the previous year when they took part in the Year 8 ICT week. Differentiation and support was designed by the specialist ICT teacher when she designed the weeks work and consisted of detailed worksheets and 'how to' reminders. The teacher started the workshop with a recap of the task stressing the success criteria and where and how resources could be found. Students were told that they could navigate to saved resources on a shared drive within the network, or that they were also able to use the internet and to resource material.
5		Orchestration by Learners	In the first setting, that of the drama theatre, the learners had little opportunity to orchestrate learning, having a passive role, sitting and listening to the presentation. In the workshop setting, however, the pupils were able to interact with the task, Exploring and experimenting with the software. They were able to make decisions within their success criteria of the appearance of their presentation, and of the content within their presentation. There was no apparent seating plan and pupils were able to elect to sit within friendship groups. This enabled collaborative working in that they were able to share ideas and to assist each other in sharing techniques.
6		Perceived Constraints	The teachers who were described as "ICT Champions" were assigned to the classes in order of ability as well. This resulted in the specialist ICT teacher supporting and facilitating the workshop of the group deemed most able, and the ICT champion with the least ability supporting and facilitating the group deemed the least able. When this rationale was questioned the response was that the teachers with the most ability would themselves have the ability to "push" those with greater ability further. However, it could also be argued that those pupils with the greater ability are more likely to be capable of independent learning and managing their own exploration of the software to bring about a successful completion of the task and not require the added expertise of the specialist teacher. Whereas, those with less ability are more likely to form misconceptions and may indeed need greater motivation, that the specialist teacher could supply with their increased in depth knowledge of the subject. It was not possible to observe any of the "ICT Champions"
7		Perceived Affordances	Affordances where very similar in nature to the previous observation, in the resources made available to the pupils for their use. Pupils were also able to increase their creativity by searching and using images and material from the internet. In

			this instance they were also required to keep a log of the sites and material they used from the internet. This enabled them to easily find the resources again, or if these resources were particularly appropriate return to the site easily at a later stage to retrieve further material. This also enabled the pupils share the sites with one another. Affordances were put in place by both the specialist ICT teacher and the specialist trainee ICT teacher I their formative feedback to the pupils with suggestions for improvement or alternative ways in which techniques can be carried out. The supply of pre-arranged success criteria for the task also enabled the [pupils to judge what was needed in order to successfully complete the task.
		Goal Directed Activity	There are a number of goal directed activities within this observation; there is the learning that has been orchestrated by both the teacher and the pupils, the task of the presentation and the successful completion of that task. In addition to this there is the activity of teaching for the teacher where they are developing those skills in the use of the chosen application.
8	Evaluation of product and process	Reflection in Action	Pupils demonstrated reflection in action, through their peer discussions, regarding the presentation itself, the resources they were using and finding, and the tools they used to make the presentation.
9		Reflection on action	There was no opportunity to witness or observe the plenary, although there was a reminder to the pupils of the task and its requirements and a brief discussion of where the teacher expected the pupils to have reached at break time. This was not reflective and involved a show of hands by the students to indicate their progress. The reminders were given by the teacher and were descriptive in nature.
10		Knowledge construction	Knowledge was constructed in that the pupils were able to use the tools of the application by the end of the observation. It was unclear how proficient they were in the use of the software previously so how much learning was difficult to ascertain. During the observation the majority of the task was exploratory and was using the lower order skills of knowledge and comprehension as described by Bloom (Bloom, et al., 1956), higher order skills of justification, analysis and evaluation, at this point were not required within the sessions. This was reinforced by them being told which software they were to use as opposed to being given the task and the success criteria and allowing the pupils to make a choice of appropriate software in order to successfully complete the task.

Final post observation dialogue and Interview. (FI)

1. How does the specialist ICT teacher address
   a. the question of pupil relationship usually developed though out the regular classroom interaction,

b. the possible lack of in-depth knowledge of individual learners within the learning environment to facilitate engagement and interaction and the development of resources to aid learning and teaching

Line No.	Dialogue
1	You have to develop a very quick rapport with the kids, by the end of the week you will probably know them better than you would had you been teaching them 1 lesson every week or fortnight.
2	Their capabilities you see very quickly. You have to differentiate very carefully, and we will set the classes by achievement.
3	My class-lists for this year 9 have the year 8's work I will arrange the classes so that all the A's are in one class B's in another etc. obviously the A's and B's I will be expecting to give extra challenges to.
4	And at the lower end there will be greater differentiation and making sure they have the support. We have so much data, we don't know how they will react to things, that is one area that is a fast learning curve. Based on global grades that doesn't show how good they are in ICT, they might have a fabulous grade and not be good or be in the STF unit but be great at ICT.
5	And it is about acknowledging that as quickly as you can, maybe in the first day.

2. How does the specialist ICT teacher address
   a. the question of pupil relationship usually developed though out the regular classroom interaction,
   b. the possible lack of in-depth knowledge of individual learners within the learning environment to facilitate engagement and interaction and the development of resources to aid learning and teaching

Line No.	Dialogue
6	We use teachers who have a particular interest in the use of ICT, all of them are masters at using ICT within their own subject area.
7	Also all the planning and differentiation is designed by me, so that when they are delivering or teaching the classes after the master - classes, those teachers with the higher abilities will be teaching the classes with the higher ability.
8	then the students who may need the greater challenge will have the teacher that is able to move that challenge on because they have greater ability

3. How are the higher order skills used and are there opportunities to develop
   a. Literacy
   b. Problem solving
   c. Thinking skills
   d. ICT concepts addressed

Line No.	Dialogue
9	Generally within the essential skills framework, but also now they have come back from their development block they are having 6 weeks of learning in their humanities block and then after that they will have the activities based on it and that will be the key assessment focus.
10	And obviously that will tick all the boxes for key stage three plus tick all the boxes for essential skills as well., the core and the wider skills. – concerned about this statement

	especially "tick all the boxes" – goes to teacher attitude?
11	There have been such a range of activity and a range of transferable skills that they are using in this model

4. What does the teacher mean by skills based curriculum

Line No.	Dialogue
12	Skill based in Bishop Gore is where we focus on different skills from the National Curriculum that we are applying our focus to and so obviously it is very driven down, so it will be for example in spreadsheets we are looking at actual referencing we are looking at the tools within the application. Not so much context, but can be content driven.
13	So tools and skills are more or less synonymous - Yes

5. How would the teacher define 'master-class'

Line No.	Dialogue
14	A master-class is a big class where we have the whole of the year group and we focus on a particular area of skills with particular success criteria for that topic area of what they are actually going to learn within that class.
15	So it is a class of everything together obviously developing skills. Demonstrating the skills and then they will then think of looking at skills and take that with them to go into their other classes.
16	So each morning it is a different master-class focusing on different skills? Yes

6. How is the learning from the master-classes sustained and transferred into long-term learning?

Line No.	Dialogue
17	The learning moves over into other curricular subjects using spreadsheets and databases in history and geography, and word for assignments, especially when they get to KS4.
18	The tools are built up in the specialist weeks and then the other subjects can use those skills in their subjects.

7. How did this model evolve?

Line No.	Dialogue
19	Now I don't know if you know much about our Curriculum 2012 that's very unique as well.
20	We have just launched with year 7 a curriculum 2012 which obviously will apply some ICT skills within that
21	it is like looking at how the Harry Potter week works (i.e. Master-classes followed by skills/ tools based classes or workshops) and focussing on other areas around the school.
22	For example we have this curriculum 2012 where they have 6 weeks of learning blocks and then they will have 2 weeks followed by that in a development block.
23	So everything they have had in their learning block will follow then in the development block.
24	We've just had now, an Antarctic challenge, so the kid's year 7 came in on last week it was launched by two teachers pretending they were Scott and Amundson and the race for the South Pole and re-enacting what happened. Then they actually had a challenge menu so they

	went back to their form classes and they had to pick different activities
25	which were kinaesthetic
26	which were naturalistic
27	which were linguistic – linked to learning styles and a focus on the STEM subjects Science, technology, engineering and maths?
28	So the type of things they had to do was, design a sledge; build a sledge take it down to the beach & race that sledge.
29	They had to design a meal and cook that meal and eat it.
30	They had to write a letter to Scott's wife and how he felt
31	There were different aspects of the curriculum used in this model.
32	Which first of all was created because of the Harry Potter week that we have actually had
33	And how successful it was so we had content e.g. harry Potter but we are using different skills within that. And that can be expanded on
34	I mean it seems to be a little bit old fashioned
35	but in the next year or so we will take parts that have worked really well and implement that within computer science hopefully.
36	That curriculum 2012 is it essentially based on the STEM subjects? No
37	just for this learning block
38	the next learning block will be the humanities. So now they have come back from their development block they are having 6 weeks of learning in their humanities block and then after that they will have the activities based on it and that will be the key assessment focus.
39	And obviously that will tick all the boxes for key stage three plus tick all the boxes for essential skills as well – see row 10
40	the core and the wider skills.
41	It is going back a bit to primary school - very much. We based ours on Casllwchwr Primary School
42	that's how they sort of run it at primary so we are seeing how it works down here and I have to say it's been absolutely fabulous
43	the kids have loved it
44	they have been very engaged
45	there are lots of activity so there have been such a range of activity and a range of transferable skills that they are using.

8. How/ who designed / conceived the model?

Line No.	Dialogue
46	Based on the primary model as stated, but we also had to think how to get the expertise in there as in a primary model there is little specialist expertise, from an ICT point of view.
47	Also the head didn't want massive blocks of ICT so it is just one week.
48	I was given some parameters and conceived it by myself.
49	We did have different models to look at, we were looking at a model that is used in Newport High School, that is how they envisaged their ICT going, but in the end they never went that way.
50	We thought we would try it one year and it was such a success the first year that we have stayed with it, and obviously I think things will change and maybe the topic is getting a bit old hat now.
51	With a computer science model we may have to take some parts that are good, but we may have to bring in some discrete lessons as well.

9. What are the pupils' feelings towards this model of teaching as opposed to more traditional methods?

Line No.	Dialogue
52	The kids love it they are engaged because it is different , it is a chance to do something different, move away from the boring routine of regular classes and do cool stuff with ICT.
53	We have had a little disruption and silliness this year but that was in the minority and it was soon sorted out.

10. Is there any way that the teacher would like to change this model should they have the opportunity?

Line No.	Dialogue
54	There is going to be huge change, not only what is going to be implemented, but also how it is going to be implemented by WAG in Key stage 3.
55	But also how much ICT because they can't really forget ICT they have still got to focus on some applications computer science, is not for all.
56	I think OCR now have just released one for entry level so maybe for some kids it may be achievable but bringing some parts.
57	Starting to think like we used to teach, like Logo, starting to think of the commands and getting that approach and then moving on and seeing SCRATCH, and moving on to Kodu using the 3D aspect
58	hopefully it will move away from the tools aspect and towards more of a concept driven aspect. Yes I hope so – contradiction to earlier theme lines 12/13
59	The implications for your model - there will be huge effects, it will change everything. And in the profession as well I mean a lot of teachers come from IT business backgrounds I know Technocamps doing a lot with staff but there need to be some more, something rigorous and more controlled of how we can do it.
60	I mean I want to go on a python training course, can you find it anywhere, NO. There is no opportunity to up skill.
61	It is more than just that because the language really is irrelevant, it is what is behind the language , it is great to learn the language, but if you have not got the concepts and the computational thinking involved, how to approach programming then it reduces itself to that click and do mentality – Yes I agree I mean from the technocamps I went to I thought I might need to go and do an electronics degree there is a danger that it is going to be so broad, where are they going to cap it off at KS4 then yes, there can be more differentiation, we can either follow the IT of the GCSE computing or we offer both, increase the choice, KS5 then again its choice. At ks3 not a great deal of electronics, even the networking side, that's vast,.

School B Data

The following appendix contains the qualitative information transcribed for School B the tables have the line number added to enable the identification of the comments in the main body of text and are split into the following sections

Data reference	Data
II	Initial interview
IO	Initial Observation
FI	Final Interview

Initial interview (II)

1. ICT capability is a term that is often used in the curriculum to describe what we want pupils to learn, what do you feel influences the development of ICT capability?
a. What in your opinion is the most crucial aspect of ICT capability?
b. How does this definition relate to ICT at Key stage three?
c. How does this relate to society?
d. What do you think the term digital literacy refers to?
e. What is the difference between that and ICT capability?

Line No	Dialogue
1	It's trying to get them to learn things rather than to teach them to become ICT capable it's about them learning to become ICT capable
2	Giving them the tools to learn for them selves
3	Learning through systems of video tutorials more than standing informant of a class and actually teaching them
4	A lot of them think they are more capable than they are they can go on the internet and they all think they can use a computer without having a clue how it works inside, what to do if something goes wrong
5	The idea of teaching them something that if something goes wrong they can use like the internet so they can find out how to fix it.
6	How to use something is probably far more important than
7	Ability to find a solution is far more beneficial
8	Great to be able to make a poster great to be able to put borders on spreadsheets but far better for them I think to be able to say "I've got a problem how do I solve that problem" ad actually work that process
9	Crucial aspect - use of higher order skills to define the problem and then to fix it
10	In KS3 primarily teaching ICT not digital literacy
11	Here we are trying to teach ICT capability especially with yr7's
12	On observation the other day yrs. 7's they come in, they were told what to do, in very basic terms, they then go on to the Moodle course they watch the videos, they look at their learning diary to see what they did last time & how they need to improve things, so it's much more based on what they have said they have done and what they've got to do.
13	Watching the videos so they can then produce their own tutorials maybe doing it in a PowerPoint things like that
14	So whilst they are teaching themselves they are also preparing resources to teach other people, without knowing it to a certain extent
15	Whereas in yrs. 10 & 11, the pupils can't do that, they've never been taught to teach themselves
16	*Part of ICT capability is learning to learn*
17	In Society too many people know how to use a particular piece of software but they don't know how to use a computer
18	The minute something goes wrong they are on the phone to the helpdesk and they are under the impression they know computers and how things work
19	They don't know how to use ICT to its best capability
20	Good question that is um
21	I suppose it depends on your standpoint what digital literacy is, because digital literacy to

	me would be getting inside the computer a bit more
22	ICT capability is I would say how to use computers to do certain things whereas digital literacy in a sense I would point it to more a computer science area rather than ICT
23	Although they are linked- ICT and Computing, I think they are two separate things
24	Even looking at the new prospectuses you can see the cross over between GCSE Computing and GCSE ICT
25	Digital literacy is a strange term that sits in the middle of ICT & computing possibly

2. The national curriculum in Wales relates ICT capability to two key strands that of Finding and analysing information and creating and communicating information, in today's world of emerging technology how do these strands relate to your thinking about ICT capability
   a. Are there any aspects of technology, emergent or indeed traditional should be included?
   b. Is this a change conceptually or are these new skills that need to be learnt?

Line No	Dialogue
26	In broad terms my definition doesn't relate to the NC definition because we're supposed to show them how to find information and show them how to convert that into something else
27	be it databases
28	spreadsheet
29	posters leaflets whatever
30	there is nothing in the curriculum telling us to teach them to teach themselves
31	Theoretically if you look at the first part
32	finding information you could argue that they need to find the information to enable them to create these resources which is an area we are getting into more but there is nothing in the specifications saying they should find their own way of getting from A-B and this is a problem with a lot of the KS3 outcomes
33	Traditional and emergent technologies should be included because if they can understand how a computer works
34	how the basic process works
35	I think then it breaks down the process of what they are doing in KS4 a lot better.
36	If they know in KS3 that they have to start with a problem and they have to work their way through to a solution at the end
37	in a variety of ways not just producing posters leaflets
38	spreadsheets but producing lines of code
39	producing things which will actually give them a different result at the end
40	think when they get to KS4 they can use that a lot better
41	This will involve new skills because a lot of the teachers involved in schools are ICT specialists
42	& they're not Computer specialists
43	that's the problem we have here
44	I teach very little KS3 I do mostly KS4
45	but for me to get back into KS3 as probably the only person that can teach any programming whatsoever I would need to come out of more of my KS4 work
46	As far as PGCE ICT specialists I don't think there are a lot of them around in certain schools

| 47 | I think a lot of them are people who have come out of business studies or even other subjects and have moved into ICT that doesn't mean they are not a specialist but there are not a lot around that embrace the world of computers and want to get into the nitty gritty of computers that's a new specialism in itself in a way |

3. The national curriculum also talks about progression in ICT capability, how do you believe this comes about
   a. What do you think progression is?
   b. What is it that helps some kids to succeed with ICT easily and others not so well?
   c. What are you looking for to progress pupils through the subject?

Line No	Dialogue
48	With ICT capability I don't know there is a huge amount of progression because I am teaching the same skills to year 9's as I am year 11's
49	Also when you see year 7's doing Photoshop work, there's not a lot of difference between what they are doing and what they're doing in year 10/11
50	There can be progression but if we are doing more Photoshop work in year 7, then by the time they get to year 11 they've got to be looking at scripting
51	We do seem to be teaching the same things to the same kids year after year
52	To do with captivation, even those that just do the work put in front of them can be captivated by the most strange things sometimes, my daughter falls in that category, she is in year 11, doing very well, she dropped her laptop broke her screen, I ordered a new screen and proceeded to fix it and she was captivated with the internal workings
53	Finds out what turns them on to a certain extent
54	Classes need to be focused more so that pupils can fit into a certain category so we can explore more with them
55	Some of them are quite happy doing what they are doing
56	Some of them are bored I know

4. There is evidence to suggest that at the end of KS2 Pupils are invigorated and excited about ICT, and yet it often appears that there is disillusionment with ICT at the end of KS3,

   a. What is your reaction to this
   b. Why would you say this is the case?

Line No	Dialogue
57	Because they have lovely pads and toys at KS2
58	the funding is better
59	and they don't have as many kids to cater for
60	30 pads in a primary goes a lot further than 30 pads in a school of 1000
61	Certain people who try to restrict the use of this type of equipment
62	putting hurdles in the way
63	Not just hardware based
64	in primary you can build up better relationships with pupils because you have them all day every day

65	and you get to know them better
66	you get to know what they do and don't like and you can motivate them easier and target set on individuals a lot better
67	in secondary where you only have them for a hour a week is that hour a week enough to really engage them properly
68	I suspect not. You need more time to engage them into the process and once you have engaged them you probably can cut it down to an hour a week.
69	What could excite them is more the Harry potter line
70	using animations in posters- -they love it
71	they'll find things in the software we don't know exist.
72	Website excite them using flash
73	menus
74	galleries etc.

5. What are your thoughts on the following text? (Extract from Gove's speech – BETT 2012)
    a. Do you agree
    b. Is it your opinion that the same can be said for the curriculum in Wales?

Line No	Dialogue
75	The first part about school's curriculum they do have ICT co-ordinators meetings, I would say the grouping together is not done as well as it could be done. Because ICT co-ordinators are not necessarily the best people to get together and speak, because I find a much better source of information is to physically go to other schools and to Twitter. I don't think meetings happen in Wales as it is perceived it should do.
76	OCR nationals – teaching them basic ICT skills not teaching them anything exciting, however, in my mind some pupils are more suited to ICT than computing, so if you try and go too far down the computing way you are going to alienate some of the others
77	*A risk in any curriculum be it England or Wales in going too far down the computing route and not sticking with some ICT because ICT is possible what has got them interested in computers in the first place.*
78	*"Schools, teachers and industry leaders have all told us that the current curriculum is too off-putting, too demotivating, and too dull.*" I agree because a GCSE these days is a GCSE in screen shots. When you've got someone who has developed a website, it's really good& then they've got to do5,6,7 pages of screen shots just to explain what they've done – it's their you can see what they've done
79	The mode of assessment is boring and tedious, a mixture of a boring curriculum and the way in which it is delivered is boring and dull
80	There should be possibly have ICT and computing as 2 separate things in KS3 I appreciate there is not the time in the curriculum for that so should they have one week ICT and one Week computing
81	Some people are worried that what he (Gove) says in here will push people away from doing ICT at KS3 and make people do ICT embedded in their subjects rather than a discrete subject as it is now.
82	Personally I think he should keep it as a discrete subject but mix computing into it more then there is an issue with training certain teachers
83	I would say there are only certain teachers who enjoy the computing part a lot of ICT teachers would hate the idea of it

6. Within the NC orders for ICT (Wales 2008) it is recognised that ICT is a key component of education and entitlements for the provision of ICT are established, however, the way in which that entitlement is organised either on a cross-curricular basis or as discrete ICT lessons is left up to the policy of the individual schools. Do you believe this has an impact on the development of ICT Capability and if so in what way and how?

84	As far as PGCE ICT specialists I don't think there are a lot of them around in certain schools, I think a lot of them are people who have come out of business studies or even other subjects and have moved into ICT that doesn't mean they are not a specialist but there are not a lot around that embrace the world of computers and want to get into the nitty gritty of computers that's a new specialism in itself in a way
85	ICT should be as a separate subject because in other core subjects you've got enough to teach without having to concentrate on ICT skills – I don't try and teach geography in ICT lessons
86	People teaching ICT should be talking to other subjects saying what are you teaching at the moment and then I can use some of that to improve capability using other subjects to help teach it as opposed to embedding it in other subjects

7. Can you identify an element or elements of your practice which you believe target the development of ICT capability in a particular way?
    a. Why do you think that this is so effective in the teaching of ICT capability
    b. Is there anything in this practice that you would like to investigate or experiment with?

Line No	Dialogue
87	The use of video tutorials on Moodle
88	They go on to Moodle, they have the course in front of them, they have the tasks and they have the video tutorial
89	Video tutorials help them complete the task
90	Embedding learning diaries so they remember what they have done
91	We have a lot of preparation but it is minimal input during the actual session from us as teachers and they are working independently all together – helping each other
92	Effective because it proves they are learning
93	Proves they are capable of doing something on their own
94	Getting the resources and monitoring those resources is key.
95	It's their work
96	The effect of the learning diaries is important because we've only just started using that
97	Trying to decide how effective they actually are, are they making a huge difference to what they did last week

Initial Observation (IO)

The analysis of the initial classroom observation can be seen in the table below.

Line No	School B class room observations		
1	Intra-Action	Features of Learner	The learners are year 9. The observed group was 'top set' and as such high ability; this group had the confidence to explore the

			tools of the software independently and had developed clear ideas about how they wished their finished product to appear.
2		Features of the setting	One of the features of the setting was a classroom, that was their usual classroom, the pupils were confident and at ease with this familiarity. They were secure with this familiarity, understanding the ambiance and the rules within the classroom. This security is likely to add to their confidence and assist the learning process. The pupils were able to sit with their friends and whilst on task there was companionship, and discussion both about the task and in some cases other topics, however this 'chat' did not appear to distract from the pupils work, and decreased at moments of concentration. Other features included a light and airy setting, which was cool but not cold and these factors together produced an environment conducive to comfortable working conditions. There were pictures and technical vocabulary around the room, and the setup was such that the teacher could easily see all the computer screens and circulate as needed.
3		Product	The product was two-fold and this appeared to differ depending on the viewpoint taken. For the teacher the product was not just a website, but a website that has been built to suit an appropriate audience in the first part, and in the second part the ability of the pupils to explain to a younger audience how to achieve this using this particular software by means of Microsoft PowerPoint presentation. For the pupils it was an appealing website demonstrating their chosen subject. This can be evidenced by the variety of colour images and text used by individuals depending on their topic area. It was interesting to note that many of the girls appeared to take greater time over the placing of images and text, and the use of font and colour, whereas the boys tended to spend time using a variety of software other than the one they were exploring to produce graphics or buttons for navigation bars to enhance their site.
`4	Interactions	Orchestration by Teachers and others	During the lesson the teacher spent a short time reminding the pupils of what they were studying and what the expected outcomes of the lesson were. The pupils were also asked to consult their learning diaries to establish what they had achieved to date and what they still had to achieve. These learning diaries consisted of an electronic document detailing their achievements and a brief discussion of how this was attained on a lesson by lesson basis. There was also an explanation of the success criteria of the task. The teacher also circulated the class chatting with the pupils using a language that encouraged the pupils to explain what they were trying to achieve. The teacher had given themselves a role of facilitator to the learning rather than being in direct control of the teaching. This was achieved by the preparation of help sheets and video tutorials which enabled the pupils to take a greater autonomy of their own learning. There was also the need on occasion to

			remind pupils to stay on-task.
5		Orchestration by Learners	As stated above much of the learning was orchestrated by the pupils. It was clear that the pupils were used to this strategy and quite comfortable with it. The pupils were well motivated and eager to achieve, this may have been down to the fact that they were top set and had a confidence built by a personal expectation of success, but may also be that they were comfortable with being in control of their learning. The pupils used a number of strategies to promote their learning including ; • Discussion of the dilemma with their neighbour • Consultation of their learning diaries • Examination of part or all of a help sheet or video tutorial Only after the above three strategies had been exhausted did they approach the teacher for advice.
6		Perceived Constraints	The constraints within which the pupils operated were largely the expectations and success criteria of the task, in that to achieve success in the piece of work there were certain elements which had to be included. There were no constraints as to time, or the software they used to achieve this apart from software that was being used to design the website.
7		Perceived Affordances	There were many affordances existent within this lesson, not least the comfort with which the pupils experienced the strategy for learning which was employed in this lesson. A large proportion of the class immediately logged on to their PC's and commenced work, having checked their learning diaries for their progress, prior to the teacher outlining objectives and giving instruction. As previously mentioned the resources available to the pupils was also an affordance, especially in the way in which they were used, by allowing them access to all of the resources there was no need to give out hard copy help sheets. With the presence of hard copy help sheets there is often an inclination of pupils to take the 'easy' option and use the scaffolding, whether they need it or not, this does not push the zone of proximal development (Vygotsky). Having scaffolding available but not obviously, means that the pupils were making a conscious effort to explore the software without scaffolding and as such extend their zone of proximal development. However, this is not always positive in nature, this style of learning can also assist in the formation of misconceptions, in that the pupils may have established a way to achieve an end, but this may not be the most effective or efficacious method and without correction misconceptions may occur. If this is then taken as knowledge and is passed over to their peers they may be perpetuating this misconception.
8		Goal Directed Activity	Whilst one part of this was the exploration and use of web design software, there was also the appropriate use of that software, so that the subsequent web site was designed with audience and purpose in mind. There was also a built in element

			using the higher order skills, in that they were required to produce a presentation teaching younger pupils to achieve the same or similar results.
9	Evaluation of product and process	Reflection in Action	Reflection in action took place with the pupils evaluating how they were going to proceed with the task, for example, why some pupils used different packages to produce the buttons for their hyperlinks, whilst others hid rollovers under images. The websites were discussed amongst themselves and they compared with each other how they were fulfilling the success criteria
10		Reflection on action	The reflection on action took the form of the pupils explaining how they achieved what they achieved in a presentation for the year 7 pupils. This meant they had to note what they had done, and how they had done this, and then put this into their own words in a way that younger pupils could understand.
11		Knowledge construction	By resynthesizing the information the pupils were taking on board the concepts in a way that allowed them bridge the gap of learning, which Vygotsky termed the 'zone of proximal development'. For example, they could explain that their use of rollovers when hidden under images, was to show the user of the website where the hyperlink would take them so that if they did not wish to move to that page they could use a different link

Final Interview. (FI)

1. How does the specialist ICT teacher address
   a. The question differentiation for less able or less mature learners?
   b. the possible lack of in-depth knowledge of individual learners within the learning environment to facilitate engagement and interaction and the development of resources to aid learning and teaching

Line No	Dialogue
1	Differentiation means that there is the ability for both less able and more mature learners to participate, this model allows more mature to be able to evolve their own thinking.
2	They know where help is. If they need it they can get it, if they don't they can work out what they're doing what they need to and they can compare this to their success criteria. It means they are able to think for themselves.
3	That could be part of developing ICT capability that ability to think for themselves.
4	It is the use of those higher order skills, and I had a lot of success with some of the year seven pupils, maybe it's because they haven't got used to the sort of teaching that goes on in secondary school, so the still able to explore more.
5	With the less able it just means that you will be directing them little bit more, that they are using the help guides more.
6	When they first come you have taken back to basics so that you can establish exactly what they know it means there is a lot more resource building there is a lot more work from an initial standpoint but once you're in the classroom you're more of facilitator.
7	And because the pupils are more in control of their own learning they tend to be more motivated they tend to get on with what they have to do. It's different with the SEN classes, those classes need a more structured approach I don't think the freedom allowed

	to those more able works with them so well.

2. How is the relationship between the ICT capability of the non-specialist teacher and the development of ICT capability in low achievers addressed, especially if using this model is there evidence of a disparity in the level or type of capability developed?

Line No	Dialogue
8	This model of facilitation doesn't tend to be used in this area.
9	The non-specialist teacher they need to have that defined structured approach.
10	Most non-specialist teachers tend to spend more time on the subject they comfortable with the subjects they know well. This wouldn't work with them.
11	This tends to work best when the subject knowledge is strong so that if questions are unusual, you can either answer them will direct the children to a place where they can find the answer themselves.
12	For example, if a teacher is more confident with something like presentations, you'll find they will spend more time on the aspect of communication, and say web design.

3. Is it hoped that in the use of this model from year 7 there is likely to be an increase in the development of the higher order skills as well as the level of ICT capability?

Line No	Dialogue
13	That was the plan, however the model was used mainly by myself, and as I am no longer teaching key stage three but concentrating on key stage four and to key stage five because of my computing skills.
14	As said earlier had some success in the past but that was isolated.

4. What does the teacher understand by a skills based curriculum

Line No	Dialogue
15	Skills based curriculum well it is supposed to mean using a wide basis of skills not just ICT but also thinking problem solving, not sure that this is the case in reality.
16	Within essential skills Wales for example it is a criteria based assessment which means that if they have carried out a certain technique e.g. putting a hyperlink or hotspot the web design, then they get rewarded certain marks. It is really not going too heavily on the reasons why they put up a hotspot or why they using a hyperlink.
17	Do you think this is aided or hindered by some of the more popular applications used for example scratch? It depends on who is teaching it.
18	If there is a background understanding then you will get some of the reasons why you do certain things taught.
19	It goes back to the capability of the teacher, if the teacher is confident in the application, then they are likely to teach why certain things or techniques and routines are carried out. If not then there is a danger that it just becomes "a click this icon and this action will occur" in that case I suppose it becomes a tool based curriculum.
20	Do you think this happens a lot? In certain instances it probably does so what was designed as a skills-based curriculum in reality is too reliant on tools and not reliant on the concepts enough.

5. How did this model evolve?

Line	Dialogue

No	
21	Not really sure how the model design evolved, we noticed that some of the more able students were finding videos to help their own use.
22	We found that there was more motivation and more interest when they were teaching themselves or helping themselves than when they were being subjected to a lot of talk at the front of the class.
23	They were keen to get on with it themselves so we developed resources to help them do this.

6. How/ who designed / conceived the model?

Line No	Dialogue
24	Its departmental approach really
25	And yet earlier you said that you were the main person using this approach? Yes *I suppose that because it suits my style.*

7. What are the pupil's feelings towards this model of teaching as opposed to more traditional methods?

Line No	Dialogue
26	They are very motivated by it as said earlier there are interested with getting on with it and have control over their own work on their own learning.
27	Yes there are some that need prodding and some off task but they soon learn that they have to get that work done so they might as well do it from start.
28	They enjoy it.

8. What does the teacher understand by progression and how does this relate to their comment "With ICT capability I don't know there is a huge amount of progression because I am teaching the same skills to year 9's as I am year 11's"

Line No	Dialogue
29	Yeah, progression I still think that there is a danger that we can be teaching the same thing in year 10 as we are in year eight.
30	I know it is in greater depth, but essentially we still doing the similar things.
31	There needs to be change whereby we can push them further.
32	I think we can get the opportunity by bringing computer science
33	I hope this will increase their interest as well. For example, I was fixing my daughters laptop the other day so I had it all open on the table and she came up and started watching. Now I know she's labelled as able and talented, but she was fascinated by what was going on inside and after a while when talking, she started getting very different idea of what ICT in computer science and everything is all about I'd like to see that in more of my classrooms so I think bringing computer in or computer science or whatever you want to call it is a good thing.

9. With the model of teaching the teacher is acting as a facilitator of the learning, but the autonomy or control lies with the pupil and as such is reliant upon factors such as ability, motivation and interest, does this have an effect on progression and the movement of the learning from one target to another?

Line No	Dialogue
34	I think it has to because to a certain extent although within the curriculum students are leading their own learning their finding out what they need to find out their learning what they need to learn to fulfil the success criteria.
35	And yes it probably is reliant on factors such as ability and motivation and interest but because they have their own control that motivation and interest is increased anyway.
36	And as that is increased then greater learning takes place so the abilities increased.
37	They are aware of their own success criteria and they do what they need to do to fulfil it.
38	There will always be some who will do above and beyond and there will always be some pupils who need to be pushed and reminded of what they're doing that's the nature of teaching.

School C Data

The following appendix contains the qualitative information transcribed for School C the tables have the line number added to enable the identification of the comments in the main body of text and are split into the following sections

Data reference	Data
II	Initial interview
IO	Initial Observation
PRD	Post reflective Dialogue
FO	Final Observation
FI	Final Interview

Initial interview (II)

1. ICT capability is a term that is often used in the curriculum to describe what we want pupils to learn, what do you feel influences the development of ICT capability?
a. What in your opinion is the most crucial aspect of ICT capability?
b. How does this definition relate to ICT at Key stage three?
c. How does this relate to society?
d. What do you think the term digital literacy refers to?
e. What is the difference between that and ICT capability?

Line No	Dialogue
1	Personally I think that the term ICT capability is interpreted in a number of different ways.
2	For me, it is not simply about acquiring and retaining knowledge or information, but also knowing how to use it appropriately.
3	Some may see it as imparting knowledge on how to complete a specific task, but for me it is allowing them to identify how to solve a problem based on the knowledge that they have.
4	At KS3 there is too much of 'to complete this task you need to….'. In fact I believe that it should be a case of "using what knowledge you have how would you complete this task?"
5	Though KS3 I feel that you should start with skill development, then move to improving terminology. Once this is in place, look to develop problem solving. In promoting all three together at KS3 this will promote pupils desire to improve on the work that they produce.
6	I believe that digital literacy is the knowledge of digital devices and their uses. This focuses on the fact that ICT is a constantly changing subject – something that is not always taught (which probably gave MG his direction for his statement at BETT).
7	However, digital literacy communication is only between two experts and not an expert and a basic user, which at this level of communication many 'experts' find it difficult to do. This is an area that needs to be addressed.

2. The national curriculum in Wales relates ICT capability to two key strands that of Finding and analysing information and creating and communicating information, in today's world of emerging technology how do these strands relate to your thinking about ICT capability
a. Are there any aspects of technology, emergent or indeed traditional should be included?

b. Is this a change conceptually or are these new skills that need to be learnt?

Line No	Dialogue
8	I think that there is a case for the two areas to be combined. Creating and communicating are so essential, yet often neglected for the Finding and analysing.
9	The NC in Wales give much more scope for what skills can be taught, and what topics, so that these areas can really be focused on.
10	As a result of the constant changing of the subject Teachers need to ensure that they are always up to date and current with technology.
11	The subject needs to be up to date – any teacher that is not willing to do this is not passionate about the subject.
12	To promote development you do need to know to a degree where we have come from so that we can identify a direction that we are going it, but primarily ICT is a forward focusing subject, which requires an appropriate mix of the two strands.

3. The national curriculum also talks about progression in ICT capability, how do you believe this comes about
   a. What do you think progression is?
   b. What is it that helps some kids to succeed with ICT easily and others not so well?
   c. What are you looking for to progress pupils through the subject?

Line No	Dialogue
13	I believe that ICT capability comes in the following stages : Skills; Terminology; Problem solving
14	I believe that it is first important for the pupils to get to know the software and how to complete tasks using it.
15	Once this has been achieved you can look at developing terminology. From this point there are able to use accurate ICT terms and phrases in relation to the topic that they are covering. From this point you would look to use the skills and terminology to make decisions to solve problems that have been given to them.
16	For example – here is a problem, this is what you need to produce, what software would you use, why would you use that one instead of that other one.
17	I think that some pupils progress as they look at things as a bigger picture and are able to think of logical steps to achieve their goal.
18	Some pupils are not capable of visualising the steps and struggle.
19	I also wonder if this leans more in favour towards to kinaesthetic learners to some degree. .
20	For pupils to progress through the subject they need most importantly a good sold foundation, that needs to be put in place in year 7.
21	Teachers need then to look to build on this through KS3. There is a lot of responsibility on the teacher – they are a kind of farmer. I believe that true ICT capability can be seen at KS4 in the GCSE pupils

4. There is evidence to suggest that at the end of KS2 Pupils are invigorated and excited about ICT, and yet it often appears that there is disillusionment with ICT at the end of KS3,
   a. What is your reaction to this
   b. Why would you say this is the case?

Line No	Dialogue
22	I completely agree with this statement. I have noticed the decline over the last few years in the number of pupils that are taking GCSE IT.
23	This is mainly down to 2 reasons: CT appears in an option group along with other equally popular subjects, and careers advice seems to tell pupils to choose science or a 2nd language over ICT
24	For some reason they have lost sight of the fact that a vast proportion of jobs these days require a degree of ICT skills.
25	I also feel that the introduction of Essential Skills / Key skills qualifications at KS3 plays a large part in this.
26	Anyone who is passionate about ICT will know that it is not only about spread sheets and databases; however, they are a requirement in this qualification.
27	It is important that children leave school with recognised qualifications, but they do paint an inaccurate picture about the world of ICT.
28	At ks2 the ICT uses fun software to grasp their attention, almost games like.
29	However, when they enter KS3 the software they start to use is often industry/ business standard. The problem then is that a false image of ICT is produced. All of a sudden pupils believe that ICT is all about spread sheets, databases and word processing. This is having an impact on the numbers who take GCSE ICT.
30	For a number of qualification hands are tied as to what they can do or use. Teachers can work hard to produce a scenario to make the tasks more enjoyable; but ultimately pupils don't tend to enjoy the work.

5. What are your thoughts on the following text? (Extract from Gove's speech – BETT 2012)
   a. Do you agree
   b. Is it your opinion that the same can be said for the curriculum in Wales?

Line No	Dialogue
31	I completely disagree with Mr Gove's statement, in fact the first time that I heard it, it angered me.
32	To hear teachers say that the current curriculum is too off-putting, too demotivating, too dull raises a number of questions.
33	How can a subjects specialist teacher allow their subject to become this?
34	ICT is a constantly changing subject; technology is changing at an alarming rate, so how can it be too dull?
35	There is always something new to teach!
36	I am aware that in Wales the restraints around the NC are open to interpretation, but this still requires teachers to put the hard work in, which is what the professional requires.
37	It is simply the teachers that are not stretching the children not the subject. which is what the profession requires. It is simply the teachers that are not stretching the children not the subject.
38	You have to wonder what is the true motivation behind the change of direction in bringing Computing to the fore front.
39	Has this anything to do with the government's plans to build the UK version of Silicon Valley in the coming years and they are looking to develop a workforce for it?

Line No	Dialogue
40	Not all people who are passionate about ICT are programmers, so does the move to computing mean that it becomes off-putting to many more?

6. Within the NC orders for ICT (Wales 2008) it is recognised that ICT is a key component of education and entitlements for the provision of ICT are established, however, the way in which that entitlement is organised either on a cross-curricular basis or as discrete ICT lessons is left up to the policy of the individual schools. Do you believe this has an impact on the development of ICT Capability and if so in what way and how?

Line No	Dialogue
41	Simply put, ICT cannot be taught by 'polyfilla' teachers.
42	A number of schools will believe that ICT is a subject that can be taught by non-specialist teachers.
43	They are often used to fill spaces on a timetable if the subject is taught discretely.
44	However, you will often find that due to limited knowledge in the subject it has an effect on the pupils learning.
45	I have had experience of that where the following year it becomes a picking up the pieces, and instead of developing learning you are covering areas that should have previously been covered.
46	When you look at how many jobs these days require a degree of ICT capability I feel that it is essential that the subject is taught discreetly by subject specialists.

7. Can you identify an element or elements of your practice which you believe target the development of ICT capability in a particular way?
    a. Why do you think that this is so effective in the teaching of ICT capability
    b. Is there anything in this practice that you would like to investigate or experiment with

Line No	Dialogue
47	We look to ensure that most if not all tasks set are in a context.
48	This way the pupils are able to show a true level of ICT capability, combining skills, knowledge and 'problem solving'.
49	I think that is effective this way and gives a true indication to the individual's level of capability. It is all well and good being able to answer questions but I feel that it is essential that knowledge and skill is imparted to the given situation and the needs and requirements are evident.
50	In practicing in this way I believe that ICT capability is promoted and develops
51	

Initial Observation (IO)

The analysis of the initial classroom observation can be seen in the table below.

Line no	School C class room observations		
1	Intra-Action	Features of Learner	The learners are a mixed ability year 8 class, they are predominantly from a deprived area of Port Talbot in South Wales; there is a high incidence of special needs within the school. The pupils whilst being open and forthright are not necessarily confident in their own abilities and can be in need of support. Evidence of this can be seen in the way they will approach you and engage you in conversation on a general level, however when discussing their work they can be non-committal unless you are their teacher with whom they do feel confident. The presence of an observer in this class did not appear to affect the pupils.
2		Features of the setting	The classroom is a large and airy room, with peripheral PC's set up in pairs, there are central tables around which the pupils sit for the teacher's exposition, prior to moving to the PC's where they complete the task. There is a relaxed and comfortable atmosphere within the class and the pupils appear comfortable, there is a good relationship with their teacher evidenced by the rapport and humour used within the class, both on greeting the pupils on entry to the class and when he cajoles the pupils to remain on task.
3		Product	The product is quite complex, in that for the pupils it is the design of a website using Microsoft PowerPoint ensuring that it is aesthetically pleasing and the ability and opportunity to use their individual creativity. On another note for the teacher it is the ability to appropriately plan a website for a particular audience and given a specific purpose. Furthermore, the success criteria also demand that there is a degree of 'Welshness' about the site.
4	Interactions	Orchestration by Teachers and others	The conditions for learning is predominately orchestrated by the teacher, in that the lesson objectives are specific and once shared remain on the board as a constant reminder to the pupils. Any presentational material is used as an aide memoir, but the majority of the exposition takes a dialogic approach, with discussion generated within the class by using a no hands up policy and the use of open questioning with the use of prompts. Key words and technical terminology is also available on the whiteboard and these are used to generate both an understanding and application within the discussion. It is not enough that the pupils can repeat the terminology and its meaning; the discussion ensures that they also think about and relate how these terms and concepts can be applied and used within the website. There is discussion regarding the appropriate use of information with regard to purpose, and the pupils respond with the type of information they are planning to use and why this might be important for the product they are advertising by building the website and the sort of audience or specifically who their target audience might be.
5		Orchestration	There is an orchestration by the pupils though this is subtle, and

		by Learners	has been and occurs in such a way that it is not immediately obvious. Due to the ease with which discussion has been generated within the exposition, the pupils start to make suggestions of their own, and follow through this thinking when on task. There is also the facility within the class of the learning partners. This allows the pupils to assist their peers, though only in their team, this works with a seating plan and generates a cooperative working environment. Some of the more able of the mixed ability task take a greater control of their own learning in that they are more able to adapt the previous discussion to fit their particular piece of work. For example there were some that incorporated the 'Welshness' by the use of the Welsh flag as image and then did not use it again, whilst others used the flag, and made it transparent so that they could use it as a background and place images and text an over it. There were others who incorporated some of the Welsh language in addition to the Welsh flag.
6		Perceived Constraints	There were a number of constraints within the lesson, these included the success criteria for the task, and for example the need to use hyperlinks how these were used was left up to the creativity of the pupil. A further constraint was that the planning was to be carried out in PowerPoint, this may have been to ensure that adequate planning occurred prior to building the site within a web authoring software where greater flexibility is allowed. There is an expectation of pupils that if they are participating in an ICT class that they use ICT, and for some the need to plan a project can be considered as a waste of time, when they can use ICT to open up the desired software and start the task, so the use of Microsoft PowerPoint as a planning aide as opposed to paper and pens may be more appropriate here. This may also have been planned as a middle mixed ability group, they are unlikely to have the confidence in their own ability to take their earning forward without clear structure and boundaries. Indeed as mentioned previously whilst confident and forthright with strangers or observers in their class they reserved the discussion of their work to each other or their teacher.
7		Perceived Affordances	The affordances include a clear understanding by the pupils of what they were expected to achieve and the dialogic discussion at an earlier phase of the lesson allowed them to construct this in such a way that each of the pupils were able to know exactly what they aimed to do. The complexity of the task and the achievements of the pupils depended on their individual ability. Another affordance within the lesson was the personal differentiation that the pupils received through discussion and use of the learning ladders that allowed each pupil to establish what they had achieved and how they were going to move this forward to achieving the next level. The system mentioned earlier of learning partners freed the

			teacher from assisting pupils where there was a problem of how to carry out a task. If a pupil was unsure they first asked their team partner, and then if they could not assist, then another member of the team before approaching the teacher for assistance. The advantage of this system meant that where there was a simple question of how to do something and this usually was how to bring about an effect within the programme, this could be answered by a team member, freeing the teacher up to assist in more complex matters, particularly righting any misconceptions arising in the conceptual aspect of the learning. However this system is not without its drawbacks or disadvantages, there is a real danger and indeed this was observed on occasion, that when a team member is asked about a problem, instead of discussing the problem and showing or explaining the answer, the team member who was asked merely carries out the task for that pupil who had the query. Another disadvantage is that for some of the pupils being asked by others to assist is mildly disruptive and may move the pull off task for longer than is necessary. Finally the structure and timings of the exposition, task and recap, gave the pupils a structure, whereby there was a clear pattern within which the pupils were working and this enabled them to be confident in what they had to achieve and in what time frame.
8		Goal Directed Activity	The goal directed activity was one of planning; the focus was to produce a website and how they did this had to be justified against audience and purpose in order to achieve the summative level for this piece of work.
9	Evaluation of product and process	Reflection in Action	Reflection in action was present in the form of discussion within the pairs and teams about what the individuals were attempting to achieve. And to a lesser extent why they were carrying it out in this way, there were comments such as "if you use a picture and link it then you don't get a load of words". Also in those cases where the learning partner was used and the partner did not just carry out the task, then whoever was assisting had to resynthesize the technique and put this into their own words, in order to adequately explain what they were explaining.
10		Reflection on action	The reflection on action came within the plenary and with the use of learning ladders, was that the pupils were required to assess what they had achieved and ascertain what they needed to do to progress the work.
11		Knowledge construction	Throughout the lesson there was the use of dialogue and two way conversation about the topic in hand. This conversation and dialogue took the form of prompting the pupils understanding and knowledge by the use of open questions and was not concentrating on the 'hows' but was investigating the 'why's' for example "tell me why you are using that colour scheme?" with the answer involving or alluding to corporate identity. Thus showing the pupils understanding, had there

			been the use of short closed questions there would not have been the same degree of discussion generated, also the pupils would not have had to put complex concepts into their own words to answer the question.

Post reflective dialogue (PRD)

What are your key reflections of this lesson?	
1	Trust is an important part of teaching in this school, the pupils need to trust you to respond , so teaching in this way where they are free to voice their opinions builds that trust
2	Yes you will get some who are awkward, but we try and use ICT to get around that, if they can start succeeding here, they can feel they have a better chance.
3	They like to interact with each other
4	They set their own targets, sometimes with more help or 'pushing' to a certain direction than others, but that way they know what they have to do.
5	Then it is up to then, most times if they helped design what they need to do – learning ladders, they have a better understanding of what they need to do. It works for them.
6	They also like to talk about things, they all have really good ideas, so why not use them
How about the development of ICT is this retained?	
7	Yes, it seems to be, kids are great explorers, you can show them the ideal way, but they will still explore a software and work out how they can use it.
8	They are also really good at working out those other kids who may be able to help them when they get stuck. They instinctively know when someone is good at something
9	That's why they like the 'buddy system'
How about the level of ICT capability amongst the teachers	
10	We are quite lucky really
12	The ICT capability of the teachers can definitely have an impact, but I would say that most of them are fairly good.
13	Also w tend to leave the computer rooms open so they can come and use them, and if they want them for a class, then they can book them
Is there anything you might like to change	
14	I don't know, we have spent a long time developing the pedagogy here and it really seems to suit the kids here.
15	I am a little concerned at the changes which might be imposed on us those.
16	I don't see a need to introduce computer science at KS3, I don't think it would help our kids.
17	There is so much specialism they need a good basis and then they can explore different routes later.

Final Observation (FO)

Line no	School C class room observations		
1	Intra-Action	Features of Learner	The learners are year 8, and are in the low ability group, however many of the learners have a greater ability than their

			set would suggest. The pupils are confident and content in the classroom setting, and there is only a minor amount of low level disruption. The pupils' confidence was apparent when they were able to question the presence of the observer in a forthright, yet friendly manner. The pupils also show their confidence in the way in which they explored the a software applications and in the conclusions they drew from the questioning
2		Features of the setting	The class room is a large and airy classroom with desktop computers set around the periphery and tables I the centre of the room. This means that the pupils are away from distractions when the teacher needs the pupils to concentrate on him, e.g. in the exposition/ demonstration and the plenary. There is a seating plan in place for the pupils when they are on task and this arranged in such a way as to afford a peer buddy system where help can be sought if necessary. The weather that day was overcast which meant electric overhead light was used, however this did not appear to impact on the students. The room is a fairly large rectangular classroom and as such when the teacher was formatively assessing at one end, there was an incidence of low level disruption at the opposite end. When the teacher became aware of the disruption it was rectified with a look followed up by a quiet comment. No sanctions were necessary. The size and layout of the room can mean that it is difficult to be totally aware of the whole class all the time.
3		Product	The Product was twofold, from the teachers perspective the product was the learning that was taking place and that involved appropriate use of the tools existent within the application. From the pupils perspective the product was the production of Mr Melon Head.
4	Interactions	Orchestration by Teachers and others	The orchestration for learning was the responsibility of the teacher. There was a trainee teacher present who acted as an LSA, but the scheme of work and lesson plan had been written and implemented by the teacher. The lesson objectives where clear and concise and the pupils were sure of what was required of them. The questioning used was open ended and promoted discussion and debate within the class, this enabled the pupils to put what they had seen and heard into their own words and to start making their own constructs of the information. The task was discussed and success criteria were formulated between the teacher and the class, this enabled the pupils to have a greater understanding of the requirements, which in turn would better enable them to succeed in the task. There was also the buddy /peer/ help system in operation throughout the pupils task
5		Orchestration by Learners	Students used independent exploration in certain instances to orchestrate their own learning. They also assisted each other in a buddy and team basis prior to asking the teacher for assistance. They liked to have control over their own learning,

			as evidenced by the way they discussed their progress on the task with their buddies. They were able to try certain tools to see their effect and then it was noticed that if they were unhappy with the way in which it worked, they undid the work and tried a different tool.
6		Perceived Constraints	There were constraints in that they were given a set task and set resources to use. The task was structured and a given result was required, however this conversely allowed them the time and focus to concentrate on the use of the tools required to successfully achieve the task.
7		Perceived Affordances	Affordances took the form of the buddy system previously outlined in that it allowed the pupils opportunity to discuss and teach their fellow pupils how they achieved certain effects, whilst the very nature of this system means that some pupils have a greater opportunity to apply this form of learning and build their own constructs in the social activity of teaching their peers, others benefited from having the teaching from a peer. When a pupil teaches another pupil there is a tendency to have the discourse at a level and in a manner that is common to both pupils. Also as previously mentioned the very constraint which limited the task was an affordance in that it allowed the pupils to focus their learning on the use of the tools. It also allowed the repeated use of layers. The use of layers in this way links with the way in which pupils can develop routines and processes which are components (Kennewell, 2003a) of ICT capability.
8		Goal Directed Activity	Like the product there are again multiple goals of the teaching and learning activity, that of learning the skills and tools needed to operate Adobe Photoshop effectively and to the extent that its use can be transferred cross curricularly for its use within design and technology. And from a pupils point of view the completion of the set task.
9	Evaluation of product and process	Reflection in Action	This can be seen by the way in which the pupils discussed the task as they were doing it. Also by the way in which they showed each other different ways of using the tools under investigation. Again this was also evident throughout the exposition with the answers to the open questions and the application of the software to real life scenarios.
10		Reflection on action	The plenary allowed the pupils not only to answer questions about the application, but to also express why they had used the software and the tools within it in the way in which they had used them. When discussing the use of the application within the real world and the world of work the pupils were building scenarios for possible use as their forms of answers. E.g. " it could be used to make celebrities look better"
11		Knowledge construction	The knowledge construction was evident in their references to the difference between this application and adobe Illustrator and from a different viewpoint the use of Windows Paint. There was an understanding that the software applications are used for different purposes depending on what you wished to

			achieve.

Final post observation dialogue and Interview. (FI)

1. how does the specialist ICT teacher address
   a. The question of differentiation for more able or more mature learners?
   b. the possible of individual learners to take greater control of their learning within the learning environment ?

Line No	Dialogue
1	As a whole school differentiation is highlighted and the question is always asked "what are you doing not only for the less able but also for the more able and talented.
2	I think the problem has been in the past that the question has been for the less able, but not for the more able and talented.
3	It is the extremes of ability that you need to be careful off and it is not about simplifying work but to enable there to still be a push, so that you can push the others.
4	Personally addressing the more able and talented comes in different forms.
5	To give them an additional exercise is not suitable that is not differentiation that is just doing the same task worded in a different way or in a different context.
6	So you need to use a challenge of the higher ability where they may need to think outside the box.
7	Looking at what lesson was or even in some cases I've used them as a teaching assistant depending on the class and they are often given the role of existing and explaining the problem and how they can solve it emphasising that you on to explain and talk not do it for them.
8	Use of learning partners and the classes set out to people children partnering up together do you plan from different differentiation in a way it does matter what sort of situation they going to watch classroom teaching, kids will know who are the more able and talented and who they can turn to fix problem.
9	It's not something that is really well thought out in the ICT situation a lot of time the seating arrangements are dictated by the classroom behaviour or parental requests that people on sitting together.
10	So more by class rules than by the ability of pupils but within those groups it becomes clear that the movement to, who are the more able and talented pupils know who to turn to assist them with the problem there are times though that you think hold a minute everyone is going to that one person and they are not benefiting at all but the whole thing of working as a group we found success it keeps it fresh we change around every half term so they get a new partner or new team every half term it makes them get used to working with others and they develop skill as well they don't get too comfy.
11	Another member of Department uses deck cards as they go in and change certain turn over and match open and matchup pairs with the red cards is one group and black cards is not the group.
12	So there is no real control as to where they sit are but there has to be some scope for movement might whip in a quick shuffle so that you can keep that flexibility.
13	You also find that those kids with behaviour problems are also bad attendance so they may not be there when the cards are dealt.
14	Differentiation for the less able - it's nicely said about them doing well because the unit pupils have only come back into mainstream IT within the last five years problem that we had in the past was that IT may not be best for them because the LSA's were doing the work from the

	pupils so the pupils were learning anything. But they've now come back in and we will teach them the same exactly the same skills and knowledge as mainstream as a set one would be taught.
15	It's the approach you take with them it may be the exercises that are different or it may be the time e.g. the tops might take one lesson to do something where as with the unit kids you may take two or three sessions, don't rush them that's the main thing and we've had some fantastic results with it especially you can see this with the year nine kids when they're taking the essential skills Wales tests.
16	But they've all been achieving a level I which speaks volumes that were doing something right otherwise they'd be struggling.
17	Different approach your resources may have to look different in that the layout may be different it a lot may have trouble with their reading age someone visually impaired so we make sure we read profiles of everyone and look at the areas that they teachers need to address to make the curriculum accessible to them.
18	They cannot fit the profile or plan that you may use for the higher ability and so you have to know you class and put your resources according to their abilities and according to their needs.
19	And even sometimes step-by-step approach with the more difficult tasks may be to start of doing it all together to build their confidence up whilst they become familiar with where all the tools are with the LSA's play a massive part in as well.
20	How does that affect the use of school C's learning ladders is a case of with the learning ladders concept that we have here which came about from and of an Afl working party all of the year group right the way through will use that, there is far greater discussion with a lower ability group there may be prompting for their achievements and their success criteria, however with a higher ability group they are more able to set the criteria themselves.
21	It may be that we create a collective one rather than individual learning ladders each of them will see different things example they will see the marking criteria so once they have created a ladder we will make l marking criteria available to them so they can make the adjustments than so they'll have around then we may make a collective one based on their idea

2. How is the relationship between the ICT department and other departments defined that enables working together on a cross curricular basis?

Line No	Dialogue
22	it came into being really with the year nine when we look at essential skills, is started really work what they call the key skills and we find especially with our pupils that if they get asked to do a task and one lesson and then get asked the same one another one repetition before we do and we are completely unaware and you do this.
23	We realised that here were missing something we did a an inset literacy and numeracy and of different departments that together there was a huge shock table when we worked out that cross each half term where we were using literacy and numeracy there will plan to see where we were moving over and it was highlighted that whilst we were doing was key skills ICT English were doing communication and part of the requirement was to do multiple page document in both so in the departments working together we came up with the suggestion and piloted 3 years ago.
24	They would write the document in English so the grammar and punctuation is done in English and then in IT structure using desktop publishing the newsletter and bring all the other elements into it.
25	So in ICT we had to make ourselves familiar with the requirements of English and likewise

	English had to make themselves familiar with the requirements of IT.
26	It's been really successful and we've noticed a change in Pupils' attitudes and also from myself when you've marked all the projects you're marking half the work and you've got a specialist marking the English side things, you're able to concentrate on the IT which is your specialist subject and not worry too much about the English side for example with the apostrophes in the right place.
27	You also notice the pupils are less reluctant they come in and they've got their English book saying and then ready to start their articles.
28	We work with the DT in that we will use image editing in Photoshop in ICT and so that when they go to DT they can use that but the DT teacher would do an advanced session and they can then use that in their production side or practical side of their DT.
29	Subjects like geography was done on one of lesson introducing them to moviemaker or photostory and then the Geography Department have gone off and done a project using that software.
30	Links tend to be on a one-off basis so that we can introduce them to an application and they can then produce something that is required within their different subject areas.
31	It also encourage staff to look at using other things so they're not just doing a PowerPoint any more they can make a movie using moviemaker. Consequently the ICT capability of staff within the school which is improving.
32	We are also lucky in that we have some ICT rooms available so that the non-ICT teachers can explore and use software so that confident within the classroom.
33	And this increased ICT capability staff has had an impact on improving the ICT capability of the kids.
34	I see where they are given a choice now they don't take the easy route the looking at how they can get tracks from CDs into presentations instead of having it as a basic "job finished" attitude getting far more creative they are starting to move away from that problem where they are making a PowerPoint they think everything has to whirl around and overuse of transitions.
35	Now they are taking order into account so they are beginning to rationalise appropriate use.
36	The higher order skills are being influenced by something that we strive for within ICT lessons as well. We don't do a little illustrator we will look at Illustrator will look at photo shop will look paints so we will look at entry-level right the way up to the industry standard and then give them a problem, such as West Midlands Safari Park require new logo and it's up to you to produce that logo. We don't tell them which software to use they have to pick it and they then have to justify why they pick it.
37	They come to understand that if they want to work with photos the way to go is photo shop if they want to use vector they need to use something like illustrator they have to make a conscious decision.
38	There is also competitive edge they don't want to put something on the screen they rushed they don't want to you we seem to be using paint and they should have been using Illustrator in someone else's used vectors and anchor points.
39	The learning partnerships also has an influence on the competition aspect is see it partnership point of view, you see it in two ways, you set one as in one person will say to the other how to do that can you show me how to do it like that I'd like to build to do that.
40	And you'll see learning going on between those two people and the partner leading it.
41	And on the other way you will see to partnerships who are competitive items to better the new almost edging each other on pushing each other on to increase their skills to be able to do other things and it moves onto other subjects.
42	They are given ownership and they take far more interest in a piece of work they have that ownership they are in control of how they are going to learn what to do how to put what

	within that piece of work.

3. What does the teacher understand by a skills based curriculum

Line No	Dialogue
43	I'm just thinking of a skill based curriculum I think about teaching tools.
44	It is not about the choice of why those tools are used, it is simply the tools and how to use them, if you want to do something you simply do this, then this then this etc. its equipping them with the knowledge to do something, but not the knowledge of why you choose to do it this way.
45	It does not use the problem solving skills or higher order kills. Given that when you defined ICT capability you discussed the use of the higher order skills, how does a skills based curriculum and your definition link together - e.g. yr. 8 doing dtp, they ask us to ID on sow where you use the different skills.
46	We came up with a project which identified a real business called Pete Seats and we set them a task where this business is being refurbished, he wants a new menu, a certificate that eats the big breakfast, a couple of different documents.
47	What we are looking for is the decision to research the business, and the pupils develop documents according to company colours etc.
48	Not just producing a document but producing an appropriate document. So you are using those higher order skills stated in your definition of ICT capability, although you do not define them as being in a skills based curriculum - Yes

4. How did this model evolve? How/ who designed / conceived the model?

Line No	Dialogue
49	The thing is at the moment it's quite interesting because even though we have pupils who are on this the same course within OCR nationals we are actually working very independently.
50	We know what the outcomes are that we want and what we are pushing for.
51	The model this is designed by Stuart and myself he obviously has the final say as head of Department but it's at a departmental level.
52	We have a good relationship here Stuart has areas of expertise that I have got and there's other areas that I like to think I'm stronger in and it's definitely been evident at key stage four this year we've talked completely different work both achieving the results.
53	In year nine for example everyone across the subjects takes essential skills once is dictated from above we have no option in that. Final say on the model is from above when we're working for example with the English Department is designed between the ICT Department and the English Department put the final say as above.
54	There is more autonomy for the rest apart from the essential skills Wales.
55	Every year we change something, we changed year seven scheme of work three times in the last years.
56	In year eight we got to half term and an opportunity arose so the scheme of work change to take part of the opportunity and it worked really well so apart from the year nine essential skills we have the autonomy and freedom and flexibility to adjust to scheme of work this week.

5. What are the pupil's feelings towards this model of teaching as opposed to more traditional methods? With the model of teaching the teacher is acting as a facilitator of the learning, but the autonomy or control lies with the pupil and as such is reliant upon factors such as ability, motivation and interest, does this have an effect on progression and the movement of the learning from one target to another?

Line No	Dialogue

57	On the whole the pupils react well to learning ladders and learning partnerships, however, there does have to be a degree of personal motivation and responsibility.
58	There are some who when working in a partnership will sit back and let the other partner do the work. In my experience this goes with the pupils' attitude towards work, rather than a lack or perceived lack of ability.
59	With some pupils it may depend on how they are that day, but it also depends on what baggage they may be bringing in that day.
60	It can be very difficult to motivate certain pupils because of what may be going on outside the school, things we have no control over, and probably more in this school than in many others, because of the locale and type of pupil here.
61	You could also say that it is human nature in that if someone is going to roll their sleeves up and do the work, then some will sit back and let them.
62	There is more work for the teacher in that they have to keep on top they have to keep their eye on who is doing what and how the contributions are made.
63	Some drawbacks are the lack of control on the one hand and the need to control pupil input to a greater extent. The whole idea of the learning partners and working in teams is a way of assessing them, working with others, communication skills.
64	How do you know who has done what, where are they in terms of the work achieved.
65	But the rewards are also there in their development.

6. What do you understand by Digital literacy

Line No	Dialogue
66	How do you address the area of digital literacy – first came across this in Uni, could see it by those who excelled in programming but were unable to communicating were not so good.
67	IT needs the 2 areas, you need those who are good at the more technical support and those who can do the programming. It is difficult but it's through the promotion I believe of communication and working with others at grass roots level.
68	Less about different pedagogies, more about expanding the range of understanding.
69	Greater inject at an early age more of the IT aspects, there may be a greater broader result.
70	Adding IT to programming rather keeping them in isolation.
71	Especially at KS3 where you are moulding them.
72	There needs to be greater emphasis on the wider aspects of IT rather than going down a narrow route of programming
73	At KS3/4 I think it should be just ICT , the other options can come later.
74	Why are the government making these suggestions?
75	Here those who have excelled at ICT would struggle at computing, but could excel in the IT industry.
76	What is the government's motive for doing it?
77	Computing is not for my pupils. I feel there is a danger of putting too great a specialism in to the curriculum too early.

7. If you could do this in any other way

Line No	Dialogue
78	the only other way of doing it that I can see based on the way we have our SOW structured, that if the tasks that were set were aimed at what the ESW tasks would be.
79	In yr. 8 they are looking at spreadsheets so as a summative task in yr. 8 when they are looking at spreadsheets any way why not do the ESW spreadsheet then.
80	Maybe do ESW in yr. 8 and finish in yr. 9 instead of it taking up so much of the year prior to taking choices, because the danger is that some pupils who were interested and motivated by

	ICT get put off after all the ESW in yr. 9.
81	Trying to find somewhere that you can put ESW where it doesn't have an impact on choices.
82	We've looked at for a couple of years, we've tried different things, we tried something different last year, but we won't see the effect it has had until the options this year.