The relevance of role play to the learning of mathematics in the primary classroom

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THE RELEVANCE OF ROLE PLAY TO THE LEARNING OF MATHEMATICS IN THE PRIMARY CLASSROOM

by

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ABSTRACT

This thesis reports on an investigation into the relevance of role play to the learning of mathematics. It is a case study of one Reception and one Year Four class during the academic year 2011-2012, where role play was used for children to explore mathematics that 'made human sense' (Donaldson 1978).

This study is grounded in social constructivist theories of learning, seen as the product of interaction amongst members of communities. It starts from the theoretical perspective of play being a key medium for children's learning, drawing on a body of literature positively linking play to young children's development. It takes the view from accumulating educational research, that discussion and social interaction are significant in learning mathematics and that learners' mathematical identities affect their engagement.

The following questions were posed in this study:

- *What mathematics can be learned through role play?*
- *What does mathematics learning look like in different role play contexts?*
- *To what extent might role play affect the development of mathematical resilience, involvement and a positive attitude to the subject?*
- *What particular classroom conditions positively affect mathematics learning through role play?*
- *What adult intervention helps or hinders?*

Ontologically, this study considers participants' interactions and behaviours and their interpretations of these, as central to a situation. In order to address these questions and reflect my views on knowledge, a qualitative, interpretative methodology was adopted for this study.

The findings suggest that role play is useful for mathematical learning and that it is possible to engage in complex mathematics through role play. I argue that the potency of role play is its ability to suspend disbelief and engage children as participants in a community of learners.

This study also concludes there is potential for developing children's mathematical awareness and metacognition through reflecting on role play. Whilst the importance of reflection on learning is well established, how a child learns about themselves as a mathematician is under-researched. This study begins to consider this issue.

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This thesis is dedicated to my parents who would have been very proud.

INTRODUCTION TO THE STUDY

> "*There is a danger that mathematics is seen by children as a subject in which they learn about other people's ideas, particularly yours, and that it has little to do with them.*" (Straker 1993: 10)

The subject of my research straddles the pedagogy of mathematics and that of early years. My focus is how play and mathematics interact in a classroom, the mathematics curriculum as experienced by a group of children in a primary school classroom at a particular point in time – what they do, what they say, their identities and perceptions. The research is grounded in my 30 years professional practice as a primary teacher, with a special interest in the learning and teaching of mathematics, particularly in the earlier primary years. I began with a belief that mathematics could be better for primary children. This stemmed from my personal (negative) experience of mathematics education along with a steadily increasing body of research documenting the disengagement of learners of all ages from mathematics, despite their overall level of mathematical achievement (Buxton 1981, Hughes 1986, Askew and Wiliam 1995, Hannula 2002, Noddings 2006, Klein 2007, Boaler 2009, Askew, Hodgen, Hossain and Bretscher 2010, Borthwick 2011). As an early years teacher I am well aware that 'learning through play' underpins early years pedagogy in the United Kingdom in the twenty-first century (Pellegrini and Boyd 1993, Broadhead 2006, Broadhead, Howard and Wood 2010, Chilvers 2012). However, research into effective and sustained *mathematical* play is scarce, as evidenced in my review of literature in Chapter One of this study.

As an educational consultant with a particular interest in the early years I was struck by this statement by Sue Gifford:

> "*I began to conclude that children's role play was concerned with the larger themes of life, like love and power, rather than mundane things like the price of potatoes*." (Gifford 2005:2)

Had I, as Gifford implies, been wasting my time preparing role play activities aimed at developing children's mathematics? This study set out to examine the extent to which role play might be effective for learning mathematics in a school that had made the decision to develop role play as one aspect of their pupils' experience of the learning of mathematics in all age-groups. Was it possible to plan authentic (Twomey Fosnot and Dolk 2001a, 2001b, 20022001a, 2001b, 2002) mathematical activities that readily captured children's interest and involvement (Lowrie 2011)? Was it possible to pinpoint any mathematical learning taking place when children were engaged in such play? I made the decision that the most revealing way of exploring this was to video-record children engaging in such play.

As the study progressed I became aware of the opportunity it offered to research mathematics that is shared and mediated through peers as well as teachers. The issues this study tackles, namely, cognitive learning in relation to affective and socio-cultural issues, warrant examination at a time when government guidance for mathematics practice continues to reflect a transmission approach to mathematics education (DfE 2013). While research stemming from Vygotsky identified talk and interaction as important for learning (Vygotsky and

Kozulin 1987) to date there have been few studies of these in relation to mathematics learning and none where social dramatic, or role play has been analysed as a vehicle for learning mathematics with any age group.

(i) Social constructivism

At the heart of interpretations of knowledge as the product of interaction in a cultural context is the work of Wenger (1998) who saw humans as social beings belonging to many communities of practice and 'knowing' as learners actively participating in 'valued enterprises' to produce meaning. As the study progressed, it became my intention to examine whether Wenger's concept of a community of practice might inform and develop current understandings of mathematics learning and teaching, by examining how role play might contribute to the nurturing of such communities. The concept of learners jointly constructing learning in communities of practice underpins the entire study and is analysed in Chapter One.

From the accumulating body of research literature into learning from a socio-cultural perspective, evidence of the following two main issues has emerged:

- social interaction plays a critical part in learning (Howe and Mercer 2007, Howe 2009), and
- peers sharing understanding through the use of language enhances understanding (Alexander 2006, Barnes 2008).

As both social interaction and communication are often cited as effective features of role play (Montgomerie 2009) could mathematical role play aid mathematical understanding? What environments best facilitate the construction of mathematical knowledge is one question at the heart of this study.

(ii) Mathematics learning

By mathematics I mean a socially constructed, symbolic language created to represent relationships, such as those of number and geometry, to solve problems and to convey ideas to others. For this study I take the view, in keeping with Boaler (2009) that rather than being a fixed body of knowledge, mathematics is a human activity and a social phenomenon. Such a definition highlights language and communication as integral elements of the learning of mathematics and thus renders it available to observe in action.

As I collected my data, video observations of groups of children collaborating on various tasks designed for them to encounter and explore some mathematics through some form of fantasy play, it became clear that mathematics was observable through their exploratory talk (Wegerif and Mercer 1997). I made a decision when designing my framework for data collection to use video extracts to play back to participating children where I had identified them as engaging in mathematics, in order to establish if they were able to recognise what they were learning. Immediately, I was struck by the ability of children to reflect on their learning on two levels; firstly by being able to identify relevant mathematics and secondly, by being able to reflect on how they learn, a kind of meta-learning. Thus ‘metacognition’ became an important theme in this study, and is discussed in detail in Chapter Six.

By understanding mathematics as a human activity and a social phenomenon, the nature of teacher/child relationships became central to my analysis. Drawing on Askew (2008) I came to consider it essential to examine the roles and relationships being played out in the classroom (and school) in understanding children's mathematical learning. Teaching, in terms of the structure, design and the development of tasks, the formation of groups and adults' expectations of children, as well as the quality of relationships within the classroom between peers and between teacher and learner all became significant to the study. Here were elements of 'dialogic' teaching, involving ongoing discussion between teacher and students, where plans are made and changed as a result of such discussion. Hence, control and independence became additional themes to explore in this study, as dialogic teaching redefines the pedagogic role of the teacher in the classroom to one where control is shared (Tanner and Jones 2007).

(iii) Play and Role Play

For the purposes of this study it was necessary to examine the phenomenon of *play* that underpins early years' pedagogy in the United Kingdom in the twenty-first century. Although play lies at its heart in documentation if not in practice, there is little agreement on either the definition or characteristics of play. Although seen as essential for young children's development (Broadhead 2006, Broadhead et al 2010) it is viewed as 'time off' for even slightly older children. What we consider to be 'play' is contextually and culturally dependent, varying according to time and participants.

'Role play', as a particular type of play, encompasses a range of terms including socio-dramatic, imaginative and fantasy play, all of which involve some form of transformation of identity and incorporate plot and story line. My working definition of role play is 'walking in another's shoes' (Williams 2006). My experience had demonstrated that young children in particular seemed attracted to this type of fantasy play and I became interested in the work of American educator Gusin Paley, who maintains fantasy play is mankind's "*...best-used learning tool"* (Paley 2004a:8) because the pretend element makes situations dependable, controllable and thus risk-free for young children. As an early years teacher and teacher/adviser I had spent considerable time and energy creating and planning for role play that encompassed mathematical activities (Williams 2006) and yet research evidence seemed to indicate that participants, rather than engaging in mathematics when role-playing, were instead attending to social issues such as power and control (Gifford 2005). This study is the story of my exploration of children in two classrooms where role play was seen as central to their mathematical experience.

For this study, I use the term 'role play' to apply to all observations where participants are engaged in some imaginative play that entails a suspension of classroom reality, a 'suspension of literalness' (Garvey 1977) and where they might at times be 'walking in another's shoes'. Quite early on in my research one issue that emerged was whether the children I was observing were really engaged in role play. I remain sceptical about this, however as the analysis of my observations developed I came to believe that although this was an interesting question, it was not as important as my observations of learners jointly constructing mathematical meaning through sense-making discussions of make-believe scenarios.

(iv) Identities

"*The question of identity is every child's most serious occupation.*" (Paley 1990:31).

How we see ourselves as learners affects how we learn (Sfard 2011) and learning cannot be understood separately from the social identities both children and teachers adopt in classrooms (Askew 2008). Underlying my interest in identity was the fact that many members of our society define themselves negatively in terms of mathematics (Boaler 2009). Our sense of self (or selves) affects how we as learners see mathematics as relevant, necessary or learnable. Learning in turn changes who we are, by altering our ability to participate, to belong and to negotiate meaning (Wenger 1998). Critical to this analysis is an understanding of identity as both socially produced and situated (Askew 2008, Lawler 2008) rather than as given and fixed.

Identity is central to role play and of significance to this study is whether engaging in mathematical play 'in role' other than as oneself, allows children to connect to mathematics in a different way. Does it allow children to take a mathematical risk because the risk of personal failure is suspended? Does it allow children to play with mathematical ideas where there may be no consequences, no right or wrong answers? Here I draw on Wenger, who saw imagination instead of a withdrawal from reality, as requiring the ability to disengage, to take risks, to explore and to create unlikely connections (Wenger 1998).

(v) The specific problem area

At the time this study took place (2010 – 2013) owing to a change in Government, the (non-statutory) National Numeracy Strategy (DfEE 1999) had loosened its grip on mathematics teaching in the sense that no longer was a three-part model expected for every mathematics lesson, a model that had largely persisted until the 2011 demise of the National Strategies (DfES 2006). In addition, the National Curriculum was under review. The new curriculum was published in 2013 (DfE 2013). Teachers were now familiar enough with national requirements to experiment with their approach to teaching mathematics. Whilst some schools considered the hiatus in government advice a vacuum, it also offered schools who cared to, the space to innovate or at least review how they taught mathematics. The study school seized that opportunity.

(vi) The aim and purposes of this study

The aim of my research was to investigate role play in different forms as a strategy for learning mathematics with primary aged children.

The purposes of the study were three-fold:

- To develop an understanding of the mathematics that different ages of children learn and rehearse in the context of role play and identify the factors that support or inhibit such mathematical learning;
- To explore the influence of role play on pupil resilience and engagement in mathematics;
- To investigate aspects of the adult's role that further children's mathematical learning and confidence in this context.

In order to pursue these aims, I posed the following research questions.

(vii) Research questions

The following questions were posed and addressed in this study:

- *What mathematics can be learned through role play?*

- *What does mathematics learning look like in different role play contexts?*
- *To what extent might role play affect the development of mathematical resilience, involvement and a positive attitude to the subject?*
- *What particular classroom conditions positively affect mathematics learning through role play?*
- *What adult intervention helps or hinders such mathematical learning?*

I address my research questions through a qualitative, interpretive research methodology based on first-hand experience through observation. My epistemological position views knowledge of the social world as being generated both by those observing and participating. This study examines both the existence (or not) of role play and mathematics learning; interactions and actions, and the interpretations and decision-making of the participants. It is a case study of role play in two classes in one English primary school during the academic year of 2011-2012, one Reception class (4- and 5-year-olds) and one Year Four class (8- and 9-year-olds).

This study is a piece of grounded theorizing in the sense that my starting point was a 'foreshadowed problem' (Malinowski 1922, cited in Hammersley and Atkinson 1983) that maybe role play was not effective for learning mathematics. I draw upon case study as my main methodological approach as my two study classrooms were identified at the outset as 'cases of' (Freebody 2003) role play appearing to be working within a wider, national context where role play did not appear to be doing so. This study generated video, audio and interview data from participating children and adults, which was analysed for recurrent themes and related to the published literature regarding the learning and teaching of mathematics.

(viii) Chapter outline

In Chapter One, published research findings are analysed in relation to the two main themes of the study: approaches to the teaching and learning of mathematics and play as a way of learning.

In Chapter Two, I describe and discuss the context and ethos of the study school and the two classrooms and in which the study took place.

In Chapter Three, I begin by discussing issues of knowledge and knowing in order to account for my research methods. I go on to analyse my role as researcher / teacher and describe my data collection and analysis methods.

The three following chapters consist of my data analysis:

Chapter Four analyses the data in terms of mathematical learning that I observed when children role played; children's identities as learners of mathematics, as well as aspects of the adults' roles in furthering such learning.

Chapter Five examines what mathematical role play might look like and its functions; and Chapter Six explores the role that reflection and metacognition play in learning mathematics and learning about oneself as a mathematician.

In Chapter Seven, I report on the findings and conclusions of the study. I reflect on the thesis and consider the implications for mathematics learning and teaching; policy and research, and identify future research questions.

CHAPTER ONE

LITERATURE REVIEW: WHAT IS KNOWN ABOUT TEACHING MATHEMATICS AND WHAT IS THE RELEVANCE OF PLAY TO LEARNING?

My research straddles the pedagogy of mathematics teaching and learning and that of early years. My focus is how role play and mathematics might interact in a classroom in order to foster learning: to explore the mathematics curriculum as experienced and perceived by a group of children in a primary school classroom at a particular point in time in terms of what they do and what they say.

In this chapter I begin by investigating current theories about learning mathematics (Section One). Section Two examines theories about learning through play and in particular, role play.

In relation to mathematics, the main questions under discussion are as follows:

- *How is mathematics understood and perceived, both within our society and within the education community?*
- *What are the main pedagogical approaches to the teaching of mathematics?*
- *How are these related to recent major curriculum developments?*
- *What are the relevant theories about and research into how children learn?*
- *How do these relate to the learning of mathematics and what is the connection, or otherwise, between theory and practice?*

In relation to role play, the main questions discussed are as follows:

- *How has role play been understood and what are its main characteristics?*

- *What are the various theories relating to the contribution of play to learning?*
- *How do these theories relate to recent curriculum developments in the early years?*

1.1 WHAT IS KNOWN ABOUT MATHEMATICS LEARNING?

Here I examine current theories about learning mathematics and how these ideas relate to my research. I begin by examining definitions and perceptions of mathematics (1.1.1). I go on to consider the main teaching approaches over time (1.1.2) and recent key curriculum developments in mathematics education (1.1.3). 1.1.4 discusses what research tells us about how children learn, and this is followed by the examination of some key theories in the learning of mathematics pertinent to my study: constructivism, the role of talk and discussion, communities of practice, affective learning and contextualised mathematics (1.1.5 – 1.1.9). Section one concludes with an examination of the role played in mathematics learning by reflection and metacognition (1.1.10).

It is not my intention to recount a history of the practice of mathematics teaching and learning but rather to examine the significant elements that underpin current classroom practice (in the United Kingdom in the twenty-first century) in relation to my research questions.

1.1.1 What is mathematics and how is it perceived nationally?

Unlike many disciplines, there is no generally agreed definition of mathematics, which has been re-conceptualised over time, as new branches of mathematics have been developed (Thompson 2008). Mathematics has been construed as both a creation of the human mind (Orton 1992) and a variable collection of mathematical content:

"...[Mathematics is] *the study of the properties of patterns and symbols"* (Klabe 1986: 66)

Polya recognised two sides to mathematics, one consisting of content and another as mathematical activity:

"*Yes, mathematics has two faces; it is the rigorous science of Euclid but it is also something else [...] mathematics in the making appears as an experimental, inductive science.*" (Polya 1957: vii)

Isaacson (1992) argues that mathematics, like the study of the English language and English literature, is in fact two subjects, and should have two slots on a school timetable, utilitarian maths skills and maths for its own sake, where pupils are exposed to rigour, proof and elegance. Boaler (2009) makes the case that the lack of an agreed definition is due to school mathematics being a misrepresentation of 'real' mathematics as undertaken by both mathematicians and those outside the classroom. Others have argued that the definition a mathematics teacher operates with depends upon whether they see their role as a transmitter of facts or as a facilitator (Ollerton 2010).

For this study I operate with a definition in keeping with Boaler (2009) that rather than being a fixed body of knowledge, mathematics is a human activity and a social phenomenon. A socially constructed symbolic language used to represent relationships of number and geometry and to convey these ideas to others (DfEE/QCA 2000b). Such a definition highlights language and communication as integral elements of the learning of mathematics and thus renders it available to observe in action.

Mathematics pervades every aspect of modern life and it is clear that international importance is placed on the value of its learning by educationalists, employers and the public alike (Askew and Wiliam 1995, ACME 2011). Mathematical success is highly prized in the workplace, attracting much media attention, with successive governments expending substantial amounts of money and time providing for these high expectations. Children too, see mathematics as important (Ofsted 2008) but mainly as something you do in order to become good at it within school (Walls 2009). For over 100 years in England, public concern over pupils' standards, particularly in the area of number skills, has been a persistent topic for discussion in both media and mathematics education literature (McIntosh 1981, Brown 2010). This concern is fuelled by international comparison scales such as PISA (The Programme for International Student Assessment) (OECD 2010, 2013) and the Trends in International Mathematics and Science Study (TIMSS 1999) undertaken by the International Association for the Evaluation of Educational Achievement (IEA).

Vorderman et al's report into mathematics education begins from the premise that the English education system is "... *simply not working*" (Vorderman, Porkess, Budd, Dunne and Rahman-Hart 2011:5) and focuses on how we might aspire to reach the attainment levels of the consistently 'higher performing' countries by making root and branch changes in particular to secondary school mathematics, including extending the statutory study of mathematics beyond age

16. The 2008 Ofsted report (Ofsted 2008), based on evidence from inspections of mathematics between April 2005 and December 2007 in 192 maintained primary and secondary schools and using data from national tests and public examinations, concluded that although the previous decade had seen significant rises in standards in mathematics for pupils of all ages, more recently the rate of improvement had slowed in Key Stage 2 and stalled in Key Stage 1. Moreover, there is continuing anxiety over the numbers of pupils choosing to take mathematics at Advanced Level (Boaler 2009) and over the shortage of adequately qualified mathematics teachers at secondary school level (Smith 2004, Vorderman et al 2011) where 30% of lessons are reportedly taught by non-specialists (Smith 2004). There is also periodic unease over the significance of primary teachers' subject knowledge (ACME 2006, 2011, DCSF 2008b, Vorderman et al 2011).

Mathematics as a subject is highly valued but the picture on how successful our students are mathematically is not clear. It is clear that both the English public and policy-makers remain concerned over the quality of mathematics education experienced by our young people and how this equips them for life outside school. Of course, high attainment in international comparisons does not imply high attainment in problem solving (Askew et al 2010).

1.1.2 The main pedagogical approaches to the teaching of mathematics.

Mathematics has developed and expanded as a discipline over time. Rather than being construed as a collection of topics for study, mathematics is often considered to be about methods, logic and application (Brown 2010, ACME

2011) and we can see this development in the major changes to teaching mathematics. Since Polya's significant book (Polya 1957) those working in mathematics education have continued to struggle with the challenge of teaching subject knowledge and helping student mathematicians become both proficient and confident in working mathematically. It is possible to summarise three main pedagogical approaches to the teaching of mathematics:

- *demonstration by teacher followed by practice by pupil;*
- *teaching with the aid of structured apparatus,* and
- *teaching through problem solving and investigation.*

Although the latter two overlap, I consider each of these in turn.

(i) Demonstration by teacher followed by practice by pupil.

Often described as a traditional approach to teaching mathematics, demonstration by teacher followed by practice by the pupil could also be viewed as teaching *procedurally* (Brown 2010), whereby the accurate use of calculating procedures and the manipulation of mathematical skills is taught without reference to the learner's understanding. Similarly, and famously, Skemp (1976, 2006) distinguished between teaching for 'instrumental understanding' as opposed to 'relational understanding'. By the latter he refers to knowing both what to do and why, whereas he described instrumental understanding as applying 'rules without reasons'.

This procedural, instrumental approach typifies most mathematics education prior to 1970 and much since, particularly as learners become older (Lerman 2000). It rests on the assumption that mathematics exists as a body of knowledge passed on by knowledgeable others to passive individuals. Knowing something is thus construed as owning something (Orton 1992). Behaviourism supplied the rationale for a metaphor of building blocks and the pedagogy of drill and practice (Lerman 2000) where mathematics is seen as hierarchical, consisting of units of knowledge to be accumulated and combined to achieve increasing competence. This approach, although still widespread, is largely discredited by research (Holt 1964, 1967, Sfard 1998). The introduction in 1995 of national testing for 11 year olds mainly consisting of closed problems, may well be reinforcing an approach where test preparation takes preference over other teaching approaches (Brown 2010) particularly as these test results are used to measure and rank schools' performance in the form of 'league tables'.

(ii) Teaching with the aid of structured apparatus.

As a response to dissatisfaction with the model of demonstration and practice, concrete, structured apparatus began to be used to 'teach' mathematics during the 1960s and 1970s, particularly within the primary years. Mathematics is seen as consisting of difficult and abstract mathematical ideas which children have difficulty grasping. The key terms here are teaching for 'relational understanding' (Skemp 2006) or a conceptual approach to teaching as opposed to one that is procedural (Brown 2010). Frederick Froebel (1782 – 1852) and Maria Montessori (1870 – 1952) were early educators who represented number relationships with patterns, shape and colour based on the assumption that learners construct their knowledge and understanding aided by the use of specifically designed apparatus (Merttens 1987, Gattegno 1974, 1987, 1988, ATM 1989, Cuisenaire Company of America 1996, Wing 2001, Dienes and Thomas 2009). Apparatus can be used both 'instructionally' as a prop to aid understanding of an abstract concept and thus ultimately discarded once internalised, and also to explore mathematical ideas (Skemp 2006). How and when concrete materials are used in mathematics work depends upon both the philosophical and theoretical roots of the apparatus and a teacher's theoretical position. Activity with practical manipulatives began to form the basis of activities provided by published mathematics schemes (Merttens 1996) most recently typified by the 'Numicon' materials (Claughton 2014).

(iii) Teaching through problem solving and investigation.

Since Polya (1957) successful mathematics learning has been construed by many as the effective application of mathematical knowledge. The Cockcroft Report stated that: "*the ability to solve problems is at the heart of mathematics*" (DES 1982:73). Teaching approaches where the solving of problems and the learners' ability to apply their mathematical knowledge are central, or where opportunities to investigate abstract mathematics without a clear end point, provide significant challenges to the traditional mathematical pedagogy where facts are simply transmitted to learners.

Psychologists have applied the term 'problem' to those situations in which an individual "*... perform*(s) *a task not previously encountered and for which externally provided instructions do not specify completely the mode of solution."* (Resnick and Glaser 1976). Problem solving provides opportunities for learners to use and apply skills and knowledge. Whilst long recognised as a critical aspect of mathematics learning, it is also recognised as a difficult aspect to teach (Jones 2003). Where mathematics is presented as a series of open-ended problems, teachers have less control over the direction and pace of the lesson, the very existence of a hierarchy of facts is challenged and teachers work from learners' facilities rather than their deficits, as can be seen in the work of Ollerton (2003, 2006, 2010). This is a view of learners as actively constructing, pursuing and refining knowledge, as apprentice mathematicians, drawing on mathematical knowledge when it is required (Nickson and Lerman 1992, Baker, Street and Tomlin 2003). It rests on an appreciation of mathematical knowledge as something active and impermanent, along with a view of mathematics as a social activity in which learners participate as part of a community (Wenger 1998, Lave and Wenger 1991, Pratt 2006, Kanes and Lerman 2008). Mathematics teachers provide contexts for learners to investigate and through working together, learners' mathematical development is supported (Ollerton 2010). Related to this approach is a pedagogy that gives emphasis to contextualised, authentic or 'real life' mathematics (Twomey et al 2001a, 2001b, 2002, Onion, Lane and Lister 2008). All these terms are problematic but 'real life' or 'real world' problems are seen as those stemming from an often complex environmental situation, requiring learners to simplify and model to find a solution (Askew and Wiliam 1995). The term 'authentic' has been used similarly but both terms have also been construed as problems that are relevant to learners' lives and interests (Twomey Fosnot et al 2001a, 2001b, 2002). For this study I use Heathcote's definition of authentic as a learning experience that is genuine and purposeful for the participants (Heathcote, Johnson and O'Neill 1984, Montgomerie 2009): the 'making human sense' of Donaldson (1978, 1992).

Twomey Fosnot and Dolk's work (2001a, 2001b, 2002) provides contextual frames or problems in which they situate some mathematics teaching and learning. These are problematic situations that support investigation and inquiry. Another, slightly different example of approaching mathematics through problems is that of Zazkis and Liljedahl (2009) who outline ways of using stories in which to situate mathematics teaching, thereby providing a background to some mathematics, introduce or accompany some mathematics, explain some mathematics or set up a mathematical question (Zazkis and Liljedahl 2009).

Over the past 50 years, debates have ranged between what is termed the ‘traditional’ approach to teaching mathematics and what are seen as more ‘progressive’ approaches (Boaler 2009, Brown 2010). Arguments for the former articulate a fear that any achievement of pupils will be lost if there is a change wholesale to a more progressive approach, which emphasises the autonomy and empowerment of children and schools to make decisions about what and how to teach (Brown 2010). Brown refers to the teaching pendulum swinging back and forth over the years between two positions she broadly characterises as ‘procedural’ and ‘progressive’. She argues that the direction of swing is dependent upon the current social and economic circumstances, with high unemployment tending to lead to an increase in state intervention and a focus on uniform teaching of procedural number skills to suit what is perceived as the requirements of the state. Neither schools nor policy-makers sit outside of the culture and attitudes of the wider society and the tensions within it (Brown 2011).

From the late 1980s there has been a period of considerable upheaval in the teaching of mathematics (Thompson 2010). Central to this was Skemp’s distinction between ‘instrumental’ understanding and a more powerful ‘relational’ understanding (Skemp 1976) as well as Denvir and Brown’s research with 7-9 year olds challenging the learning of mathematics as a linear process (Denvir and Brown 1986). Comprehensive accounts exist of changes to the mathematics education curriculum since the 1980s (Nickson and Lerman 1992, Lerman 2000, Brown 2010, 2011). Broadly speaking there was a general movement from an approach distinguished mainly by dissemination with an emphasis on procedural knowledge and individualized learning, to one where understanding was at the forefront, before a more gradual move towards a more collaborative, investigative approach.

In the next sub-section I examine how these major pedagogical approaches to the teaching of mathematics have been reflected in officially sanctioned developments.

1.1.3 Key curriculum developments in mathematics education

> "*In general, curricula are developed to change education, to introduce new content or new goals, or to teach the existing curriculum according to new insights."*

(Gravemeijer 1994:445)

At any point in history different curricula exist: the 'official', published curriculum conceived by those in power and the curriculum implemented in the different classrooms and age groups and experienced by classroom teachers and learners. Discrepancy exists between what people in positions of power appear to value and what takes place in classrooms, as well as between what teachers do and what they say they do (Askew 2010, Brown 2010, 2011).

Various curriculum initiatives since the introduction of the first National Curriculum in 1989 (DES 1989) have broadly adopted a 'relational' pedagogy emphasising understanding (Skemp 1976, 2006). To a limited extent these initiatives have also placed an emphasis on problem solving but only subsequent to mathematical ‘concepts’ having been taught and understood. The development towards a more collaborative, investigative approach began with the Cockcroft Report in 1982 (DES 1982). Latterly, this was modified to become a more pedestrian ‘using and applying mathematics’ teaching strand in both the National Curriculum of 1999 (DfEE/QCA 1999) and the Primary National Strategy (DfES 2006). Reference to problem solving has been removed from the 2013 curriculum, being mentioned solely in its aims: fluency, problem solving and reasoning (DfE 2013).

The advent of the 1996 National Numeracy Project had a far-reaching effect on the shape and content of primary schools’ mathematics lessons (Brown 2010). With its offspring the National Numeracy Strategy (NNS) (DfEE 1999) and the Primary National Strategy (PNS) (DfES 2006), a whole class taught ‘daily numeracy lesson’ was recommended for primary schools, alongside the provision of detailed planning advice for teachers. The Labour government of the time sought to enforce the advice of the NNS (DfEE 1999) and the later PNS (DfES 2006) by making the guidance appear statutory and by requiring school inspectors (Ofsted) to focus on the recommendations as evidenced in classroom practice during their inspections. Despite the daily, three-part mathematics lesson being a non-statutory recommendation, it became virtually universally adopted by primary schools (Brown 2010). Mathematics became re-defined as numeracy and in addition numeracy was being re-defined as abstract number calculations and routine word problems (Brown 2010, 2011). However successful the implementation of the National Numeracy Strategy, national test results remained disappointing (Brown 2010).

In terms of early years mathematics, since the Hadow Report of 1933 (Board of Education 1933) there has been an emphasis on experience over the acquisition of knowledge. Traditionally, young children were viewed as 'incompetent' mathematicians (Munn 2008) and research into young children's early mathematical development ignored the context in which learning takes place (Aubrey and Durmaz 2008). A focus on young children's abilities rather than their inabilities that began with Hughes' groundbreaking work (Hughes 1986) led to a different picture emerging. However, pressure from a top-down content-driven curriculum for older learners resulted in the introduction of learning goals for pre-statutory school age children in 1997 (SCAA 1997) leading to a series of Early Years Foundation Stage curriculum documents (DfEE/QCA 2000a, DfES 2007, DfE 2012). There is a lack of evidence of what might constitute effective mathematical learning within early years settings in comparison to literacy-based evidence (Aubrey 2003) perhaps due to the fact that the overriding emphasis from early years educators is on young children's social and emotional development (David 1998, Gifford 2005). The influential REPEY research into effective early learning contains no mathematical evidence (Siraj-Blatchford, Sylva, Muttock, Gilden and Bell 2002).

Since the 1980s there has been a development from the more 'integrated' mathematical experiences, which practitioners had difficulty in articulating (Tizard, Blatchford, Burke, Farquar and Plewis 1988) to an increasing emphasis on adult involvement, stemming from the writings of Vygotsky (1933, 1978). Early years teachers are expected to draw on children's prior experiences in teaching mathematics and although research has presented evidence of young children able to operate successfully mathematically in familiar settings (Aubrey, 2003, Hunting 2010, Lee 2010), pre-school children's mathematics learning has been found to be very varied (Aubrey 2003, Gifford 2005, 2010) with enormous disparity in the experiences children bring to school.

Young children learn at different rates and in different ways, through observation, instruction and rehearsal, play and talk (Gifford 2005). Generally, research supports multi-sensory approaches and opportunities for young children to physically experience mathematics (Gifford 2008). Gifford's research identified cognitive, emotional, social and physical processes as being important in young children's learning (Gifford 2005, 2008). The 2008 Williams' review identified building on play; making the most of everyday routines and spontaneous learning; adults that support, challenge and extend children's thinking, and giving children opportunities to record their mathematical experiences as critical elements of effective early years pedagogy. Pertinent to my study is that this report specifically highlights that opportunities for developing mathematical understanding through imaginative play are missed in classroom practice (DCSF 2008b). Over time, these elements have been reflected in different ways and in differing degrees in various curriculum initiatives but these are inconsistent in their observance of the philosophy of active learning and exploration (Gifford 2010). The question of how much mathematical discussion, exploration or sustained play takes place in early years settings remains.

Despite a rapidly changing official curriculum and various detailed recommendations, Askew argues that the decisions teachers make about how to teach mathematics are based on their beliefs, articulated or not, about the relationship they see between teaching and learning (Askew, Brown, Rhodes, Johnson and Wiliam 1997, Askew 2010). Askew et al's (1997) research into effective teachers of numeracy indicates that the beliefs of the teachers surveyed were significant (measured by gains made in average class performance across the school year) in terms of children's outcomes as well as what they did in the classroom. The authors identified three broad orientations to teaching mathematics: connectionist, transmission and discovery and argued that having a connectionist orientation was what seemed to differentiate an effective teacher. A connectionist approach meant dialogue between teacher and pupil was seen as a key way for children to access the mathematical knowledge of the teacher and for teachers to connect with children's understandings. Ollerton (2010) uses a similar distinction when identifying differences in teaching approaches he describes as 'didactic' versus 'facilitating'. Both 'connectivist' and 'facilitating' could be broadly associated with the social constructivist approach, which I discuss further below.

Currently, all the broad pedagogical viewpoints outlined briefly above co-exist in educational practice to varying degrees; at various stages of the educational system, within the same school, within the same classroom on different occasions, or even in the same classroom in relation to what different children are offered. These variations in practice can be seen to be as much to do with how teachers see their role as to curriculum initiatives (Askew 2010). Conflicts exist between what teachers are encouraged to do, such as increase opportunities for children to engage in problem solving, and other Government requirements, such as those for increasing speed and pace in learning typified in timed national tests at age 11, the final year of primary schooling (STA 2013).

The following sections 1.4 – 1.10 examine the main strands of research into how mathematics is learned.

1.1.4 What is known about how children learn?

The main distinction between a cognitive and social constructivist view of learning is that constructivists understand it as a social activity, where children learn about social practices rather than simply ideas (Gifford 2008).

Education as an academic discipline has been dominated by psychology and psychological theories (Wexler 2009) and initially, notions of inherited intelligence led to research being focussed on cognitive factors affecting classroom learning (Goswami and Bryant 2007). Cognitive theories on learning rest on neuro-scientific research into the brain and cognitive research into mathematics education draws on well-established methodologies stemming from psychology. These have been heavily influenced by Piaget's background in the biological sciences and his theory of stages of development (Piaget 1971, 1977, Piaget, Gruber and Voneche 1977) that views learning as an individual's gradual acquisition of knowledge through a series of distinct phases of development. In focusing on the individual, cognitivists have difficulty accounting for the complexities of a classroom or any social learning situation. Piaget later adapted his theories to encompass learning as interaction with the environment and thus contributed to constructivist arguments (Orton 1992).

Donaldson (1978) was significant in bringing into question the conclusions drawn from Piaget's studies and marked the beginnings of an association between learning and social contexts. Her research challenged the dominant theories of the time by demonstrating that pre-school children could not only succeed at Piaget's experiments but were also able to exceed the expectations set by Piaget's levels. Donaldson did this by re-situating Piaget's experiments in a framework and using language that made 'human sense' to the child (Donaldson 1978). Hughes (1981, 1986) built on Donaldson's work and focused his research on pre-school children's number knowledge. He embedded addition and subtraction problems in a concrete context that three-year-olds understood. Hughes found that the physical context not only enabled the children to solve simple calculation problems but they were also able to invent their own number symbols - clear evidence of children constructing their own mathematics. He also identified that a too-early concentration on formal written symbolism contributed to young children's difficulties with school mathematics.

In the 1990s research began to question the separation of *what* is learned from *how* and *where* it is learned (Askew and Wiliam 1995). Situated cognition as it became known, considers knowledge as inseparable from doing and from the context in which it is learned. Thus all knowledge is situated in activity that is bound to social, cultural and physical contexts (Carraher, Carraher, and Schliemann 1985, Lave 1988, Watson and Winbourne 2008). In this analysis learning, rather than being about accumulating knowledge, is about becoming increasingly effective across different situations. From a teaching perspective, it is argued that many pupils find difficulty in transferring and applying skills and knowledge from one context to another, particularly from a tidy, school context to a complex, out-of-school context. It is argued that teaching isolated mathematical content is ineffective and that attention needs to be paid to integrating the concept, the relevant teaching activity and the culture of the classroom (Askew and Wiliam 1995). These were the beginnings of movements to locate theories of learning in social processes, relying on careful observation and experience rather than a narrow focus on empirical findings (Wexler 2009).

What follows is a consideration of some of the key aspects in relation to learning mathematics:

- the influence of constructivism on learning and teaching;
- the role of social interaction and talk in learning;
- affective learning and the roles played by identity;
- the problem with problem solving;
- research into the role played by reflection and metacognition in learning.

1.1.5 The influence of constructivism

At the basis of constructivism lies the belief that new knowledge is largely constructed by the learner and has to become an integral part of the structure of knowledge held by that individual (Orton 1992). During the 1980s, frameworks for interpreting the social foundations of knowledge, as opposed to how an individual learns, began to appear. Social constructivist philosophies into learning questioned theories that considered children's intellectual achievements as solely the product of individual discovery and instead regarded knowledge as something created and shared amongst members of communities, where learners are seen as agents in their own learning. Lerman has referred to these developments in mathematics education research as 'the social turn' (Lerman 2000). Largely as a result of the work of researchers such as Nunes (Nunes and Bryant 1996) who identified the disparity between 'street mathematics' and 'school mathematics' and Lave (1988) who raised questions about the relationship of school mathematics to how people outside of school used mathematics effectively, mathematics began to be understood as a product of social situations (Lerman 2000) and construed as a network of relationships. Mathematics was to be discovered and created by participants through their interaction; as something in which the student must engage (Gravemeijer 1994, Sfard 1998).

The Russian psychologist Vygotsky's work had a major influence on the development of social constructivist theorists in education (Holzman 2009)h. However, as his ideas did not appear in the West until long after they were first written and then only slowly, his influence is complex. Since Vygotsky (1978) there has developed an extensive body of research material into social constructivist approaches to learning (Bandura 1977, von Glaserfeld 1995) of which Howe and Mercer provide a cogent summary (Howe and Mercer 2007). Arguments for regarding mathematics as a collaborative activity, shaped by its participants, as dynamic rather than static have increased since the 1980s (Cuoco, Goldenberg and Mark 1996, Baker, Street and Tomlin 2003). Authors such as Walkerdine (1988, 1998), Klein (2007) and Lerman (2000) understand mathematics as part of the social practices of a community and learning mathematics takes place by participating as a member of a group, a class or a school. From a social constructivist perspective a community of mathematics learners is one where everyone is collaboratively engaged in mathematics. Thus learners flourish where supportive relationships are nurtured both between learners and between learner and adults (Edwards and Mercer 1987, Howe and Mercer 2007, Mercer 2012). Social constructivism rests on ideas of apprenticeship and community. However, critics argue that the classroom is not the marketplace and thus the joint goal pursued by apprentice and master is not always obvious in the mathematics classroom (Ainley, Pratt, and Hansen 2006).

Following on from the innovative work of Papert in developing the computer programming language LOGO (Papert 1980, Steffe and Weigel 1994) Ainley et al (2006) propose the creation of joint goals through the use of computer microworlds as one alternative.

It is self evident that individual learners cannot construct the entirety of mathematical knowledge for themselves and hence it seems pertinent to ask: what environments best facilitate the construction of mathematical knowledge? Mathematical knowing, as Mason J H (2002) suggests, must be about knowing *how*, knowing *that* and knowing *to* apply various facts, procedures and definitions. The learner needs to appreciate each aspect of 'knowing' and the teacher needs to facilitate the necessary connections. A connectionist view of teaching would therefore seem more apt – at the root of which lies discussion.

1.1.6 Talk and discussion

The accumulating evidence is so overwhelming in relation to talk playing a key role in cognitive development and perceptual learning across a wide range of curriculum areas, that talk is now recognised as central to learning by both constructivist and cognitive theorists (Davis, Meyer and Noddings 1990, Wegerif and Mercer 1997, Mercer 2000, Barnes D 2008, Monaghan 2005, 2010, Mercer 2012). However, whereas a cognitivist might focus on language acquisition and on establishing simple causal relationships between the brain and external stimulation, constructivists see the quality of talk and interaction between learners as critical to learning.

The particular elements of talk that support learning have been identified as 'exploratory talk': sharing knowledge, challenging ideas, evaluating evidence and considering options in a reasoned, equitable fashion, where all are expected to contribute, opinions and ideas are respected and considered and agreement is sought (Howe and Tolmie 2003, Mercer and Sams 2006, Wheeldon 2006, Howe and Mercer 2007, Howe 2009, Mercer 2012m). Other researchers have identified the important role talk plays in thinking aloud (Barnes D 2008) as well as conflict discussions or 'argument-in-discussion' (Ryan and Williams 2010) with a shared problem as a focus to begin a productive dialogue between pupils and teacher. Hufferd-Ackles' case study into one teacher's mathematics lessons over one school year pinpoints opening up the classroom to students' ideas as being a critical step in establishing what they term a 'math-talk learning community' (Hufferd-Ackles, Fuson and Gamoran Sherin 2004). Similarly, Monaghan's research claimed exploratory talk was teachable and observable (Monaghan 2005, 2010).

However, research has also found that productive talk of this nature occurs only rarely, if at all, in most classrooms:

> "*Unfortunately, one of the strongest messages to emerge from work surveying classroom activity is that, at least in British primary schools, exploratory talk seldom occurs. On the contrary, much classroom-based talk amongst children is of limited educational value*."

(Howe and Mercer 2007:8)

Aubrey and Durmaz (2008) point out that whilst teaching methods and classroom organisation may have changed, pupil-teacher interaction remains dominated by closed questions and recall. Rather than pointing to a lack of ability in children to engage in such rich conversations, there is evidence that the environment is critical to its occurrence and the role of the teacher crucial (Mercer and Sams 2006). Studies of children's talk in pre-school settings as well as off-task talk amongst older children revealed children using talk in rich ways to make sense of their worlds (Howe and Mercer 2007, Williams 1989). Houssart and Mason (2009) make the case for listening to what children say, do and produce as they engage in mathematics as being an integral part of teaching and imply that supportive environments are required to nurture such contributions.

Linked to this, early years' research has pinpointed adult-child interaction with some degree of 'sustained, shared thinking' as being of particular value in improving a young child's cognitive achievement (Siraj-Blatchford, Sylva, Muttock, Gilden and Bell 2002). 'Sustained shared thinking' is said to occur when, as a result of adult-child conversation attempting to reach mutual understanding, the child's level of thinking is 'lifted'. Siraj-Blatchford et al's research also found that such interactions are uncommon and difficult to generate in early years settings (Siraj-Blatchford et al 2002). Significantly for my research, this study into effective early childhood settings contains no examples of 'sustained shared thinking' in mathematical learning. Part of my research examines to what extent the use of role play scenarios might be effective in stimulating such talk in mathematics and what kinds of adult intervention best supports such talk.

Also relevant is the notion of 'dialogic teaching' as explored by Alexander (2006, 2010). This type of teaching, akin to sustained shared thinking, uses talk to stimulate students' thinking and extend their learning as well as assisting the teacher in diagnosing learners' understandings. Alexander saw dialogic teaching as entailing the following key features: interactions encouraging learners to think in different ways, questions that call for more than recall, answers which are justified and followed up, teacher feedback encouraging extended contributions, discussion which probes and challenges, as well as what he terms ‘professional engagement with the subject matter’ and a classroom climate which cultivates these features. Alexander sought to redefine the pedagogic role of the teacher in classroom discourse (Montgomerie 2009) but the implementation of whole class teaching within the National Strategies (DfES 2006) allowed little opportunity for pupils to engage in extended responses or to express their own ideas in this way. Instead the interactive whole-class teaching that was implemented became vast teacher-led question and answer sessions (Tanner et al 2007). In her post-structural analysis of Australian primary mathematics classrooms, Klein (2007) has argued that classroom practices counteract any perception of learners as authoritative and capable. Her research demonstrates how much teaching-learning interaction often privileges adult control and direction and ignores diversity, which works against the production of confident and proficient young mathematicians and turns learners off mathematics.

“*It is not that the mathematics is difficult but that the learning becomes so because of teachers’ humanist assumptions about learners and the unproblematic application of factual knowledge*.”
(Klein 2007: 318)

By ‘humanist’ Klein is referring here to working with assumptions of individuals as rational and psychologically independent beings. Instead Klein argues that learning is dependent upon learners participating in various environments where participation in that discourse is often conditional on power relationships. A ‘discourse’ defines a community and is understood as the words, practices and rules used to govern and generate that community’s behaviour. The next subsection examines the idea of learning as active participation and interaction between communities of learners all engaged in mathematics together.

1.1.7 Communities of practice

Rather than learning being an individual pursuit, separated from the rest of our activities, from Lave and Wenger (1991), elaborated by Wenger (1998), came the notion of learning and meaning-making as a social phenomenon, interconnected with and inseparable from the worlds we inhabit:

> *“So what if we adopted a different perspective, one that placed learning in the context of our lived experience or participation in this world?”*

(Wenger 1998: 3)

Wenger’s four main premises regarding learning are as follows:

- we are social beings;
- knowledge is competence with respect to valued enterprises;
- knowing is participating in such enterprises, actively engaging in the world, and
- learning is the production of meaning (Wenger 1998).

Wenger emphasised *participation* as an essential part of learning, arguing that as part of our daily lives we belong to many ‘communities of practice’ where learning takes place as we engage in actions and interactions as members of these communities. His is a social theory of learning, embedded in culture and history and resting on connections between social participants.

A mathematical learning community is one where participants share experiences, use the same language to talk about these, work together to establish joint ownership of a mathematical idea and carry out practices with purposes that are connected explicitly with the history and current practices of the community. Participants are able to relate what is taking place with other, linked activities, as part of the joint experience of the group. A mathematical community has to take account of, and make reference to, children's outside experiences of mathematics (Gifford 2008). The 'Maths in the City' project in New York schools (Twomey Fosnot and Dolk 2001a, 2001b, 2002, Dolk and Twomey Fosnot 2004, 2005) is one example of carefully structured support for nurturing participation in a community of practice in a primary mathematics classroom. It focuses on changing teachers' notions of what it means to learn and to do mathematics, viewing learning and teaching as inseparable and the teacher's job as facilitating what they term 'mathematizing', or jointly constructing mathematical meaning.

Hufferd-Ackles et al's (2004) 'math-talk learning community' is predicated on the involvement of students' ideas in the lesson, with the following four features as central:

- shifting questioning from teacher to child, with teacher and child as co-questioners;
- explaining mathematical thinking, with children given opportunities to articulate their ideas;

- shifting the source of mathematical ideas, with children and teacher being the source, and,
- relocating responsibility for learning, with children evaluating self and others, asking questions and participating.

The authors argue that all students at all levels of mathematics can participate and learn in such a community and conclude that, rather than the child altering their behaviour, for example by adopting various ‘rules for talk’, the emphasis is on the adult changing their behaviour in order to increase students’ confidence, enough to take risks.

Learning of this sort is a deeply personal activity, about ‘being and becoming’ with strong links to identity and belonging (Wenger 1998). From this perspective, the learning of knowledge cannot be separated from the learner. What we learn affects and changes us; and how we see ourselves as learners affects how we learn. This is discussed in the following sub-section.

1.1.8 Affective learning and identity

“*Far too many students hate maths.*” (Boaler 2009:1)

“*As they learn about mathematics, children are also learning about themselves – who they are, who they might become*.” (Walls 2009: vii)

Sfard’s (2011) research into what might cause success or failure in learning mathematics defines everything that happens in a mathematics classroom as discourse (Foucault and Rabinow 1984). A discourse thus draws some people together whilst excluding others (Sfard 2008). Sfard's research into latter primary and secondary mathematics classrooms illustrates the interplay of what she terms 'mathematizing' and 'identifying' (ATM 1989, Gattegno 1974, 1988, Twomey Fosnot and Dolk 2001a, 2001b 2002). Sfard's contention is that learners' identities are formed within a community and are contagious. It is the learner's sense of their identity that shapes their success or otherwise in mathematics (Sfard 2011). Similarly, Askew (2008) argues that rather than one's social identity as a learner being fixed, it is a product of the interplay between the culture of the classroom and the relationships that are set up within it. Classroom culture is complex and ambiguous, but refers to the affordances and constraints operating in each classroom. In other words, issues of identity and how we see ourselves are not only significant in learning mathematics but children's learning cannot be understood separately from the classroom context and what happens within it. Social identity became central to Askew's research into why different children in the same class made different rates of progress in their learning (Askew 2008).

Like it or not, mathematics is part of how we define ourselves and as Boaler (2009) points out, many members of our population define themselves negatively in relation to mathematics. Noddings (1984) argues that whilst operating under an ethic of caring, the teacher's task is to receive and accept students' feelings towards a subject as part of their response to what is taught. Her argument is that if we achieve our ends instructionally but the student hates the subject, then we have failed educationally (Noddings 1984). Evidence from the 1999 TIMSS (Trends in International Mathematics and Science) comparing pupils' mathematical competence at 10 and 14 years of age over 40 countries, in both England and New Zealand (a 'higher performing' country) showed students' attitudes to mathematics as declining over their school years (TIMSS 1999, Askew 2008, Walls 2009). As well as being obvious in much anecdotal evidence the link between emotion and learning mathematics has been recognised since the work of Skemp (1977) and Buxton (1981). Lewis pinpoints the cost of ignoring such negative attitudes and experiences:

> *"Apart from what we might call the social consequences, the serious impediment that such a negative affect (or disaffection) creates in the life as lived and experienced by students in mathematics classes is limiting and debilitating."* (Lewis 2013: 71)

Askew et al (2010) found that high-performing countries in terms of international comparisons were as concerned about students' negative attitudes to the subject as those countries that were seen as lower performing. The authors argue that, in an exam-driven culture, enjoyment is achieved through success attained rather than the pleasure of learning in itself. They go on to make the rather disheartening statement that: "*High achievement and pleasure in learning mathematics are difficult goals to reconcile*." (Askew et al 2010: 20).

What makes attitude difficult to study is that it is not a single concept but a complex combination of emotion, belief and social context (Hannula 2002). In a comprehensive review of research into attitudes to mathematics, Goldin, Epstein, Schorr and Warner (2011) point to the complexity of the affective dimension of mathematics learning, involving an interaction of the cognitive, the social and the individual. They describe this as a intricate mix of *emotions* which are transitory, *attitudes* which are cognitive and more stable, and *beliefs* as the most enduring being both affective and cognitive. Walshaw and Anthony's (2008) research linked students' academic outcomes to social outcomes such as the formation of a productive learning disposition, making a positive personal contribution, and student wellbeing. Dweck (1999) has comprehensively examined the connection between confidence, attitude and success in her extensive research into learners from early years to high school. She argues persuasively and surprisingly that, rather than boosting a desire for challenge, success can have the opposite effect. She explains this by stating that highly skilled students are more inclined to worry about failure, question their ability and 'wilt' at obstacles. What Dweck finds important for success is the student's 'theory of intelligence', as this impacts on their ability to thrive on challenge and stick at difficult tasks. For those believing intelligence – such as ability in mathematics - is a fixed entity, challenges are a threat to self-esteem. For those believing intelligence is incremental and can thus alter, it is learning and effort that are valued over outright success (Dweck 1999, 2006).

Linked to these findings, Askew and Wiliam (1995) argue that one of the most important things a teacher can do is to foster a view in their pupils of mathematical ability as changeable rather than something that is fixed. Similarly, Watson, De Geest and Prestage (2003) have pinpointed fostering a 'goal of learning' (rather than completing tasks or 'fitting in') amongst lower attaining students as important for mathematical success.

Related to this, yet contradictory to the notion of a community of practice, is the practice of grouping pupils in terms of their perceived 'ability' for mathematics. This is a controversial area because issues to do with streaming, setting and grouping are linked to personal belief systems as well as to developments in educational theory (Boaler 2004, Allen 2009). ‘Streaming’ is the practice of separating pupils into separate hierarchical groups which stay together for all lessons, whereas ‘setting’ places pupils of similar ability together from more that one class for certain lessons and ‘grouping’, more common in primary teaching, is the formation of separate, often flexible groups of children of similar ability within one class. An increase in arguments supporting the divisive and self-perpetuating nature of setting and streaming in mathematics education led to an increase in mixed-ability teaching in the 1970s and 1980s but the advent of a National Curriculum emphasising academic success meant a return to separating pupils by perceived ability (Boaler 2004). Moreover, there is some evidence that the practice of ‘setting’ has become more common following the implementation of the Primary National Strategies (Marks 2011). Boaler’s (2004, 2009) research into secondary age pupils has found that even when pupils are grouped homogeneously it remains difficult to teach to suit all participants, that pupils did not feel their grouping fairly reflected their ability and the set in which they were placed dictated the opportunities they were offered. Any ‘ability’ grouping can set up expectations for pupils (low or high) from which it is difficult for them to break free (Askew and Wiliam 1995). The labelling associated with being seen as a member of the ‘top set’ or the ‘bottom set’ having a particularly negative effect on pupils’ attitudes towards the subject (Boaler 2004, 2009).

Dweck (1999, 2006) has much to say about how students’ theories of learning are influenced by, and influence how, a pupil achieves, as well as how teachers can affect these, for example by a school focussing on ‘learning goals’ rather than ‘performance goals’:

> "*... with a learning goal, students don't have to feel that they're already good at something in order to hang in and keep trying."* (Dweck 1999:17)

In relation to early years mathematics teaching, Rhydderch-Evans (2003) points out that when we focus on mathematics learning in the foundation stage, rarely do adults put energy into encouraging young learners to develop the necessary skills of resilience and persistence in order to be successful mathematicians. Gifford (2010) argues that open-ended, exploratory and extended activities that are 'unobtrusively structured' and based on observation are likely to lead to the development of positive attitudes to learning. According to Gifford (2005, 2010) the pedagogy of play is important for investigative work in mathematics. However, Gifford also points to the large disparity in young children's pre-school mathematics experiences and to the 'fragility' of the mathematics of some children when they start school (Gifford 2010). She argues clearly that official recommendations for the whole-class teaching of mathematics has built anxiety and exposed these children to failure. Many would agree with Gifford's analysis and have seriously questioned an early start on more formal mathematics teaching, arguing that it has an extremely detrimental affect on both young children's mathematical development and positive attitudes (Pound 1999, Aubrey 2003, Gifford 2005, Carruthers and Worthington 2006, Aubrey and Durmaz 2008, Askew et al 2010).

Self-image is key to children's successful learning (Dweck 1999) and children's views of mathematics are bound up with the variety of social identities that play out in every classroom (Askew 2008). Issues of identity are crucial in whether a learner sees mathematics as relevant, necessary or learnable. Learning changes who we are by changing our ability to participate, to belong and to negotiate meaning (Lave and Wenger 1991, Wenger 1998, Pendlington 2006, Sfard 2011).

Cross (2004) citing Cockroft paragraph 243 (DES 1982) identifies engagement and excitement in mathematics as the most important challenge for educators to address, in relation to both pupils and teachers. Attending to pupil attitude whilst keeping an eye on attainment measured by performance in high-stakes testing is a difficult paradox for schools to address (Craft and Jeffrey 2008). Brehony (2005), discussing the policies of the Labour Government of that time refers to 'excellence and enjoyment' (DfES 2003) as an 'irreconcilable contradiction'. A poor attitude to mathematics affects our ability to operate mathematically as a nation (Boaler 2009). Addressing pupil attitude has led mathematics educators to emphasise mathematical problem-solving over the last 20 years and Boaler (ibid) argues that when 'real maths' is taught (by which she means mathematics involving problem solving, exploring puzzles and creating ideas as well as discussing different ways of working) then many more people are successful and enjoy mathematics. 'Real maths' or problem solving gives learners a flavour of the mathematics we use outside school and of behaving mathematically.

1.1.9 Contextualised mathematics and problem solving

Over recent years there has been much discussion around the contextualisation of mathematics in order to make it more 'meaningful' to learners. This links to research findings of school mathematics as disconnected from people's use of mathematics in the outside world (Carraher et al 1985, Lave

1988) and findings that adults and children are more successful at solving numerical problems in practical situations, often inventing their own methods rather than using methods taught within school (Hughes 1986, Clausen-May and Vappula 2005, Boaler 2009). This was termed 'folk mathematics' by Maier in 1980, in other words, the mathematics that 'folks' do in their everyday lives (Boaler 1993). Partly as a response to the apparent disconnection between school mathematics and the world outside the classroom, aspects of ‘the real world’ were introduced into mathematics lessons and are apparent in the various incarnations of the National Curriculum and its assessment, where a degree of contextualisation has been emphasised (Clausen-May and Vappula 2005).

In terms of early years education, educators such as Bruce (1991) argue that mathematics for young children should not be ‘split off from everyday life’. However, Gifford (2005) argues it is not clear how much mathematics is learned from everyday, ‘realistic’ activities such as cooking and shopping, although daily routines can provide regular practice of mathematics skills such as counting the number of children present for lunch. Carr, Peters and Young-Loveridge (1994) maintain that the ability and willingness of young children to tackle mathematical problems depends upon the interrelationship between the following three factors: how familiar the context, how meaningful the purpose and how complex the task.

There is considerable inconsistency over the meanting of terms such as ‘context’ and ‘real’. Askew (2003) identifies what he terms ‘action problems’ as those having a direct influence on everyday life and as a preferable term to ‘real’. Askew (ibid) also uses the term ‘real’ together with ‘curious’ or ‘believable’ to refer to problems that require something to intrigue, struggle with, to ponder and to solve. Such problems can originate from anywhere, not necessarily the outside, ‘real’ world. Cooper and Dunn (2004), on the other hand define ‘realistic items’ as those:

> *“... which place mathematical operations within contexts including everyday objects, events and people.”* (Cooper and Dunn 2004:70)

The term ‘contextualisation’ encompasses word or story problems, problems in context, ‘real world’ mathematics and ‘real’ problem solving. The first two of these could be categorised as the most familiar, where:

> “*... questions are modelled on situations that children are likely to have met or experienced.*” (Blinko 2007:5)

The popularity of word problems waxes and wanes (Askew 2003) and word problems now exist almost entirely as test questions or test revision. The claim for including contextualized test questions is that these assess pupils’ ability to use and apply their mathematical skills and knowledge. Is there research evidence that the inclusion of context goes any way towards making abstract mathematical problems more accessible? Evidence for the impact of contextualised problems on pupils’ success is patchy but seems to point to pupils experiencing problems in transferring knowledge from the abstract to the concrete and visa versa. Clausen-May and Vappula (2005) report that between 31% and 42% of pupils aged 13-14 years would only solve either abstract or contextualized problems but not both. Blinko (2007) found that primary children were influenced by the ‘friendliness’ of the question and as questions with a context often include a picture, it made these appear more accessible, although some children changed their minds at a closer look!

The ‘everyday life’ on which such mathematics is predicated is questionable. We can neither assume that all pupils have lunched at a salad bar (QCA 2010) camped (QCA 1998) or washed cars (QCA 2004), all examples used to contextualise the English national test questions for 11 year olds, nor can we assume that children identify with these contexts (Boaler 1993). Rather than ‘clueing pupils in’ to routes to a solution, anecdotal evidence of my own gathered over years demonstrates that children find such problems both difficult to access and difficult to answer, despite class teachers ‘training’ them in doing so. Cooper and Dunn’s (2004) research into the unintended consequences of testing the mathematical knowledge of 10-11 and 13-14 year old learners by using ‘realistically’ contextualised items demonstrates that there was both an age and social class difference in their pupils’ abilities to respond appropriately to such test items, with the younger, ‘working class’ pupils more likely to misread the demands of a contextualised test item. This implies that interpreting and answering contextualised mathematics questions is a complex mix of the mathematical, the syntactic and the social (or the three interrelated features identified by Carr et al (1994) of, how complex the task, how familiar the context and how meaningful the purpose).

It is an extremely narrow interpretation of contextualisation when it involves the addition of a simple story or model to aid pupils’ success in answering a question – what Boaler terms the ‘make-believe’ of mathematics questions (Boaler 1993). In relation to both test questions and the addition of quasi-realistic contexts in which to situate the mathematical problem, the issue is not about asking whether these are situations that children are likely to have experienced but rather whether they have any meaning to the children and whether they are *real* problems in the sense there is something to struggle with, ponder and solve (Askew 2003). Askew points out that most problems encountered by current pupils are 'dubious problems' "*... existing only to provide dressed-up exercises.*" (Askew 2003:85). The use of this sort of word problem as a teaching device is rare and Askew's (2005) work on word problems is unusual as it is aimed at the development of children's reasoning skills rather than on answering calculations disguised by artificial contexts.

Pratt (2006) suggests that what is crucial is that children can see how mathematics relates to situations, be they adult, imaginary or purely mathematical. He recommends setting mathematics work in 'problematic contexts', after Fielker (1997), who outlines strategies for turning mathematics into something more purposeful. Ollerton too (2003, 2006, 2010) has tirelessly championed using problem solving and problem posing in a similar way as the vehicle for developing secondary-age pupil's learning and enjoyment of mathematics.

The question seems to be 'real to whom?' Reality and what it means is just as much of an issue in early years education and links to Donaldson's (1978) and Hughes' (1986) creation of problems for young children that 'make human sense'. In Hughes case, the problems were constructed as games and similarly in Gifford (2005). Walkerdine (1988) criticises the 'real life' contexts used in early years classrooms as being meaningful to adults rather than children. Moreover, she argues that the structured play activities commonly offered in early years classrooms are completely different to those experienced outside the classroom. 'Classroom' shopping bears no relation to a child shopping with a parent. A school shopkeeper behind a counter asks what we want, prices are often unrealistic (invented to 'match' the identified learning objectives for number) and the goods, once 'bought' in whole pennies, not requiring change, are usually returned to the shelves. Others have similarly criticised school shopping tasks (Griffiths 2001, Ainley et al 2006). Finally, Walkerdine argues that there can be no such thing as mathematics in context, as mathematics is nothing more than a discourse of mathematicians, in other words, something that takes place between participants in the mathematics community.

On the other hand, initiatives such as Realistic Mathematics Education (RME) (Hough and Gough 2007, Hough 2012) have a much richer interpretation of context in relation to mathematics. RME has as its founding principles, that mathematics must be connected to reality, stay close to children and be relevant to society in order to be of human value. Related projects such as Math in the City describe how context is used effectively in mathematics teaching to create a community of learner mathematicians, as discussed in 1.7 (Towmey Fosnot and Dolk, 2001a, 2001b, 2002). After Freudenthal (2002), who argues that students should begin by mathematizing subject matter from reality and follow this by analysing their mathematical activity (Gravemeijer 1994), Math in the City takes the use of 'realistic' contexts a step further than simply using these to engage learners in some mathematics. Instead, they take common children's experiences as starting points for mathematical exploration, experimentation and questioning. The emphasis in RME is not simply on the 'real world' but on offering students situations that they can imagine, that are real to them and on using these situations to support learning by constructing mathematical models. The Dutch translation of 'imagine' is 'zich realiseren' or making something real in one's mind

(Anghileri 2001). This is a very different interpretation of ‘real’ and would appear to allow for contexts based both on fantasy and on mathematics for its own sake. Ollerton (2010), however, argues that establishing which real-life tasks children might be interested in requires discussion with them. For RME, it is not the case that any ‘reality’ will do in which to locate the mathematics. On the contrary, contexts are carefully designed, researched and developed in order to lead towards what is seen as an important mathematical model.

Contextualised mathematics, real-life problem solving and such similar terms have been interpreted in a variety of ways and more work needs to be done to integrate the solving of problems into most learners’ experiences of mathematics. This forms part of the complex relationship between social practices and mathematics learning. However, another important area is more internal to the learner, that is, the relationship between learning and learners’ reflecting on that learning. The final subsection in this section examines what the literature says about how learning is supported by reflection.

1.1.10 The role of reflection and metacognition

Reflection is seen as a form of mental processing that has its origins in the statement attributed to American psychologist and educational reformer John Dewey: “*We do not learn from experience. We learn from reflecting on experience*.” Dewey defined reflection as:

> “*... active, persistent and careful consideration of any belief or practice in light of reasons that support it and the further consequences to which it tends.*” (Dewey 2004: 6)

Reflection is a purposeful activity where cognition, feelings and emotions about the learning experience are brought together (Flavell 1979, Boud, Keogh and Walker 1985, Robson 2010). Negative or positive feelings about the experience or oneself in relation to the experience can affect learning.

Metacognition and reflection have been considered by many researchers. Moon (1999) points out that one of the defining characteristics of what she terms 'surface' learning is that it does not involve reflection. Boud et al (1985) refer to reflective activity as only being understood by reference to the context within which it takes place and hence it is a social rather than an individual process. They see each individual's thinking as being shaped by the social and cultural context in which it takes place (Boud et al 1985). The authors argue that reflection takes place throughout a learning experience in order to anticipate what is going to happen, to deal with new input as well as to consolidate what has happened with prior learning. It is clear that teachers can neither learn *for* children nor reflect for them (Boud et al 1985). Gattegno's "*subordination of teaching to learning"* (Gattegno 1971: ii) is pertinent in relation to this. By subordinating teaching to learning we shift our attention from the 'what' we teach, to focus on how to enable learners to learn (the 'how'). Mathematics educators have identified the action of 'reflecting' on mathematical activity as an essential element in learning mathematics (Mason and Davis 1987, Mason J H 1982, 2002, 2008a 2008b, Freudenthal 2002). Gravemeijer (1994) for example, talks of students beginning by mathematizing from reality and next analysing their own mathematical activity through reflection. Mason and Davis (1987) talk of reflecting in order to make sense of what is noticed and also highlight that as learners reflect, they shift their awareness from the particular case in hand to a more general mathematical idea by recognising what is similar in "... *apparently disparate situations*." (Mason and Davis 1987:1). Such 'metacognitive shifts' bring learning into conscious awareness. Without this movement, learning from an event does not happen. Mason and Davis (ibid) identify various instruments that stimulate such a shift of awareness, such as 'witnessing' (the presence of someone else) or 'resonance' (a word or image provoking rich past experiences). The 'doing' of the mathematics is not seen as enough; without the reflection, connections to larger themes and other awarenesses are not forged. At the basis of this argument is Gattegno's statement: 'only awareness is educable' (ATM 1989, Gattegno 1987).

Metacognition, a loosely defined term first used by Flavell in 1976 to refer to: "*... one's knowledge concerning one's own cognitive processes and products or anything related to them ...*" (Flavell 1976: 232), otherwise known as 'thinking about thinking', has been identified as a key ingredient in problem solving (Resnick and Glaser 1976, Mayer 1978) and also important in the development of areas such as reading, writing and science (Fisher 1987, 1995). Like Boud et al (1985) Flavell (1979) identified 'metacognitive experiences' as those taking place during an on-going cognitive endeavour. Metacognitive skills include planning how to approach a learning task and monitoring and evaluating progress towards its completion. Flavell (1979) classified two further components; firstly 'metacognitive knowledge' (or awareness) of others and ourselves as cognitive processors; and secondly, 'metacognitive regulation', the control of cognition.

Reflective practice is not seen as something that occurs automatically, but something that needs to be developed in learners. One example is the Campaign for Learning's 'learning to learn' initiative, aimed at developing pupils ability to reflect upon how they learn (Lucas, Greany, Rodd and Wicks 2002). An example of developing early years' reflective practice is the strategy of 're-proposal' used in the Italian pre-schools of Reggio Emilia (Malaguzzi 1993, Abbott and Nutbrown 2001a). Re-proposal is the final part of the three Reggio Emilia principles of *observing* children, *documenting* their learning and *re-proposing* their thinking. It is the act of re-playing or re-flecting learners' thinking back to them. In re-proposal, adult observers choose and note accurately a short piece of overheard child's speech, later reading this back to the child for them to build on and investigate further. Proponents of this strategy are clear that this should be done with no adult interpretation or additional comment thus leaving the space for the learner to think about thinking.

Research into metacognition and reflection in younger children is more recent and includes Whitebread, Bingham, Grau, Pino Pasternak and Sangster's (2007) observations of children between the ages of three and five years of age engaging in a variety of metacognitive and self-regulatory behaviours. They found these were particularly evident when these young children were engaged in self-initiated, unsupervised, small group activities. The authors inferred metacognitive behaviours as shared regulation or planning and motivational monitoring and reflection. They argued that providing opportunities for children to work and play in small groups without adult involvement supports the development of metacognitive talk.

Interestingly for this study, a number of researchers have used video to stimulate reflective discussions with learners (Tanner and Jones 2007, Jones, Tanner, Kennewell, Parkinson, Denny, Anthony, Beauchamp, Jones, Lewis and

Loughran 2009). Tanner and Jones (2007) whilst investigating the effectiveness of interactive teaching through ICT, extended their use of videoed teaching episodes as a reflective tool for teachers, to using video with children between the ages of 5-14 years to stimulate reflection on their own learning. They found that very young children were able to articulate opinions about the ways in which ICT supported their learning. The authors identified four categories of reflection in these pupils with an adjustment taking place in their learning as a result; affective comments, recall of lesson, description of intended learning, and metacognitive comments about their learning. Tanner and Jones (ibid) distinguished between metacognitive skills such as self-regulation and metacognitive knowledge about one's own learning and thinking processes, arguing the latter as a later development and both as being dependent upon the nurturing of reflective teaching approaches within the classroom. Robson (2010) challenges the view that such abilities are later developing as evidenced in her videoed episodes of self-initiated play activities used to initiate semi-structured 'reflective dialogues' with four year-olds. She found extensive evidence of metacognitive and self-regulatory behaviours in children aged three and four years of age, both in the children's activities and later during the reflective dialogues. Griffiths (2011) worked with low-attaining seven to eleven year olds and video recorded her interviews with the children as they worked on some mathematics. She viewed the recordings with the children and found that they could both explain how they worked things out and identify what they had learnt. Griffiths refers to this as Stimulated Recall (SR), an approach used with adults in counselling, medicine, language teaching and sports coaching to encourage recall. Griffiths pinpoints the potential of SR in developing children's skills at recognising when and how they have learnt something.

Of particular relevance to this study, Tanner, Jones and Lewis (2011) researched the extent to which children of five to seven years of age were consciously aware of their thinking processes. They made use of what they termed Video Stimulated Reflective Dialogue (VSRD) where short teaching and learning episodes that had been videoed by the children were used as the basis for conversations about the children's thinking. Although previously the authors had found little evidence of explicit metacognitive knowledge of learning amongst children of this age, by encouraging children to select evidence of learning and thinking by videoing episodes themselves, the authors found these young children were able to demonstrate conscious awareness of their thinking and learning. In other words, the methodology itself encouraged metacognitive articulation as it challenged the children to work at this level (Tanner et al 2011).

IN CONCLUSION

These key issues in relation to mathematics learning have been evidenced from this review of research:

- social interaction and peers sharing understanding through the use of language enhances understanding;
- learners disengagement from mathematics is well documented, at all ages;
- identity plays a critical part in learning.

> *"Danya is already a mathematician" She is not exceptional in this since all children are mathematicians."*
>
> (Hewitt 2000:10)

Whilst there is evidence that all children have the capability of acting as mathematicians and thinking mathematically (ATM 1989, Gattegno 1971, 1973, 1988, Hughes 1986, Hewitt 2000, Williams 1989, 2003, 2006) the picture becomes more complicated when we look at what happens in the classroom and how the political arena affects both mathematics teaching and learning and how we view mathematics. There is support for the argument that a gap exists between theory and practice. Similarly, there is a gap between what we know about what 'works' with children and what actually happens in most mathematics classrooms (Boaler 2009) as well as differences in teachers' interpretations of advice (Askew et al 1997, Askew 2010). My own observations for over 20 years would support this view. Askew et al (1997) found that it was teachers' beliefs about teaching and learning that influenced their effectiveness, rather than the way they organised their mathematics class. Another way of understanding such a gap is through the lens of Freudenthal (Gravemeijer 1994) who distinguishes between *curriculum* development and *educational* development, with curriculum development focusing on the product that embodies the educational change a Government wishes to achieve, rather than on learning processes. As a result, curriculum development is less successful in the sense of affecting practice.

Mathematical achievement is not solely to do with procedural fluency, although this is by far the easier element to assess and track (Askew 2010). Mathematical behaviour and processes could be argued to be a more important indicator of mathematical success (Cuoco et al 1996) as well as the ability to apply knowledge (Pratt 2006, Ollerton 2010). At the same time we are currently struggling to take account of how children feel about their mathematics learning (Cross 2004).

How then, might we provide a different and a much richer mathematical experience for our children (Boaler 2009)? This is the question my research attempts to investigate. Over 30 years ago Hughes wrote:

"*Clearly there is a challenge facing us. We have on our side, however, a strength which is often underestimated: the immense capacity of young children to grasp difficult ideas if they are presented in ways which interest them and make sense to them*." (Hughes 1986:184)

But there is a tension here. In a climate where teachers are expected to plan lessons for children based on a series of statutory learning objectives organised into years (DfE 2013) the children's own interests become less important. It is difficult to see how creative curriculum development can take place if schools are judged simply on test and exam scores. Ainley et al (2006) refer to what they call a 'planning paradox':

"... if teachers plan from tightly focused learning objectives, the tasks they set are likely to be unrewarding for the pupils, and mathematically impoverished. If teaching is planned around engaging tasks, the pupils' activity may be far richer, but it is likely to be less focused and learning may be difficult to assess."

(Ainley et al 2006:3)

My research unpicks attempts in two classrooms to tackle this paradox, by using role play as a way of engaging learners in some mathematics. As background to this, the following section examines current theories on play and the history of role play in education.

1.2 PLAY – A WAY OF LEARNING?

What Gifford (2004b) terms the 'secret garden of play' is a vast area of study and research. It is not my intention to recount the history of play pedagogy, but rather to examine the significant elements of the pedagogy of play that underpin classroom practice, particularly in the early years, in the United Kingdom in the twenty-first century in relation to my research questions. I begin by examining the definitions and characteristics of role play and of play more generally (1.2.1). I go on to consider the arguments and theories relating to the contribution of play to learning as portrayed in educational literature and pedagogy, re-visiting understandings of play generally, locating these in time and social context (1.2.2). I discuss research into the significance of role play for learning (1.2.3) and how role play has featured in the curriculum (1.2.4). Finally, I tease out how theories on play relate to curriculum developments in the early years (1.2.5) and specifically to mathematics learning (1.2.6).

Despite agreeing with Vygotsky that play is a major factor in cognitive development, cognitive theorists remain unclear about the role it plays in learning (Goswami and Bryant 2007). They pinpoint imaginary play as an early form of symbolic activity and the beginnings of a capacity to understand cognition and of self-regulation. They accept evidence that very young children can think logically and abstractly via language, pretend play and imagination but this seems to miss the richness of emotion and involvement felt by players. It is this latter elusive element that I explore here, whilst examining my evidence of role play in Reception and Year Four.

1.2.1 Definitions of role play and play

Role play for education has been known as a method since the 1940s. Its origins are attributed to physician Joseph Moreno, a contemporary of Freud in the 1920s and 30s, who began to apply dramatic improvisation as a treatment for psychiatric patients. He developed ‘psychodrama’, a technique based on Aristotle’s idea of role-play as a therapy providing emotional release (Yardley-Matwiejczuk 1997, Montgomerie 2009) and later modified his approach to help groups address social problems, calling this ‘sociodrama’. The term ‘role’ originates from the rolled script used by actors in Ancient Greece: this script becoming the part, or ‘role’, the actors played.

Definitions of role play encompass a range of activities characterised by participants imagining themselves (or others) as another person in ‘as if’ or simulated circumstances and situations (van Ments 1989, Yardley-Matwiejczuk 1997). During role play, participants are involved in a ‘willing suspension of disbelief’ (Yardley-Matwiejczuk 1997). Whereas other similar play-types (such as fantasy or make believe) might be individual in nature, role play is seen as having a social component. Garvey (1977) views the process of make-believe as a matter of communication between participants and Smilansky and Shefatya (1990, cited by Tucker 2008) define socio-dramatic play as play that requires interaction, communication and cooperation.

> ‘[...] *the shared pretend play between children in which they temporarily act out the part of someone else using pretend actions and utterances.’*
> (Harris, cited by Rogers and Evans 2007:165)

Blank-Grief (1974) distinguishes pretend from ‘in-role play’, arguing role play is a special case of pretend play:

> “*Role play refers to any activity in which the child assumes a distinct identity different from his own*.” (Blank-Grief 1974:387)

In other words, whereas role play involves taking on and speaking from an alternative identity, as in “*Can I help you, Sir*?”, pretend play might not, for example, “*I’m driving to the shop*”.

The common thread in all these definitions is the issue of identity, with echoes of Goffman (1990) who sought to analyse all human social encounters in terms of the adoption of roles with people as players in a dramatic performance. For the purposes of this study, I will define role play as a child temporarily ‘walking in another’s shoes’ (Williams 2006). This may involve players assuming either a separate identity as defined by Blank-Grief (1974) or a separate social position.

Role-playing seems to be a natural part of children’s pretend play that occurs across cultures and time periods. It became fashionable in education as a result of its use in applied psychology and therapy where such simulations focus on behaviours and are usually linked to change. Mann and Mann’s 1956 definition of role play included two aspects, firstly where an individual is asked to perform a role not normally their own, and secondly, when they are asked to perform a normal role but in a setting where it does not normally occur (Yardley-Matwiejczuk 1997). It is the former that has the closest relation to role play as used within education. Players might play themselves, imaginary people or ‘real’ others. Scenarios might be simple, elaborate, familiar or strange. The action might last for moments, or be played out over days (van Ments 1989).

Role play differs to acting in that it does not require an audience or a dramatist’s script but follows a more ‘therapeutic’ route that develops participants’ own ideas and understanding (van Ments 1989). It is this latter element that educationalists have adopted.

In educational literature the phrase ‘role play’ is used interchangeably with the following terms, all of which involve some kind of transformation of identity:

- imaginative play –which may include puppets, toys and small world scenarios. This play might be individual as well as social and collaborative;
- fantasy, pretend play and make-believe – which might be individual or collaborative and has connections to dramatic play and,
- socio-dramatic play – which has its roots in drama education and implies some interaction with others.

Garvey (1977) identifies the following four categories of role play:

- functional roles such as a server of a meal or a car driver;

- family roles; ‘character’ roles, both stereotyped and fictional, where actions and attributes are highly predictable, such as wicked witch or fire fighter and,
- fictional roles with proper names and whose source is stories, television or oral traditions, such as Father Christmas or Doctor Who.

Similarly, Hendy and Toon (2001) distinguish between socio-dramatic play and thematic-fantasy play. They see the former as encompassing activities such as pretending to lay the table or feed the baby and thematic-fantasy play involving the building of fictional narratives and imaginary worlds based on stories familiar to the players.

Literature on role play in classrooms points to an undervaluing of such play in the eyes of both children and adults, with a lack of adult involvement and guidance (Hendy and Toon 2001, Rogers and Evans 2008). Observations of Reception classes in particular have shown role play operating either as a ‘holding’ activity or as a reward, distinguishable and separate from adult-directed ‘work’, and in which adults seldom engage once it is organised. The idea of ‘play tutoring’ was developed by Smilansky in 1968 and included ideas of *modelling*, where an adult joins in with the play, *verbal guidance* to help children develop the story at the heart of the drama, *thematic-fantasy training* where children act out stories where the plot is known to all, and *imaginative play training* to develop children’s make-believe skills through, for example, the use of puppets. Garvey (1977) also argues for tutoring by an adult to help children elaborate on make believe play by providing role-playing models, proposing imaginative situations, and using ‘evocative toys’ or objects to suggest a particular activity.

As for child play more generally, despite a broad agreement on its value in both psychological and educational circles, there is little agreement on either the definition or characteristics of play. Piaget defined play as:

"... a behaviour used during the development of children to learn about their environment which produces enjoyment." (Piaget 1951)

Piaget's definition links play and learning and identifies enjoyment as the main result. Similarly, Eibl-Eibesfeldt defined play as "*... an experimental dialogue with the environment*" (Eibl-Eibesfeldt 1967:31). Bruce's definition of play is as something that is self-initiated and spontaneous (Bruce 1991, 2001). All these definitions understate social or imaginary aspects of play and contrast with Broadhead (2004) and Garvey (1977), who emphasise the social nature of play from its beginnings:

"... play with others is primary." (Garvey 1977:14).

Hutt (1976) sees play as encompassing a heterogeneous assortment of activities from the physical cavorting of young animals to the ritualized games of human adults. Hutt (Hutt 1976, Hutt, Tyler, Hutt and Christopherson 1989) distinguishes between exploration (or investigation) and imaginative play; between children playing to discover 'what does this *object do*?" and playing as in: 'what can *I do* with this object?' although she states that it is difficult to distinguish the two in the very young.

Perhaps it is more useful to consider some characteristics of play, the most often stated being that play is undertaken for its own sake because it is enjoyable, having no extrinsic reward or purpose, ‘uncoupled’ from the usual consequences:

“*Play is to a considerable extent, revocable*.” (Garvey 1977: 32).

Garvey’s (1977) analysis of play makes reference to the repetitive, systematic and rule-governed nature of child’s play. She identifies four descriptive characteristics of play:

- pleasurable, enjoyable; valued by the player;
- no extrinsic goals, it is more an enjoyment of means than devoted to a particular end; it is inherently unproductive;
- spontaneous and voluntary, freely chosen by the player and,
- involves some active engagement on part of the player.

This is not an unproblematic analysis, however. If play has no extrinsic goals, where might this leave playing on a bicycle until one rides unaided? Hewitt (2000) refers to this as children working to achieve ‘mastery’ (often obsessively) in order to acquire the skills they need in order to take on future challenges. Perhaps this is not play at all? Sylva, Bruner and Genova’s (1974) definition encompasses product and goals:

“*The essence of play is the dominance of means over ends. This is not to say that play is without goals – witness the toddler building a tower of blocks – but in play the process is more important that the product.”*

(Sylva et al 1974: 244)

Whilst it may be that it is the process of playing that is of chief importance to the participants, this is not necessarily the case in competitive sporting events, which are also described as play. What we consider to be play is contextually and culturally dependent, variable according to time and participants. Seeing two grown men chase each other would be viewed differently from seeing two children doing the same thing. Sutton-Smith's (1988) review of research into weapon play (of which five of the eight studies found exposure to war toys having some effect on boy's aggression) argues these were flawed as the researchers failed to distinguish between play-fighting and real aggression. Holland (2003) argues that what we recognise as play and not-play is influenced by our values.
On these terms she challenges the 'zero-tolerance' approach to play-fighting common in early years settings over the last 30 years, analysing the origins of such intolerance and explaining this in terms of wider social issues such as the history and attitudes of teachers sympathetic to the women's peace movement, for example. In common with other cultural norms, play cannot be neutrally interpreted (Sutton-Smith 2001).

Can all that young children do together be termed play? Is it possible to distinguish between a child who is playing and not playing? Hutt's (1976) distinction between children investigating and their more playful responses seem similar to Hewitt's (2000) reference to 'toys being tools for learning' rather than objects for enjoyment for his young daughter. Brown (1996) draws similarities between healthy work, seen by the participant as enjoyable, purposeful, creative and rewarding and the characteristics of play. It seems that children can accurately distinguish between play and not-play, fantasy play and reality (Holland 2003) while Garvey (1977) highlights that children are able to say whether they are playing or not by the age of three. Whilst play is often social, requiring some rules and containing some degree of repetition, children's definitions of play seldom contain the characteristics identified by adult educators (such as progress or improvement) indicating that what is developmentally important for an adult might be simply play from a child's point of view. Significantly for my thesis, I agree with Garvey, that:

> "*All play requires the players to understand that what is done is not what it appears to be*." (Garvey 1977:13).

The term 'play' remains an ambiguous and 'slippery' concept (Sutton-Smith 2001) it can be said to encompass a wide range of occurrences from the very private (mind play) to the very public (competitions or performance). As a word neither clearly defined nor globally understood by practitioners nor policy makers (Moyles 2010) this has lead to many different construings of the term 'play' in relation to children learning examined below.

1.2.2 Theories regarding the contribution of play to learning

The origin of toys is prehistoric and children's toys and games have been found in every culture throughout time (Layne 2008). British philosopher Locke (1632 – 1704) initiated a gradual change in attitude from that of children as miniature adults expected to occupy themselves, to a more liberal position viewing childhood as valuable in its own right, along with an acknowledgement of a child's right to play (Locke 1689).

Although there is literature arguing that play is good for all as it activates many neural pathways simultaneously (Brown and Vaughan 2009) it is within early years education that arguments regarding play being a ‘good thing’ proliferate. Since the 19th century play has been linked to supporting young children’s learning. The idea that play is beneficial for children’s well being, social adjustment and their intellectual and creative development (amongst other cognitive and social phenomena) is now well entrenched in early years pedagogy. ‘*Play is the child’s work’*, attributed to psychoanalyst and social reformer Susan (Issacs 1933) and her catalogue of observations at the Malting House School was influential in shaping attitudes to early years education (Urquhart 2008). Educational theories of play stem from research into animal play where play is seen as necessary for both individual and group development in that it contributes to necessary skills, rehearses adult behaviour, or adapts the organism to its surroundings (Garvey 1997, Bruce 1991, Jarvis 2010). It was German educator Froebel (1782- 1852) who developed the view that play was the highest phase of children’s development and his idealisation of play continues to influence pre-school education. Froebel’s is a rhetoric that believes in the possibility of the development of moral characteristics and understanding through play activity and through play with a collection of objects (The Gifts) as symbols of cosmic perfection (Brosterman 1997).

But it is the influence of Piaget’s separation of children’s play into three - increasingly sophisticated – stages, together with his theory on stages of development (Piaget and Inhelder 1969, Piaget 1971, Pulaski 1971, Piaget, Gruber, and Vonëche 1977) that has had a widespread influence on education. Instead of a focus on the value or role of different play-types on learning, play was categorized by age and young children's play depicted as relatively unsophisticated. Piaget's saw the three stages of play as beginning with '*sensory motor play'* dominant in the first two years of a child's life, through '*symbolic or representational play'* foremost between the ages of 2-6, and finally to '*games with rules'* that become central in later childhood. From Piaget to Broadhead et al in 2010 children are portrayed as progressing through various stages of development towards more highly complex and powerful modes of play. Examples of stages of play development include Broadhead's (2004) 'social play continuum', Sutton-Smith's (2001) 'play-scale' and Smilansky's (1968) cognitive stages of play. Arguably the most pervasive of these educationally is Piaget's and although his theories have been well critiqued they have a continuing influence. It is notable that stemming from Piaget's psychological analysis, every curriculum initiative to date relies on a sequential view of children's development. This is apparent through the national adoption, (via curriculum documentation) of terms such as 'stage', 'level', 'phase', 'period', 'step' and 'scale' (SCAA 1997, DfEE 1999, DfEE/QCA 2000a, DfEE/QCA 2000b, DfES 2007, DfE 2012).

A more recent piece of research reinterprets play-stages and classifies types of play that may be preferred by different ages of child. Evaldsson and Corsaro (cited in Freebody 2003:75) found that 5- and 6-year-old Italian children preferred improvisational play, whereas pre-adolescents displayed a preference for games. They argued that games with rules are overly demanding of young children's cognitive skills whereas overt rules protected older participants from potential embarrassment. Whilst I would argue this has some welcome flexibility, in my experience it depends what we interpret as 'improvisational'. Many adolescents currently enjoy improvisational games in virtual environments and the improvisational games of younger children involve invented, complex rules. Paley, a North American kindergarten teacher for over 30 years, implies a looser notion of stages of development as more appropriate for young children:

"To imagine that the purpose of early childhood education is to re-order the stages of human development is like the story of the prince who was turned into a frog. In attempting to turn children into creatures that are unchildlike, we ignore all the messages children give us as they play." (Paley, 7th May 2004b)

In an attempt to expand what play is and might be to different people at different times and in different places, Sutton-Smith (2001) identifies seven 'rhetorics of play':

- '*play as progress*' – the language of modern day early years education;
- '*play as fate'* - games of chance;
- '*play as power'* – sports and contests;
- '*play as identity'* – traditional community celebrations;
- '*play as the imaginary'* – some kind of transformation as a characteristic of play;
- '*the self* ' – solitary, escape activities and,
- '*play as frivolous'* – a negative rhetoric of fraudsters.

By 'rhetorics' Sutton-Smith means a persuasive discourse adopted by group members to convince others of the authenticity of their beliefs. He uses 'rhetorics' (plural) to imply variations in understanding of terms and within education there is a range of understandings of the nature and value of play. Some question why rhetorics of 'play as progress' have become so entrenched, particularly in early years' discussions. Walkerdine (1984) argues that developmental psychology is a historically specific idea. She outlines a political analysis of the play rhetoric as producing rational, well-adjusted adults. Her argument, that certain historical conditions make certain things possible, charts Piaget's adoption into primary schooling, leading to pedagogical practices being saturated with notions of a sequence of child development. Walkerdine (1984) charts the growth of child development as a science, relating this to the move from moral education to education for understanding and freedom. She sees the emphasis on nurturing the child as a 'free' being as stemming from a reaction to what happened in Nazi Germany between 1939 and 1945. And so, children's play theory developed from this objective of nurturing freedom. Sutton-Smith (2001) argues that modern western society is unlike the wider world where inter-dependence and obedience are often valued over individuality and variability. Instead of play being to do with inclusion, belonging, membership and tradition, modern western society promotes children's independence in imaginative play and object play above other play types. Sutton-Smith (2001), too, argues from a social-historical perspective that with the advent of the Industrial Revolution there arose a desire within Western society for progress and improvement. This was backed by Darwin's theory of evolution, where every organism strives for improvement. Gradually a belief began to develop that progress was achievable. Children became increasingly separated from the world of work and were gradually seen as a separate social group. Childhood and adulthood were seen as separate states and a division arose between how play functions for an adult and for a child. Play was seen as necessary for children's growth, as a necessary activity that immature adults 'pass through' on their way to adulthood. Howe1ver, adult play was 'time off work' and therefore unproductive for adults. In support of this, Sutton-Smith (2001) points out that adults in Western societies often call their play activities by another name (e.g. hobby) as if it is uncomfortable to refer to these as 'play'.

Vygotsky (1933) saw the influence of play on a child's development as enormous, with play creating a 'zone of proximal development' (the difference between what a learner can do without help and what he or she can do with help). Around the same time as Vygotsky's theories were being introduced to the West Bruner established the importance of play to language acquisition and for socialisation through a series of influential case studies of young children's talk whilst playing (Bruner, Jolly and Sylva 1976, Bruner 1983). Cognitive theorists, although acknowledging play is a major factor in children's cognitive development, remain unconvinced about its precise role in learning. Howard (2010) states that despite decades of research, it remains difficult to isolate the benefits of play from other causal determinants such as the wider repertoire of children's activities.

There is strong support for the notion of play giving expression to both children's and adults' concerns over power and identity (Walkerdine 1981, Holland 2003, Paley 2004a, Gifford 2005). Walkerdine (1981) for example, portrays play in the early years as a 'site of struggle' and of inclusion in (or exclusion from) a group. Rhetorics of 'play as progress' often ignore young children's concerns about power, control and identity; their identities as five-year-olds, as siblings, as friends, as a girl or boy, as members of a class, a school or a group, self-chosen or adult-devised. Children's interest in belonging can be seen as part of Sutton-Smith's (2001) 'rhetorics of identity', where play is a form of bonding, membership and tradition. Much of Sutton-Smith's research from 1953

– 1994 was into the role of power in children's games. He argues that what children do whilst they play derives from their relative disempowerment in relation to adults. This is also a dominant theme in children's literature. During play they can be autonomous as they cannot be anywhere else, in a world where there are increasingly few havens from adult supervision. Palmer (2007) in her 'toxic childhood' analysis, cites being away from adult supervision as one of the two criteria always mentioned by adults regarding their own memorable play (the other being outdoors).

Criticisms of the view of children's play as causing positive developmental outcomes are mainly methodological. For example, increases in scores following play training by adults owing as much to the changed (new and special) relationship between the teacher and the child as to the play forms introduced - termed the 'tutorial stimulation effect' (Sutton-Smith 2001). It is noteworthy that these experiments rarely involve substantial play but instead study play under experimental conditions. Paley's work on the other hand, describes and analyses the engagement, depth of thinking, spoken and written language development of four- to six-year-olds whilst engaged in the development of dramatic play supported by adults in classroom situations over time (Paley 1981, 1984, 2004a).

How we see play depends upon from where and when we speak. In one sense our use as educationalists of the term 'play' has been reified (Wenger 1998). We project our personal understandings of how the world works onto the term and behave as if 'play' has a universally understood reality. What follows is an examination of the origins of role play in educational literature.

1.2.3 Role play, imagination and learning

Imaginary play was first recognised as significant at the time of the romantic movement at end of the 18th Century when the imagination was seen as a way of grasping truth, and play as involving the imagination (Sutton-Smith 2001). Kant for example (1724 -1804) argued that imagination mediated between sensory knowledge and formal reasoning. As children play, they posit 'as if' conditions and exercise aspects of their identities in a range of situations. In this sense they are 'researching' their effect on others and their reactions as they make-believe (Yardley-Matwiejczuk 1997).

Garvey (1977) distinguishes what she calls 'play with social materials' as a distinct play form and incorporates socio-dramatic or thematic play under this heading. She states that:

> *"It is unlikely that much well-formed pretend play appears before the age of three, and it is generally thought to diminish before adolescence."* (Garvey 1977:80)

Such imaginative play entails a 'suspension of literalness' (Garvey 1977) where partners must recognise that a state of play obtains in order to interpret and respond correctly to the behaviour of others. Somehow each involved actor has to signal to the others, either covertly or overtly, what the game is, what part they are playing and what part(s) they wish the others to play. Props, clothing and voice can act as 'signifiers' that can be interpreted as signalling that this is play. On many occasions I have heard children check or adjust the state of play by saying:

"I'm not playing", "Only pretend, right?", and even, "*Are you hungry for real*?" (Reception child to HW in 'Dinosaur café', March 2012).

According to Garvey (1977) play that incorporates plot and story line is a reflection of a child's developing notions of the world with children often acting out what later become their made-up stories. The idea here is of play flowing into literature. This links with the work of Paley (1981, 2004a) who makes the case for the critical role of fantasy play in the psychological, intellectual and social development of the young child. She argues that through their development of character and plot children explain their thinking and construct meaning and champions using this approach to support children's learning. Smith (2005) critiques Paley's argument as based on advocacy rather than evidence but Paley's view is summarized in the following sentence:

> *"... fantasy play is the glue that binds together all other pursuits."*
> (Paley, 2004a:8)

As well as having a range of social advantages for pupils (such as the expression of feelings, empathy and the re-examination of attitudes) Van Ments (1989) argues that role play gives: "... *life and immediacy to academic descriptive material* ..." (van Ments 1989:25), and that any material, historical, political or social, can be illuminated by simulation. Its value is in *experiencing* something rather than simply reading or hearing about it, as experience triggers understanding and change. Drama has been positively associated with children's literacy and language development for a number of years (Cremin and Pickard 2009). Role play, with its emphasis on communication, has been linked positively by a number of naturalistic studies to the development of children's language and social skills (Montgomerie 2009).

There are clear links between story-telling and imaginative or socio-dramatic play as they both build on children's capacities for fantasy and aid children's developing understanding of themselves and the world around them (Bolton 1979, van Ments 1989, Heathcote and Bolton 1999). Brown and Vaughan (2009) talk of the brain 'lighting up' during a child's dramatic play, as it combines children's motor skills, language, emotion and memory as well as important abstract themes such as 'goodies and baddies', power and loyalty. This has associations to 'episodic memory', a term first used by psychologist Tulving in the 1970s, which distinguishes between *knowing* as factual and *remembering* as a feeling associated with a past event (Goswami and Bryant 2007).

Theorists have pinpointed imaginary play as an early form of symbolic activity (Vygotsky 1933) and the beginnings of a capacity to understand cognition and self-regulation. There is evidence that fantasy play nourishes the growth of cognitive, narrative and social connectivity in young children (Paley 2004, O'Neill, Pearce and Pick 2004, Baldock 2006) and some evidence that fantasy is a pre-disposition linked to creativity (Garvey 1977, Bruner 1986, Baldock 2006). Singer's (Singer 1973, Singer and Singer 1990, Singer, Golinkoff and Hirsch-Pasek 2009) research into children's pretend play linked such play to the development of the 'narrative mode' of thinking identified by Bruner in 1986. For some years, 'narrative cognition' has been argued to be an important means by which we come to understand the world (Bruner 1990) and O'Neill and her colleagues (2004) claim that very young children's narrative story telling is a predictor of later performance in mathematics. They posit that reasoning about abstract mathematical relationships may be no different from reasoning about complex human relationships.

Others have questioned educational claims made for role play saying that its benefits are overrated - it takes time and reduces the control of the adult over what is learnt (van Ments 1989). Sutton-Smith (2001) points to the fact that much play, both adults' and children's, is repetitive. If play is a source of flexibility and innovative behaviour, how is it that so much can be banal and repetitive? Holland (2003) talks of the amount of repetitive superhero play that takes place in early years classrooms (a form of imaginative play in which children imitate popular media superheroes). Indeed it could be argued that repetition is one of the most enjoyable aspects about play. Repetitive play could be said to be about escape, or control and mastery rather than innovation (Barnes 2008)b.

Perhaps play in general opens up the possibility of thought, rather than leaving actions embedded in instinct. This analysis implies opportunity, rather than rehearsal or innovation, as a function of play. Sylva et al (1974) designed a task to see if prior play with objects affected child's ability to solve a problem with these same objects. They concluded that prior experience of free handling was more effective than watching an adult demonstrate because only then did children initiate the solution themselves. In short, problem solving requires self-initiation. In addition Sylva et al (1974) found participants had a more relaxed attitude to the task and thus were able to continue without fear of failure. This seems to connect with Paley (2004a) who pinpoints fantasy play as mankind's "*...best-used learning tool"* (Paley 2004a:8) because the pretend element makes situations dependable, controllable and thus risk-free for young children. It is this very element that might make play, and being playful, influential in developing positive attitudes to mathematics (Gifford 2005, Brown 1996), a theme that will be considered in 1.2.6.

1.2.4 Process drama

Role play as a teaching method has its roots in the early psychiatric practice of the 1920s and is widely used in psychology as it allows for the infinite manipulation of time and space (Yardley-Matwiejczuk 1997). A facilitator framed a situation for participants to prompt ‘cognitive dissonance’ thereby encouraging an individual to act differently (Yardley-Matwiejczuk 1997). These ideas influenced school drama practice and were fed by Vygotsky’s social constructivist view of learning. Vygotsky’s notions of the centrality of play, social interaction and language to learning (Vygotsky and Kozulin 1987) formed a fertile environment for the work of Heathcote, Bolton and O'Neill, chief theorists in educational drama from the 1970s (Bolton 1979, Heathcote and Bolton 1995, 1999). Their view of drama and role play has been influential and a summary follows.

Heathcote’s belief in drama as a powerful learning medium led her to develop ‘process drama’ where students and teacher work in and out of role using drama (or fantasy) to consider reality, rather than the emphasis being on producing plays. Rather than stressing story and character, Heathcote sees drama as the rehearsal of new or unsettling experiences in our minds (Wagner 1999). A contributory factor in the popularity of this approach might also have been a growing awareness of the innovative work of Stanislavski on the naturalistic approach to acting. ‘Method acting’ or ‘The Method’ became popular in the 1950s and 60s in response to what Stanislavski saw as the rigid performances common in theatres at the time. The essence of Stanislavski's method acting is the actor situating him or herself at the centre of the imaginary world, actively engaging in and observing the world from that position and generating behaviour from their own experiences (Yardley-Matwiejczuk 1997). Similarly, Heathcote pioneered an approach to learning *through* drama, with the starting point usually from one area of the curriculum. Prominence was given to problem solving by the participants acting out and thus 'living through' a particular occasion or point in time. We can see threads of Heathcote's process drama in Paley's approach to developing young children's natural fantasy play and story-telling by adult-as-director together with children-as-players to dramatise the young child's play-stories (Paley 1981, 1990, 2004a).

For both Heathcote and Bolton (1995, 1999), drama has its roots in play, as something evoked rather than directed and they equate the intervention of the adult in drama to that in children's play. Heathcote's drama pedagogy has the teacher teaching the whole class as one unit, with both teacher and children moving in and out of role, acting-in-role to develop emotion and out of role to achieve distance, reflection and objectivity. Heathcote's approach was seen as 'child centred' as it allowed for open-ended responses from children that are supported and developed by the adult. This image of an adult directing the learning draws substantively on Vygotsky's 'expert-novice' and 'scaffolding' learning (Vygotsky 1933, 1978, 1987).

Encouraging children's reflection on their dramatic experiences was an essential element of Heathcote's pedagogy and took place after a drama session. Heathcote coined the term 'dropping to the universal' to describe the point at which children make connections between the experiences of the drama world and those of the real world (Heathcote et al 1984, Heathcote and Bolton 1995, 1999). Heathcote criticised schools for transmitting 'dead knowledge', demonstrating her social constructivist perspective. Heathcote pioneered the idea of children working collectively in role to explore a range of perspectives on human life. She developed the approach of 'mantle of the expert' where children take on expert roles within a drama, working 'as if' they are authorities in a situation (Heathcote and Bolton 1995, 1999). Wearing the 'mantle of the expert' children became agents in a drama working together to meet a client's fictional needs, for example, designing a community garden for a hospital at the request of a Health Authority (Heathcote and Bolton 1995).

Montgomerie (2009) suggests that process drama as pioneered by Heathcote and developed by teachers like himself:

"... opens a way for participants to bring their individual understandings and experiences to new dramatic situations." (Montgomerie 2009:34)

This analysis links to my view of role play as a way of bringing children's own mathematical experiences to the fore in order to further their understandings. The next section (1.2.5) examines the ways that arguments about the significance of children's play have influenced the classroom.

1.2.5 Play in the classroom and in the curriculum

Despite the Hadow report (Board of Education 1933) signalling a transformation from a primary school curriculum consisting of knowledge to be acquired and facts to be stored, to one thought of in terms of activity and experience, play as a pedagogical approach has not featured in the curriculum of the primary school years. Therefore the discussion that follows refers to the early years, pre-statutory education and the tension (possibly conflict) that exists between 'play' and 'the curriculum' which is particularly relevant to this study.

Vygotsky's oft-quoted statement can be said to lie at the heart of the early years' education of modern western society:

> *"... in play a child always behaves beyond his average age, above his daily behaviour; in play it is as though he were a head taller than himself."* (Vygotsky 1978: 102)

The first curriculum for non-statutory school age children, introduced in 1996 (SCAA 1996), demonstrated a recognition of the early years as a critical period for learning and the importance of research into child development (albeit somewhat misinterpreted). This curriculum outlined the 'what' and 'how' of teaching by identifying six, inter-related areas of learning and suggesting activities such as rhymes, songs, stories and counting games to achieve these (SCAA 1996:11). The six early years curriculum areas of *personal and social development*, *language and literacy*, *mathematics*, *knowledge and understanding of the world*, *physical development* and *creative development* have remained largely intact to date. By 2000, the original six curriuculum areas had evolved into a dedicated Foundation Stage curriculum for children aged between three and five years (DfEE/QCA 2000a) and latterly into the Early Years Foundation Stage curriculum (EYFS) (DfES 2007, DfE 2012) with play became identified as its keystone:

"Play underpins the delivery of all the EYFS." (DfES 2007:07)

Despite statements such as these, within these policy documents there exists a tension between curricular and children's interests - the EYFS (DfES 2007, 2012) refers to play through 'planned purposeful activity' - as well as between official recommendations and early years' theorists, and between early years' theorists. The most effective play identified by the Effective Pre-School and Primary Education Project (EPPE) was charaterised by staff encouraging children to engage in 'academic' activities (Siraj-Blatchford et al 2002, Sylva Melhuish, Sammons, Siraj-Blatchford and Taggart 2004) but for Moyles (2010), who sees play as antithetical to outcome-based education, there is a problem with such activity:

> "*... it risks confusing the plans and purposes of adults relating to their goals for children's achievements with the authentic, but different, intentions of playing children*"
> (Moyles 2010:xi)

Wood (2010) contends that from the perspective of Government documents, play is seen as what it does for children rather than what it *means* for children. In short, play, with an emphasis on the responsive approaches of an adult to children's interests is not seen as compatible with an educational goal of knowledge acquisition. Rogers and Evans (2008) distinguish between play in school and play 'as such', where:

“*... play in school engages with contexts beyond play as such and this is a central distinction in meaning*.”

(Rogers and Evans 2008: 74)

The authors argue that their project children recognised the positioning of school role play in learning, which was often prescribed by curriculum objectives rather than children’s interests.

At the heart of the play / work tension lies how educationalists see the role of the adult in children’s learning. For educationalists from a child-centred pedagogy, play is initiated by the child and adults must have little to do with its direction or control (Bruce 1991, 2001, Moyles 1989, 2010). Moyles (2010) for example, describes play as flexible, creative and always under the control of the learner. It is the issue of control that leads to the most confusion in early years education, as described below.

Both Vygotsky and Bruner identified the role of the adult (through ‘scaffolding’) as critical in effective learning (Tucker 2008). Others (Manning and Sharp 1977, Siraj-Blatchford et al 2002, Sylva et al 2004, Broadhead 2004, Wood 2010) pinpoint the critical role of the adult, although to differing degrees and in different ways, in sustaining and developing young children’s play and progressing children’s understandings. At the end of the 1970s Manning and Sharp (1977) provided evidence for a more effective ‘structured’ form of play which for many practitioners was a new idea. Such play, involving teachers’ aims and intentions, was not seen as child-centered enough and here lies the rub for early years educators. Wood (2010) epitomizes the position by stating that if the plans of adults are privileged over those of children:

> *"... they will not really be play (though it may retain some playful elements such as positive affect, imagination and flexibility).*" (Wood 2010:16)

The situation is 'either – or' rather than allowing for different types of play taking place at different times with differing levels of adult intervention. Manning and Sharp's (1977) argument remains controversial as the authors state that *all* children's play must involve adult participation in order for cognitive development to take place. Bruce (2012) provides a more measured view:

> *"Children lead their own learning through play. They will also appreciate support and help in exploring and being offered new experiences, providing these are not forced upon them."*
> (Bruce 2012:14)

Similarly, the EPPE and REPEY studies (Siraj-Blatchford et al 2002, Sylva et al 2004, 2010) draw attention to the delicate balance of roles of the adult in early years' learning, distinguishing between the 'pedagogical interactions' of adults and children and 'pedagogical framing', which they describe as 'behind the scenes' aspects such as planning and resourcing:

> *"Our findings suggest that the most effective (excellent) settings provide both and achieve a balance between the opportunities provided for*

> *children to benefit from teacher-initiated group work and the provision of freely chosen yet potentially instructive play activities.”*
> (Siraj-Blatchford et al 2002:43)

The authors identify ‘sustained shared thinking’ as only achieveable when the child is actively engaged, motivated and involved.

Problematic for educationalists is the assertion that all play, in order to be termed ‘play’, has to be voluntary, spontaneous and freely chosen by the player (Garvey 1977). This brings into question whether classroom situations such as number games introduced by an adult (or indeed any play initiated or planned by adults) can be defined as play:

> *“Play behaviour is self-initiated. The sulky child forced to ‘play’ a maths game by his teacher is not really at play.”* (Sylva et al 1974:245)

Perhaps maths games are not play and this does not matter. What might matter in terms of motivation and children’s connection with them is that they are ‘playful’ in nature (Gifford 2005).

The belief that for an activity to be identified as play it has to be spontaneous and freely chosen by the player, reaches to the heart of all discussions about play in the early years. It has even led to recommendations of how much time should be spent on child or adult initiated activities, as if these are identifiable and disconnected events. For example, this confused paragraph in the Times Educational Supplement:

<u>"How much time to play?</u>

Sue Ellis of the National Strategies is keen to dispel the myth that children must spend 80% of their time playing. The idea arose from the EYFS assessment document which states that evidence should come 80% from child-initiated and 20% adult-led activities. But there is no such rule. Basically one-third of the day should be spent on adult-initiated and two-thirds on child-initiated activities, half of which is spent playing alongside adults."

(*Times Educational Supplement* March 2009)

An attempted distinction between 'adult- or 'child-initiated' activities (DfEE/QCA 2000a:11, DfES 2007:11) as well as a lack of clarity over terms like 'child initiated' and 'child directed' may have prevented sufficient attention being paid to the nature and quality of the interaction between adult and child as, forexample, described in the EPPE project (Siraj-Blatchford et al 2002, Sylva et al 2004, 2010). Despite plenty of evidence of adult input putting a stop to play (Holland 2003, Siraj-Blatchford et al 2002, Rogers and Evans 2007) Gifford (2005) gives examples of adults being both playful and effective in mathematics teaching. Wood (2010) makes a salient point in relation to this:

"*... the more frequently adults observe and engage in play where children control the activity, the easier it becomes for them to encourage playfulness in activities that are more structured."* (Wood 2010:16)

It is clear that play has an affective dimension as children are highly motivated to play and most do so without any adult encouragement. Thus those who work with young children use play to facilitate their own interventions, often as a reward for pursuing something else, such as non-play, teacher directed activities or ‘work’ (Wood 2010). Howard (2010) states that young children see a clear distinction between play as their self-initiated activity and work as teacher presence or direction.

Although there may be a recognition that play can aid learning prompting a desire amongst practitioners to incorporate more play or child-autonomy into learning, this requires the transfer of control from the adult to child. Ainley et al (2006) refer to the inherent tension in the process of teaching and learning as a ‘play paradox’. This is a particularly difficult transfer in a climate where policy-makers emphasise knowledge acquisition, the covering of learning objectives, and the meeting of targets rather than empowering learners. Related to this, Sutton-Smith (2001) claims that adults appear to be frightened by what he calls children’s ‘phantasmagoria’ because when children use fantasy freely they reverse the power relationship and insist they are in charge. Hence adults often prefer to play sports or games with children where they understand the rules.

Perhaps, rather than distinguishing between play and not-play, it is more helpful to talk in terms of ‘playfulness’ by both parties involved in some joint activity, which they both understand and which is built upon by the adult in order for the child to reach towards some new knowledge. What is often missed in the analysis of both child- and adult-initiated activity is attention to what adult intervention (or lack of intervention) might look like at various times and in various contexts. Gifford (2005) cogently addresses the nature of sensitive adult intervention in the context of mathematics learning in particular.

Despite general acceptance of the idea of the centrality of play to child development and effective learning, in practice there exists contradictory advice and a lack of shared practice by educators. Research seems to show that the rhetoric of the function of play in learning breaks down more in mathematics education than anywhere else (Gifford 2004a, 2005). This is due in part to a lack of discussion or illustration over what might constitute some of the important characteristics of play in different curriculum areas. In addition, the pedagogy of play-based approaches have been considered as ‘under attack’ with the introduction of various content-driven national curricula and other government initiatives since 1989 (Tucker 2008, Moyles 2010). This has led to a hardening of play theory in the early years, which Merttens (2003) refers to as an unhelpful ‘goody-baddy’ dualism between the ‘good’ as free play and practical activities and the ‘bad’ as abstract mathematics.

1.2.6 Play and mathematics

Research to date suggests that young children do not use number-knowledge when playing independently (Munn and Schaffer 1993, Young-Loveridge 1993, 2011, Munn 1997, Gifford 2005), nor do the mathematical opportunities often linked to school role play provision result in mathematical exploration (Gifford 2005). On the other hand, a single study of young children’s play with blocks found that they did make use of their spatial knowledge (Gura 1992). Similarly, work with children on constructing micro-worlds indicates that this context can also generate independent mathematical activity (Papert 1980, Steffe and Wiegel 1994). Anthony and Walshaw's review of research into effective pedagogy in mathematics suggests that whilst play can provide a starting place for much mathematical activity in early childhood settings, *engagement* seems to vary:

> *"Spontaneous free play, while potentially rich in mathematics, is not sufficient to provide mathematical experiences for young children. Evidence from observational studies suggests that children's involvement in mathematical activities appears to be moderated by their own interest and prior knowledge."*
>
> (Anthony and Walshaw 2007: 30)

This indicates that adults might need to focus on engaging children in mathematical play (Perry and Dockett 2007, Dockett and Perry 2010). Anthony and Walshaw (2007) point out that young children rely on what they term 'intuitive techniques' as they lack knowledge of more formal mathematics. However, they go on to say that experience of tackling situations that make sense to children is: *"... much more important than knowing 'correct' mathematical terminology or being able to recite basic addition facts."* (Anthony and Walshaw 2007:37).

Authors writing about the relationship between play and mathematics, Brown (1996), Rhydderch-Evans (2003) and Gifford (2002, 2005) regard playfulness and playing with ideas as critical in defining a mathematical activity as 'play'. Wood's (2010) play-work continuum, where all stages contain elements of playfulness, could be helpful in re-configuring mathematical activities. In this analysis, adult-led activities would not only be precursors to child-led play, but playful in their approach. Gifford (2002, 2005) makes a case for the use of simple games, pretence and humour when presenting problems for young children to solve. Anthony and Walshaw's (2007) review of research makes the case for mathematics arising spontaneously from children's play as well as mathematics introduced during shared interactions. The authors' state that studies suggest that mathematical ideas are not always systematically and purposefully developed in early childhood settings (Anthony and Walshaw 2007).

Gifford (2004a, 2004b) emphasises caution and warns of over-pressurising younger learners and causing anxiety about mathematics. She talks of the 'delicate balance' between the self-chosen spontaneous mathematics and teacher-directed tasks. The issue would seem to be to retain the principles of an approach that embraces children's play, playfulness and interests and to help young children learn mathematics effectively. If early years practitioners use children's ideas and innovations in which to site some mathematics, to be effective they also need to be knowledgeable about children's mathematical development, their possible 'learning trajectories', about mathematical processes as well as content and thus aware of the various directions they might help steer the play (Gifford 2005, Anthony and Walshaw 2007). Anthony and Walshaw (2007) talk of adults building young children's mathematical opportunities into familiar and appealing contexts and argue that research shows this is especially important for lower attaining learners. We have to be alert to what Bird refers to as "*... embryonic mathematics in our classrooms*" (Bird 1991:108) and plan for 'foreseen possibilities' (Bird 1991) rather than for pre-specified learning objectives. As Brown (1996) asserts:

"*In short, it is the teacher's responsibility to maintain a context in which play is possible for both herself and the child.*"

(Brown 1996:113)

Children's play is a site where sense-making mathematics can take place, which allows for the use of children's intuitive techniques. Whilst some researchers identify play as having the potential to provide enjoyable, meaningful and sensible contexts for learning about mathematics (Griffiths 2005, Gifford 2005, Ginsburg 2002, 2009), research into play and mathematics with older learners is virtually non-existent.

IN CONCLUSION

Play has been positively linked to young children's learning since social reformer Susan Isaacs campaigned for universal nursery education during the 1920s and 1930s. Understandings of what constitutes play in educational settings vary but research characterises all play (including adult play) as involving some suspension of reality, a move into a parallel world where consequences might not matter. Play has formed a central part of the early years' curriculum in a way it has not with older children. Despite individual attempts to draw the principles of the Early Years Foundation Stage (DfE 2012) into the early stages of the statutory curriculum (see for example, Tower Hamlets 2008, Moylett and Stewart 2012) the pre-statutory years of schooling remain, in terms of integrating play and learning, distinct from the statutory years.

During play, participants are characterised as having a large degree of control and autonomy over what happens, this is very different to most mathematics learning situations in educational settings. Research into play and mathematics learning is limited and restricted to younger learners where play has been identified as having the potential to provide effective contexts for learning mathematics (Griffiths 2005, Gifford 2005, Ginsburg 2002, 2009).

Role play has its roots in process drama and has been an established educational tool since the 1980s. It is seen as important in developing children's understanding of themselves and the world around them (van Ments 1989, Heathcote and Bolton 1999). However, its potential in developing pupils' mathematical understandings has not been researched. Role play and make believe appear to touch on aspects of emotion and involvement that could help engage learners in meaningful mathematical problems. This study explores two classrooms in one school who have attempted to draw mathematics from children's play interests, stemming from a belief that:

> *"Mathematics is embedded in children's play, just as it is in many aspects of their lives; children enjoy playing with everyday mathematics; and children even spontaneously play with the mathematics taught in school*." (Ginsburg 2009:30)

CHAPTER TWO THE CONTEXT OF THE STUDY

Introduction

This chapter describes the school and the two classrooms in which this study took place and places this information in a wider, geographical, historical and social context, between the years 2011 – 2013, at the time the study took place.

I begin with the assertion that no school or individual, pupil or adult, exists in isolation. Thus all action and decisions are part-and-parcel of the culture of the classroom, of the school, of the locality in which these operate, as well as the time and the wider society of which we are all a part, and which the school both affects and is affected by.

The first section of this chapter (2.1) examines the physical context of the study school. 2.2 describes the curriculum values relating to the period of this study; 2.2.1 my study school's ethos and values; 2.2.2 outlining the national socio-historical context at the time of the study, and 2.2.3 the particular curriculum of my study school. 2.3 describes my relationship with the school, and 2.4 the background to the school's focus on role play for mathematics learning. Sections 2.5 and 2.6 examine the culture of the two classrooms studied, Year Four (2.5) and Reception (2.6). Both sections consider classroom organisation, dynamics, ground rules and ethos, all of which impact on the findings of this study. Finally, I reflect on the impact of grouping children by perceived 'ability' and gender influences (2.7) and examine the quality of relationships in the study school (2.8).

2.1 The School: Physical context

Maritime School (a pseudonym) is located in a coastal town in the South West of the United Kingdom. The town has a strong maritime history stemming from Tudor times and is home to a thriving port and recently, a University. Its primary industry is tourism. The town's resident population was listed in 2004 as 25,223 (National Office of Statistics 2004). It is a typical 19th Century port development with a history of pockets of deprivation.

Maritime School is situated on a compact site in the centre of a housing estate consisting of both council and private housing, within walking distance of the sea and close to a freshwater lake. It is a community primary school, administered by the Local Education Authority, one of five primary schools in the town, all of which feed one community secondary school. Although situated in potentially the most affluent area according to census data, since 2005 Maritime School was classified as the second most deprived school in the town.

At the time of the study, the school consisted of seven single-age classes with a total of 210 pupils on roll aged from 4- to 11-years of age. The Head teacher (Mr G) had been at the school since January 2005 heading a full-time team of seven class-based teaching staff plus 16 teaching support staff. Three of the staff, including Mr G, were male. My perspective, based on five years working alongside the staff, is that Mr G had created an atmosphere in which staff worked together as an enthusiastic and effective team.

Maritime School was opened in 1964 as an Infant School (5-7 years) in 1990 extending to include juniors (8-11 years) which Mr G sees as contributing to the development of the school's individual character and ethos in that, uncommonly to many schools, it grew organically over time. He describes his school as “*a village school in a town*”, seeing similarities with local communities that grow naturally, “*not suffering from planning”* (Head teacher, personal communication, 26/03/2013). This is an interesting comment when we consider the school’s approach to curriculum planning and national initiatives which I discuss later in this chapter (2.2.3).

As a result of this lack of planning, Maritime school is squeezed into a small site. It is split-level on two floors and includes a school kitchen and hall used for meals, school assemblies, and physical education teaching. Some indoor areas of the school had recently undergone a major refurbishment. The large majority of pupils were of White British heritage. With no on-site Nursery, Foundation Stage children come to the school from a number of local pre-schools, both state and private. The school is inclusive and receives pupils from across the town, containing families prepared to go the extra distance to the school of their choice. Not unusually for schools in this part of the country, there is a school uniform seen as a mark of the school’s collective identity. The proportion of pupils with special educational needs and/or disabilities broadly reflects the national average, but varies across year groups, year on year. The main groups of needs are usually related to physical needs, speech and language, and behavioural and emotional difficulties.

2.2 Curriculum and values

The information for this section is drawn from the school website and the school prospectus, plus my own knowledge of the school and from interviews with the Head teacher held on 26th March 2013 and with the two class teachers involved in the study, on 22nd March 2012 and 17th April 2012 (Appendix 1, iii).

2.2.1 Maritime School: Ethos

Maritime School motto at this time was "A rising tide lifts all ships", paraphrasing the school's commitment to "*help everyone aspire to his or her highest expectations by providing a positive learning environment with inspirational learning experiences*" (School Prospectus, 2012 - 2013).

The school placed emphasis on what they termed the 'Seven Rs': Responsibility, Readiness, Resourcefulness, Resilience, Remembering, Reflection and Respect. These were on display in all classrooms and children were presented weekly certificates for each 'R'. The school emphasised a climate of mutual respect through three 'rules', which were persistently reinforced: '*show good manners all the time', 'care for everyone and everything'*, and '*follow all instructions with attention and thought'*.

Mr G had come with previous experience of working with 'Learning to Learn' (Lucas et al 2002) and Maritime School was based on that philosophy. According to the Head Teacher's account, he promoted child-centered education for considered reasons, seeing the staff's job as one where they created the freedom for children to learn. Mr G saw what he termed "*the current obsession with planning and organization*" as reeking great damage on children's natural abilities to learn and create. One phrase Mr G used frequently whilst talking with adults and children was, "*our school is the safest place in the world to make mistakes*". By frequently repeating this phrase his intention was to create an atmosphere where children were confident to talk through their learning without fear of embarrassment or the response of others. Mr G saw the encouragement of speaking *as* one is thinking as integral to this learning atmosphere.

Maritime School had no religious or denominational affiliation and took its values from the National Forum for Values in Education (see Appendix 8). At the time of the study, the ethos and values of the school were well established and interpreted amongst staff and pupils. Both visitors and Ofsted inspectors (Office for Standards in Education) had remarked upon the schools' welcoming atmosphere and the happy and productive working environment. The school encouraged and respected pupils' voice and a school parliament met weekly and had regular input into school life. This contributed to a feeling of underlying mutual respect that appeared to affect what happened in classrooms. Pupils were aware that points of view were taken seriously and their opinions valued. This might indicate that data from interviews with Maritime School pupils should be more reliable than is commonly considered.

The following statement from the school prospectus indicates that fostering a desire to learn was key to the school's philosophy:

> "*Learning is, of course our school's core function. We believe that children's development of understanding and knowledge is dependent upon their desire to learn, and the acquisition and application of key skills and attitudes.*
>
> *As teachers we plan to build upon children's natural enthusiasm and inquisitiveness and to continue at school the learning adventure they have begun with you. It is our desire that pupils recognise in Maritime School a community of enquiry where they can ask questions and seek answers without fear of failure, that they understand their classroom to be the safest place in the world to explore ideas, and that they are inspired by the lessons and experiences we provide.*" (School Prospectus 2012-2013: 11)

Significantly for this study, children were called members of a "*community of enquiry*" where questions were encouraged and the making of mistakes seen as integral to learning. Teachers were expected to "*share part of themselves*" (Head Teacher interview, 26/03/2013) in the sense of bringing their strengths and interests to the children's learning.

Like any school, there were differences in interpretation of these values and I observed that some staff found them easier to integrate into classroom practice than others. Non-negotiable was the Head Teacher's expectation that all classrooms were to provide a context for their learning in the form of a topic. It is here that the idea of introducing role play emerged, as a context for learning mathematics.

2.2.2 Curriculum: The national context

This sub-section outlines the national context as it affected my study school from 2010 to 2013. At the time this study began there was a national feeling that education was entering a brief period of respite following a long period of fast-paced Government interventions. Due to a change of Government after the 2010 General Election, all initiatives that had dominated mathematics education during the period prior to this study and put in place by the previous Government were halted. These included the National Numeracy Strategy (DfEE 1999) and its successor the Primary National Strategy (DfES 2006) both interventions that had shaped mathematics teaching since the advent of the first National Curriculum in 1989 (DES 1989). By the time this study ended, a new Early Years Foundation Stage framework had been published and put in place

(DfE 2012) and a new National Curriculum for the statutory school years had been published (DfE 2013) to be statutory from September 2014.

Both the Head Teacher and Deputy Head Teacher at Maritime were aware of the lull in Government initiatives and felt able to take advantage of this to make use of their knowledge of, and familiarity with, the current curriculum requirements to begin an initiative in their mathematics teaching. Also relevant were two local factors; firstly, quantitative data indicating the children's declining mathematics attainment prior to 2008 despite active school engagement in all national initiatives, and secondly, qualitative data which pointed towards children's self perception of their mathematical ability outstripping their enjoyment of the subject. Gradually role play was developed as a focus for teaching and learning mathematical problem solving. The decision to pursue this was made in the knowledge that there was no national support for such an initiative.

2.2.3 Maritime School: Curriculum

The school's documentation emphasised practical, independent learning, placing children's interests at its centre and with the aim of nurturing children who loved learning and learned well, developing the skills they needed to be able to learn in the future. Significantly for this study, from 2006 to 2010 the school was involved in the 'Learning to Learn' project (Lucas 2002). The school had been concerned about an apparent gradual decline in children's curiosity in all but the most robust learners after their Reception year. Stemming from work by Hoffman (1999) 'Learning to Learn' explored differing approaches to creating confident, effective learners. As a result of an intense involvement across the school with this sustained project, I observed that both staff and pupils had developed a rich shared language for talking about and reflecting upon learning which could be considered significant in terms of the findings of this study.

The curriculum of Maritime School was described and planned by the staff as ‘skills-based’ and based around sets of overarching skills drawn from each subject within the current National Curriculum (DfEE/QCA 2000b). When describing this, the Head Teacher referred to what he saw as the meaning of the terms ‘primary’ and ‘secondary’ education. He saw the role of the primary school as enabling children to develop the *primary skills* in order to be able to effectively access *secondary* skills and knowledge. The school curriculum was organised broadly around six headings drawn from the Early Years Foundation Stage Framework (DfES 2007): Personal, social and emotional development, Communication, language and literacy, Mathematical development, Knowledge and understanding of the world, Physical development and Creative development. Activities were planned following a whole-school topic, considered to meet national requirements as well as the school’s perceptions of local requirements. These were subsequently discussed with pupils; integrated with statutory requirements, and staff interests and strengths.

The school had been inspected by Ofsted (under section 5 of the Education Act 2005) in the Autumn term of 2010. The final report found the school was a “... *good and improving school with several excellent features*”, that secured “*... good teaching and learning, which is now promoting the pupils' good achievement*” but also pinpointed the variation in the development of pupils' basic literacy and numeracy skills throughout Key Stage Two as ‘requiring improvement’. My role developed in the wake of the 2010 Ofsted inspection and the decision to prioritise mathematics through role play as a route to returning to pupils what the Head Teacher termed ‘the freedom to learn’.

2.3 My relationship with the school

I had worked at Maritime School supporting in-service training for mathematics on an intermittent freelance basis for some years prior to the start of this study. I had previously worked with the Deputy Head Teacher (Mrs. R) when we were both members of the County Advisory Service between 1990 and 1992. Mrs. R was the Deputy Head Teacher and Year Four class teacher at the time of this study. In 2008 Mrs. R and I attended a County working group supporting role play and mathematics (see 2.4) and shortly after this, I was successful in securing funding from the National Centre for Excellence in Teaching Mathematics (NCETM) for a small-scale research project which ran for 10 months from April 2009. This involved me working with three teachers in three primary schools (this included Mrs. R) to investigate the potential for teaching and learning mathematics through role or ‘context’ play and its impact on children's and teachers’ attitudes to mathematics (Williams 2010).

In September 2010 I was asked to support the school in its mathematical development regularly on a part-time, freelance basis. Part of this work was to develop role play for mathematical learning throughout the school. This involvement was planned to last for three years until the summer of 2013 (see Appendix Five, iii, a). The school was aware that in October 2010 I had been accepted to study at Roehampton University and was happy for me to use Maritime School as my case study school for this research.

From 2010 I had two roles, one supporting members of staff in developing staff confidence and initiatives in mathematics and the other as a researcher. I discuss these two roles and how this relationship influenced my findings in Chapter Three (3.5).

2.4 Why role play?

Compulsory national testing in English primary schools at the end of Key Stage 1 (7 years of age) and Key Stage 2 (11 years of age) had been introduced by the 1988 Education Reform Act. Test results at Key Stage 1 were used to predict likely attainment of children at Key Stage 2. RAISEonline (Reporting and Analysis for Improvement through school Self-Evaluation) reports for Maritime School prior to September 2008 had shown an underlying trend of declining results for mathematics and in particular, fewer children achieving National Curriculum Level 5 (DfEE/QCA 2000b) than their Key Stage 1 national test results had indicated. Moreover, in-school diagnostic assessment of children's mathematics achievement across the school had demonstrated to staff that there might be a problem with mathematics learning. Pupils did not seem to appreciate the relevance of mathematics to life outside the classroom and enjoyment of mathematics seemed to be poor. Although the school had developed a curriculum that was felt to be more in keeping with children's interests and skills, and staff were obtaining both anecdotal and data-driven evidence of an improvement in children's attitudes to and aptitude in subjects other than mathematics, mathematics had remained largely separate from these developments due to national programmes such as the National Numeracy Strategy (DfEE 1999).

In 2008, the Deputy Head Teacher of Maritime School became involved in a county working party of teachers developing ideas for context-based mathematical play in Key Stage Two. As a result of this involvement along with staff discussions of the purposes and function of role play in the Reception class changes to classroom pracatice were made from the summer term 2009. One area in every classroom was developed as a role play area, linked to the overarching learning topic for each half term, and dedicated to mathematical play. The aim was to increase children's resilience, interest in, and enthusiasm for, mathematics as well as to increase an appreciation of the purposes of mathematics. It was hypothesized by Maritime School staff, that an increase in pupils' enjoyment of mathematics would help raise their mathematical achievement. Mrs. R monitored the mathematics results from 2008 - 2011 and these showed an improvement in achievement as well as in enjoyment across the school.

2.5 The Two study classrooms

2.5.1 The Year Four classroom

The Year Four class teacher, Mrs. R (also the Deputy Head Teacher and Lead Learner for Mathematics) had been at the school since 1994, since when she had taught from Years Two to Six. During my data collection period the Year Four class consisted of 30 children: 17 girls and 13 boys aged 8-9 years. One boy was a new school entrant at the beginning of this school year and a second boy part way through the previous year. There was one female full-time Teaching Assistant working in the class at this time. The Year Four classroom was open and bright and, in common with most UK primary classes at this time, prominently displayed both informative posters and children's work. There was a clearly defined mathematics area containing equipment and posters, a wet area with sink and access to a small, private outdoor courtyard. Uncommonly for Key Stage 2 classrooms in general, but in keeping with the rest of the school, the classrooom contained only a few tables and chairs in order for the learning environment to be as flexible as possible and allow space for a dedicated role play area.

This class was organised into four smaller working groups for mathematics broadly based on attainment as decided by ongoing teacher assessment. ‘Grouping’ such as this (collections of children of similar ability within one class, see Chapter One 1.8) is common in primary teaching. The groupings in Mrs. R’s class, although broadly stable over the year, were flexible and children joined and left groups according to Mrs. R’s assessment of their progress and what she termed “*social considerations*” such as how the group worked together (HW and Mrs. R, interview, 22/03/2012). There was an underlying belief in speaking and listening forming the bedrock of learning and of cooperative small group work fostering achievement (Askew et al 1995). On occasions, mixed-attainment, friendship groupings were used for some discrete mathematical topics, for example, ‘shape and space’ or ‘time’.

The school day began at 8:45 and ended at 15:30, with a lunch break between 12:15 and 13:15. A typical day was structured around three or four activities broadly falling before morning break, before lunch and after lunch. Although days varied according to timetabled events or outside arrangements usually the whole class worked at mathematics in groups for around an hour each morning. This was common to all classes apart from Reception. Year Four usually began each session as a class before the children moved into their current mathematics groups for differentiated work around the common mathematical theme. During the hour one group worked independently whilst Mrs. R and the Teaching Assistant taught the others. The independent group were timetabled for the mathematical role play task for half-an-hour once each week whilst the other half hour was spent on computer tasks. This arrangement meant that usually a group of around four pupils engaged in role play at any one time.

Pupils were taught to be independent when working in relation to fetching appropriate equipment, organising their work and recording. Practical work and the use of equipment, both structured and unstructured were part of every mathematics lesson. It was my perception that collaboration, discussion and communication were highly valued, for example, groups were told by Mrs. R to "*talk before you start anything*" and "[I am] *expecting to hear a lot of talk going on*". Mrs. R's pedagogical approach was interactive, dialogic teaching (Alexander 2006, 2010) in that both adults and pupils talked as well as asked and answered questions.

Since being involved in the Learning to Learn project (Lucas et al 2002) Mrs. R had gradually handed more control to the children about how they approached the statutory mathematics content of the National Curriculum (DfEE/QCA 2000b). Each Maritime School term began with an 'Open Learning Week' where normal timetables were suspended in all classes in order to stimulate and immerse the children in each topic. Although the overall class topic was decided on a school basis, precisely what was explored under this umbrella was discussed at the beginning of each term with the class and the children's ideas integrated into the teacher's plans. The starting questions for the class were: 'What do we know already?' 'What do we want to find out?' and later, 'What would you like for your role play?' Mathematics activities were then planned with reference to these discussions along with a range of published teacher material as well as the teaching objectives enshrined in the Primary National Strategy

(DfES 2006).

In 2011 Mrs. R had completed a Masters degree in mathematics education which consisted of action research into the school's journey developing role play for mathematical learning and she had a particular interest in teaching mathematics. In my perception she was an experienced, confident and accomplished teacher with expertise and drive that were fundamental to the development of mathematics through role play in the school. The findings of this study must be considered in the light of her knowledge, interest and support.

2.5.2 The Reception classroom

The class teacher, Miss H, had been at Maritime School since September 2010 and at the time of the study was in her second year of teaching the Reception class. The class began the academic year 2011-2012 with 29 children: 15 girls and 14 boys aged 4-5 years. During the summer term, one boy left the area and another arrived as a new school entrant, together with an additional girl, making a total of 30 in the summer term: 16 girls and 14 boys. There were two Teaching Assistants working in the class at this time and one regular volunteer parent- helper, all three female.

The ground floor classroom had been recently re-modelled, with new furniture. The main area was open and full of children's work, sectioned flexibly into smaller ones for writing, mathematics, craft, sand, water, role play and so on. There was a large carpeted area on which the class assembled. The room was bright and typical of those for the early years at this time with a large range of accessible, labelled equipment and resources. There was free access to all areas including an outdoor 'soft play' courtyard used throughout the day, and to a grassed, natural area, which was used more occasionally. Miss H did not restirict role play to one area of the classroom and a new indoor two-storey structure had been added recently for role play. The children (along with Miss H) decorated this in line with their current interests which Miss H felt worked more effectively as a focus for their role play rather than as a designated 'role play area'.

The day began at 8:45 and ended at 15:15. There was a lunch break between 12:00 and 13:00 and morning and afternoon sessions usually began and ended with a whole class discussion on the carpet reviewing what was currently of interest. Activity was free-flow, punctuated with small group or class sessions, for example, for phonic work, music, mathematics or PE.

At the time of the study, children nationally were admitted into Reception at the beginning of the academic year (September) in which they turned five years of age. This meant that at the beginning of the Reception year there were children who had just turned four years of age alongside those nearing five years of age. To accommodate this wide age range the classroom organisation changed week-on-week and over the school year. At the time of the study Miss H had organised children into five very flexible groupings for teacher-directed activities broadly based on the children's general attainment, as well as social considerations such as how well the group might interact. Pupils' personal, social and emotional development had high priority and the building of positive relationships between children and staff and peers was given prominence in terms of structuring and planning activities. Ongoing adult assessments of both attainment and children's personal and social skills led to frequent changes in groupings. The majority of the day throughout the academic year was set up for child-directed activity; observing and responding to children's interests was seen as the priority. Both indoors and the outside courtyard were given equal attention in terms of all learning areas and in all weathers children played outside and inside. Pupils were taught to be independent when working, in relation to choosing what they did, using equipment and organising their activity. Talk, questioning and discussion were given primacy over recording.

The starting point for mathematics work was children's interests, such as pirates or dinosaurs, with mathematical activities planned to relate to their self-directed play. Miss H would consider what mathematics it would be possible to tackle based on adult observations of children's interests: "*I then think, we could do this, or this, or this or this - too many ideas really*" (Miss H to HW, semi-structured interview, 17/04/2012). Her plans took account of the requirements of the Early Years Foundation Stage (DfES 2007) and made use of various teacher resources. Other mathematical tasks included building confidence and familiarity with structured mathematical equipment. Miss H described her approach as, "*explore – talk/discuss – move on*" (Miss H to HW, semi-structured interview, 17/04/2012). In contrast to the remainder of the school, the Reception class, whilst aware of the school's overarching topic, did not plan from this, although on occasions the class interests might coincide with those of the wider school, for example during the 2012 Olympic and Paralympic games. Miss H described her Reception class as "*'Open Learning Week' all the time*" (Miss H to HW, semi-structuted interview, 17/04/2012).

Miss H described the class that took part in the study as confident and cohesive in comparison with others, with good speaking, listening and literacy skills and quite highly developed abilities to talk and negotiate. These more developed social skills meant that the group dynamics were fluid with a high level of shared understanding within the class of what was taking place. The findings of this study are to be considered in the light of both the makeup of the case study group and Miss H's interest in and commitment to child-based learning across all curriculum areas.

2.6 Other influences

2.6.1 Single attainment groupings and gender

Maritime School did not 'set' for mathematics, which had become more common following the implementation of the Primary National Strategies (Marks 2011). Instead, from Year Two onwards pupils within each class were organised for the majority of their mathematics work into three or four groups based on current attainment (see 1.8, Chapter One) commonly known throughout the school by the names of geometric shapes. The membership of final groupings each year were passed onto the receiving teacher as evidence of 'how the children are working at the end of this year'. In Reception as previously described, groupings of children were fluid, and in all classes, there was some movement between groups over the year according to teachers' ongoing assessments. However, most often, if you were working as a member of 'the circles' you remained working as a member of 'the circles' for the majority of your mathematics work that year. This organisation was beginning to be questioned by staff during the period of this study and as a result, towards the end of this period, teachers' mathematics groupings became more flexible, with mixed attainment or friendship being used as the basis for grouping for some activities and group names changing. This was in part due to my developing evidence suggesting that children from Year Two were aware of their own and their peers' mathematical ability in terms of these groupings and defined themselves as being ‘good or ‘bad’ at mathematics accordingly.

The harmful effects of single-attainment groupings, for example, children ranking themselves in relation to others and fostering negative attitudes to the subject (Marks 2011), is well documented. This was a challenge for staff aiming to encourage an understanding in all pupils that mathematical attainment is changeable (Askew et al 1995). Rather than mathematics work being marked and graded in terms of levels, formative spoken or written feedback was given to all pupils. Hence the relationships established between teacher and pupil in the two study classes appeared to work to minimize the negative impact of attainment groupings.

I did not observe any assumptions operating in either classroom regarding gender that constrained access to activity in terms of group composition, space, behavioural style, activities or materials (Lloyd et al 1992). Although children in both classes were aware of gender and could be heard making occasional gender-specific statements such as “*Boys only!*” (Reception) or “*Those bossy girls*” (Year Four) (Whyte 1983) in both year groups both girls and boys could be observed working productively in both single- and mixed-gender groupings, by self-choice and by direction. There was no obvious gender preference observed in the Reception class towards the different role play themes in numbers of boys or girls that participated. In the Year Four class, which contained four more girls than boys, the mathematics groups were planned as mixed gender.

2.6.2 Teaching and the quality of relationships

Noddings (1984) argues that the nature of the relationship between teacher and student is the key to educational success as learners need to be aware that they are more important to the teacher than the subject matter. As my study developed, clear evidence emerged of both of the teachers at Maritime School prioritising their learners' needs above curriculum requirements, a practice underpinned by the school's ethos and values. Each teacher emphasised talking, listening, sharing and responding respectfully in every aspect of education. Subject matter was looked at *with* the pupils, pupils were actively encouraged to work together, and all contributions to discussions were respected. Gradually pupils assumed increasing responsibility in the tasks they undertook. There was no evidence of an atmosphere of ridicule over mathematical mistakes, nor an emphasis placed on speed to the detriment of thought and creativity. In my experience, and in keeping with Gifford and Latham (2013), this can be unusual in many mathematics classes, particularly at Key Stage Two.

IN CONCLUSION

I began this chapter with the assertion that no school or individual, pupil or adult, exists in isolation. Thus all action and all decisions are part-and-parcel of the culture of the classroom, of the school, of the locality in which these operate, as well as the wider society historically of which we are all a part and which the school both affects and is affected by. Hence the findings of this study cannot be understood separately from Maritime School's whole school ethos of respect, responsibility, community, collaboration, co-operation and communication. It is my view, based on my experience with this and with other primary schools, that both the children and adults at Maritime School were open to initiatives and, most importantly for this study, willing to discuss learning. The children studied were used to working independently, appeared to relish the responsibility and were developing an effective language for talking about learning.

The chapter that follows outlines the methodology of this study and is followed by three data-analysis chapters.

CHAPTER THREE

RESEARCH DESIGN, RESEARCH PROCEDURES AND METHODOLOGY

INTRODUCTION

The purpose of this chapter is to outline the research design and procedures of this study in relation to my ontological and epistemological positions. Section 3.1 explains the rationale behind the decisions I made regarding my research design, and 3.2 the research procedures. 3.3 outlines my key methods of data collection, and 3.4 examines my approach to data analysis. Finally, 3.5 explores my role as both teacher and researcher, reflecting upon the influence this has had on my research.

Niglas (2001) argues that there is no clear distinction between qualitative and quantitative research rather it is a continuum of shades. Mine is a strongly interpretivist, qualitative study. The following features and underlying beliefs typify qualitative, interpretivist approaches:

- the social world should be studied in its ‘natural’ state;
- people actively construct their worlds;
- situations are fluid and events evolve over time;
- behaviour is affected by context.

(Cohen, Manion and Morrison 2007, Davies M 2007).

My ontological position is that interactions, actions and behaviours, and the way people interpret and act on these, are central to what takes place. My epistemological position views knowledge of the social world as generated both by those observing and participating. This is discussed further in 3.1.

My research setting consisted of a seven class primary school for children aged between 4-11 years of age, situated in a coastal town in the South West of England during one academic year in the early part of the 21st century. Chapter Two described the physical factors of the study and considered their effect on the research. My study school represents a fairly typical UK primary school at this point in time in terms of organisation and structure. This is an in–depth, qualitative, interpretative case study of mathematics in two classrooms in one primary school over one academic year. I draw upon case study as my main methodological approach as my two study classrooms were identified at the outset
as 'cases of' (Freebody 2003) role play appearing to be working within a wider, national context where role play did not appear to be doing so. It utilises qualitative methodology in order to respond to inherently dynamic and complex educational activities where relationships and context are critical components (Freebody 2003). Whilst having a clear research design, this is an account of a reflexive, evolving study, exploratory and flexible enough to respond to the shifting nature of the field of study and as a result of noticing something and questioning how I will investigate it (Mason J 2012).

This study is qualitative in the sense that I make explicit the world view that I bring to the research and that guides my actions (Cresswell 2007). Interpretive case studies are often used to attempt to make sense of what is happening in classrooms (Gravemeijer 1994). Both the subject and context of my research is well matched to more qualitative, interpretative methods as human behaviours are infused with social meanings, motives, attitudes and beliefs (Hammersley and Atkinson 1983).

3.1 RESEARCH DESIGN

The following questions were posed in this study:

- *What mathematics can be learned through role play?*
- *What does mathematics learning look like in different role play contexts?*
- *To what extent might role play affect the development of mathematical resilience, involvement and a positive attitude to the subject?*
- *What particular classroom conditions positively affect mathematics learning through role play?*
- *What adult intervention helps or hinders such mathematical learning?*

What brought me to these research questions? Mason J (2012) identifies what she terms ‘difficult questions’ for every researcher to address. The first concerning the nature of the phenomena I wish to investigate. I was interested to explore the features of role play that might foster mathematical learning. One option would have been for me to observe role play in a number of schools and classrooms in order to draw out some common features, both positive and negative. Instead, having noticed where there appeared to be something interesting happening in one case, I explored this in depth to attempt to unravel the interrelationships between all the various factors.

Deciding what might represent evidence of the phenomena under study is Mason’s (2012) second question, rooted in the researcher’s theory of knowledge. In order to examine the reasons behind my approach to data collection I summarise here my position regarding issues of reality, truth and knowledge.

Ontology concerns our perceptions of reality thus alternative ontological positions tell different stories (Mason J 2012). Teaching is complex and developmental and what happens in each teaching episode is understood and experienced differently by each participant. Any 'fact' is always the product of some interpretation (Ellen 1984). Interactions and behaviours that take place within classrooms, and the way those involved interpret and respond to these, are central. Ontologically, a qualitative approach grounded in the interpretivist tradition is appropriate for this study as I am interested in how the social world of this classroom is interpreted, understood and experienced by its participants. Our actions as teachers influence the children's approach to, and involvement in, the mathematics they learn. My ontological position is not straightforward however, as truth and reality cannot be completely fluid and human beings can only behave 'as if' there is some objective reality. I do have a model of the world with which I operate at any one time.

Aristotle identified three branches of scientific knowledge: Episteme, Techne and Phronesis, the latter based on 'prudence' and 'practical wisdom' (Flyvbjerg 2001). If, stemming from Aristotle's concept of *phronesis* and typified in the work of Foucault (Foucault 1972, Foulcault and Rabinow 1984, Mills 2003) I accept that there is no universal, abstract set of truths 'out there' to be unearthed, it follows that knowledge involves the judgements and decisions we make as social beings constrained by time and that what we understand as 'truth' changes. Every researcher works with preconceptions about the phenomena they study, selecting for study those aspects they consider relevant (Hammersley and Atkinson 1983, Hammersley 2002). My epistemological position, viewing knowledge of the social world as generated by those observing and participating at any point in time, makes it necessary for me to examine not only the existence (or not) of the phenomena I wish to study – role play and mathematics learning –

but also interactions, actions and behaviours, as well as the interpretations and decisions made by those participating.

Mason (2012) goes on to ask what is my ‘intellectual puzzle’ and what the purpose is of the research? My intention is to explore and explain the interrelationship between mathematical learning and having a more playful, organic approach to mathematical content that takes into account where children’s attention might lie. The reason I engaged in this research was to challenge what I saw as the dominant dogma of the current educational climate where knowledge is seen as separate to those who generate it, as well as to explore whether it is possible to combine what are commonly viewed as two quite separate entities – mathematics and play. I examine how the position I take affects this study in section 3.5.

My study is strongly influenced by ethnography as it centres on first-hand experience through observation. Ethnographic research is a diverse qualitative research methodology grounded in a commitment to first hand experience on the basis of participant observation (Woods 1996, Taylor 2002, Mason J 2012, Cresswell 2007). My data could be described as being drawn from a ‘culture-sharing group’ suitable for ethnographic study (Cresswell 2007) and was ethnographic in the sense that I participated in people’s daily lives to collect available data to clarify the phenomena being studied (Hammersley and Atkinson 1983, Hammersley 2002). However, this study is not ethnographic in that I do not rely simply on close description of the context I observe but instead relate my analyses and interpretations of these observations to other situations. This study is research in ‘the field’, in one contained area of study (Burgess 1984) where data is collected in a single instance of a bounded system – in this ‘case’, two classrooms in one primary school during the academic year of 2011-2012, where I am developing and testing grounded emerging theory (Glaser and Strauss 1967).

3.1.1 Case study

My case study consisted of observations in two classrooms, as follows. Observations over two terms of a sample of seven Year Four children (7-8 year olds) filmed engaging in mathematical role play tasks developed by their class teacher (Mrs R), and interviews with these children about the observations. Observations over two terms of a class of Reception children (4-5 year olds) filmed engaging in mathematical role play tasks developed by their class teacher (Miss H), and interviews with children about the observations.

A case study is a specific instance investigated to throw light on a more general principle, in this case whether role play has anything to contribute to children's mathematical learning. Case study allows for other voices to be heard in the research in addition to that of the researcher. One of its claimed strengths is that it is 'strong in reality' (Cohen et al 2007) and can thus be readily understood by the intended audience, aiding appreciation of how ideas, principles and practicalities interrelate, relating theory and practice (Golby 1994). The commonly stated disadvantages of case study include the reliability of generalising from a specific instance and the difficulty of cross checking findings thus laying the research open to accusations of observer bias (Cohen et al 2007). These are issues with which all research, including experimental research, has to grapple and are discussed below.

My beliefs, along with the required depth of my enquiry, determined that my research should not only take place in one school that I considered to be a ‘case of’ my research focus but also to research closely a sample of children both within this school and within the classes within the school. In this sense it might be considered cases within a case. The two classrooms in which the research took place were atypical in that role play had already been developed particularly in regard to mathematics. It is this unrepresentative quality that I sought to investigate further in order to begin to approach my research questions.

3.1.2 Validity, Reliability and Generalisability

It is both impossible and unhelpful for social science to attempt to emulate the natural sciences as the work of the social sciences embraces rather than attempts to exclude context (Flyvbjerg 2001). Universality for a ‘phronetic’ social science (the branch of Aristotle’s scientific knowledge based on practical wisdom) lies in its attention to the specific and the particular, the minutiae of a situation, in order to better understand the general. It is interesting to note that empirical, natural scientists such as Newton, Darwin, Einstein and Galileo all used case study – i.e. the particular event – to illuminate their general theories (Flyvbjerg 2001). This study could be considered generalisable in that it produces some understanding of the wider social world of which it is a part and that is of practical utility (Williams M 1998).

Whilst qualitative researchers might criticise experimental research for drawing inferences to life ‘outside’ from what people say or do in research settings, artificial settings are still part of society and conclusions drawn from natural research will not necessarily be valid for the same setting at different times (Hammersley and Atkinson 1983, Hammersley 2002). In interpretivist social science an account is not tested against a corpus of ‘scientific’ knowledge, but instead, against the everyday experiences of the community of people from which it is drawn (Ellen 1984), in this case one community of primary teachers in Western society in the 21st century. This study makes clear its context, its parameters and its partiality. In choosing to enquire in depth in this way (by sampling within the wider case study) I have attempted to communicate something of the complexity that is recognisable in classroom interactions everywhere. Verification is about recognition, and themes and strands can be drawn out from particular situations for others to build upon. The world is complex, situations are unique and dynamic thus overall generalisations can be unhelpful and banal. Whilst acknowledging generalisation is not easy to achieve in any research, case study allows for analytic generalisation as opposed to de-contextualised, statistical generalisation. Analytic generalisation recognises context as critical whilst seeking arguments and explanations that have wider resonance (Mason J 2012). The generalisability of this study is to do with the extent to which I can make broader claims regarding mathematics learning and role play on the basis of my analysis of my observations in two classrooms, for example, what constitutes 'good' role play in terms of mathematical learning?

Reliability is to do with how accurately my research methods produced data. Validity is concerned with issues of bias and whether or not I am examining what I say I am and whether this can be recognised from my data. The validity of this study is dependant upon my being able to demonstrate how I have reached my various interpretations (Mauthner and Doucet 2003) and what has influenced these (reflexivity). Validity and validation is a key part of all research, it consists of self-validation, colleague validation and academic validation. Self-validation was an integral part of my study, as I read and re-read my transcripts of the observations whilst listening repeatedly to the recorded audio and video and keeping my research objectives in mind. This process gave me new insights. The transcripts and videos that form the core of my research data were offered for critique and analysis by others for respondent validation: the participating children and teachers all offered their interpretations of what they saw. This can be seen as a continual process of peer review and triangulation, all contributing to the generation of new data. Triangulation as a research technique for validating findings has been defined as an attempt to "... *explain more fully, the richness and complexity of human behavior by studying it from more than one standpoint*." (Cohen et al 2007:141). As my evidence emerged it was produced for critical scrutiny by colleagues in the case study school in the form both of individual interviews with selected staff and whole staff meetings. At the same time, as the study unfolded, it was also presented on a number of occasions to colleagues in the wider academic world, via conferences papers (Williams 2011, 2013). My theories, ideas and practice were modified, recorded and analysed in the light of all these discussions and those with my supervisors, as well as seminars I attended during the period of the research.

This study has meticulously collected a variety of observations and recordings in one setting and offers these for analysis. Any research is a *search* for some clarity and recognition; a looking again - *re*-search (Mason J H 2002). Any research has limitations but getting close to the phenomenon, taking the stories of others and putting stories out there is equally as illuminating as empirically driven studies.

3.2 RESEARCH PROCEDURES

This section outlines the research I carried out, with whom, when and for how long.

There are many different ways of undertaking qualitative research and decisions are based on methods of data collection that are flexible and responsive to each situation and take into account the complexity of both the data and the context (Mason J 2012). Hence, I drew up a research framework to guide my study in the two classrooms but this framework was necessarily always going to be subject to change as my research was to be both data-driven and context-sensitive. The observation schedules for both classes evolved as the data collection period progressed. See Appendix One for the two research schedules, (i) Year Four and (ii) Reception. (Red type on the Reception framework was used to indicate how I anticipated this initial framework might change).

From the outset it was intended that this study was to be based primarily around observations taken of children within classrooms as it was my belief that this would yield the richest source of data to address my research questions. I identified two classes in my study school, the Year Four and the Reception class (an initial sample), where something interesting seemed to be happening regarding role play. I asked both class teachers if they would mind if I video-recorded children engaging in role play in their classes on a small FlipVideo camera (a small, handheld, tapeless camcorder used for digital video recording). Both classes of children were used to cameras being used by adults to record them for assessment purposes as they worked and I discuss the effects of the use of a camera in this way in 3.5. Both teachers were enthusiastic as they too were interested in what was happening whilst their children played as well as in my interpretations of what was happening.

I arranged to video-record a group of seven Year Four children and devised a weekly observation schedule beginning in the second half of the autumn term 2011. I continued the data collection into the first half of the spring term 2012 when I began data collection in the Reception class. I transcribed each Year Four video immediately after it was recorded and my initial analysis began immediately (see 3.4). The second part of my data collection consisted of the recording of children in the Reception classroom which began in the second half of the spring term of 2012 and continued into the first half of the summer term (see Tables 1 and 2, below).

Table 1: Role play scenarios studied

YEAR FOUR CLASS		
Autumn term 2011	'Hemy's Floating Art Studio'	
Spring term 2012	'The French Café'	
RECEPTION CLASS		
Spring term 2012	'The Dinosaur Café'	

Summer term 2012	'Horse Jumping'	
Summer term 2012	'Faster than Usain Bolt'	

Table 2: Details of role play observations: Date, number and frequency

Dates	**Class observed**	**Number of obsvns**	**Frequency**	**Who?**
November – December 2011	YEAR FOUR 7-8 years of age	6 1	2 observations every Tuesday morning, each approx ½ hour duration. One class role play	6 children organised into 2 sub-groups & 1 whole class observation.
January – March 2012	YEAR FOUR	4	ditto	ditto
March – May 2012	RECEPTION 4-5 years of age	29	Consecutive days, up to 4 days at one time, for a period of one morning session.	Varying numbers of children

Initially I had planned to view ‘identified extracts’ of the recorded video with each teacher after each observation had been made and transcribed, and as a basis for ‘focussed conversations’ (de Vries, Thomas and Warren 2010). This proved to be impossible in practice due to the time this would require each teacher to be away from the classroom. This gave rise to an alternative approach where after viewing and transcribing each video I passed copies of these to the two teachers for them to view themselves and with the children if they wished. I later discussed their observations as well as my tentative findings with them whenever I could and when requested. I also undertook one semi-structured interview with each of the two teachers involved. The interview with the Year Four teacher took place on 22/03/2012 after all the Year Four observations were complete and as the first set of observations were completed in the Reception class, the interview with Miss H took place (17/04/2012). As my research drew to a close I also carried out one other semi-structured interview with the Head teacher (Mr G) on 26/03/2013 to clarify how the ethos of the school might be contributing to my findings.

I planned at the outset to arrange meetings with the children to watch the video recordings. In order to allow enough time for me to transcribe each observation, an interview with the Year Four children took place one week after each observation (see Table 3). These meetings were audio and video recorded and fieldwork notes taken. The process for selecting the video extracts for these interviews as well as the re-interviews themselves is discussed in 3.3.3.

Table 3: Observations and interviews with Year Four children

Autumn term dates	**Details**	**Children involved**
01/11/2011	TASK 1 OBSERVATION	Group 1 & Group 2
07/11/2011	TASK 1 INTERVIEW	Group 1 & Group 2
15/11/2011	Class intro to Task 2	Whole class
15/11/2011	TASK 2 OBSERVATION	Group 1 & Group 2
22/11/2011	TASK 2 INTERVIEW	Group 1 & Group 2
29/11/2011	TASK 3 OBSERVATION	Group 1 & Group 2
07/12/2011	Whole class role play	Whole class
09/12/2011	TASK 3 INTERVIEW	Group 1 and Group 2
Autumn term totals: 8 observations, 6 re-view interviews		
Spring term dates		
28/02/2012	TASK 4 OBSERVATION	Group 1 & Group 2
06/03/2012	TASK 4 INTERVIEW	Pairs from each group
06/03/2012	TASK 5 OBSERVATION	Group 2
21/03/2012	French café open to families: Observation	Class members
Spring term totals: 4 observations, 6 interviews.		

Regarding the Reception children, I felt waiting a week between the observation and the interview was too long and thus their interviews took place as soon as possible after the observation and before I had transcribed the original observation.

Throughout this thesis, data that is presented in this study as verbatim extracts from transcriptions of video or audio recordings, fieldwork notes or diaries are clearly indicated, headlined and dated. Extracts from observations are numbered consecutively through each chapter separately as Year Four and Reception extracts, i.e. as Year Four Extract One, or Reception Extract Two. Children's ages are given in completed years and months, for example, 5y 1m. All names are pseudonyms. Where possible, an indication is given as to how far through the recording the excerpt is extracted. All speech and direct quotations, such as from field journals, are shown in italics. Description is non-italicised, action contained within square brackets. Missing speech or transcription is shown as bracketed dots [....]; any added text is bracketed and non1-italicised. / indicates a short pause, // a longer pause.

3.2.1 My samples

Any research involves selection and decisions about how to sample from the case, in terms of time and context as well as participants (Hammersley and Atkinson 1983, Hammersley 2002). My decisions regarding time and context are covered elsewhere in this chapter. From everything that took place in each classroom, a decision on how and on what basis to select a sample of children to observe was necessary. Sampling would allow me to develop a theoretically and empirically grounded argument for 'something in particular' (Mason J 2012). Details about my observation sample from Year Four are as follows.

<u>(i) Year Four</u>

My decision was to observe the same group of children tackling different tasks over time rather than observing many different children tackling the same task. I felt that this would allow me to get closer to my object of study, the interaction between the children and the role play. I would keep one factor stable, i.e. the children, observe them in different scenarios and look for similarities between scenarios for themes to follow up. Mrs R's approach at this time was to set a weekly role play task for each mathematics group to tackle and I would watch that develop with one group of children. An entry from my Research Diary from October 2011, reflects on the appropriateness of my decision:

> *That* [observing the same group over time] *is how teaching works in this class, recommended* [in terms of] *Assessment for Learning (DCSF 2008c) – set task, analyse, adapt, set next/follow-up task. Talks with teacher and children will cause us to adapt what we do, try something and I can watch that develop; rather than contrast 'same' task (it won't be!) across different children.*
>
> **Research diary entry, 05/10/2011**

In the event, the children were divided into two sub-groups for their role play session and so I observed 'the same' task with two smaller groups over one morning. The decision about which children to observe was based on the following three factors. Firstly, personal observations that children identified as 'less higher attaining' mathematically seemed to improve their performance in this context. Secondly, where role play mathematics is clearly context based there was research showing that 'lower attaining' learners are confused by context (Clausen-May and Vappula 2005). Thirdly, findings obtained from 'higher-attaining' children may not be seen as generalisable to less 'well attaining' and less confident children. My final decision was to study a group identified as this time as *just above* the ‘lowest attainers’ in mathematics. My hunch was that ‘lower attainers’ could produce a powerful result, as what could be seen as successful with a ‘just-below-average’ group, might be more likely to work for the rest of the class.

My resulting sample of seven children from Year Four formed one working group for mathematics (known as the ‘triangles’) being one group of the four organised by Mrs R within the class broadly based on mathematical attainment. Each mathematics group was timetabled weekly for role play and divided into two sub-groups for this session with half engaging in the role play and half working on computers. This led to me observing two groups of three or four children, each for about 30- 40 minutes (Group 1 and Group 2) each tackling the same task on the same day. Group 1 consisted of two girls and two boys, Group 2 of three girls and two boys. This yielded a relatively natural collection of data in that it matched the organisation of this class. I recorded what I saw and as a result I have both positive and negative data, in the sense of how much mathematics took place. Table 4 outlines the video data generated from the Year Four class.

Table 4: Video data from Year Four: Details of 12 videos

[‘ = minutes; “ = seconds]

Description	**Dates**	**Video category & length**	
Scenario: **‘Hemy’s Floating Art Studio’**	**2nd half of Autumn term 2011**	**Class**	**Group**

Task: 'Tide Times'	01/11/2011		2 videos Group 1: 19'05" Group 2: 28'41"
Task: 'Fish Patterns'	15/11/2011	1 video, Class discussion: 7'21"	2 videos Group 1: 35'45" Group 2: 23'13"
Task: 'Pricing Paintings'	29/11/2011		2 videos Group 1: 20'55" Group 2: 29' 02"
Task: 'Auction of Paintings'	09/12/2011	1 video, Class Role Play: 42'18"	
Scenario: 'The French Café'	**First half of spring term, 2012** 26/02/2012		2 videos Group 1: 23'50" Group 2: 34'38"
Task: 'Staff meeting'	06/03/2012		1 video Group 1: 31'45"
Task: 'Finale'	20/03/2012		1 video: 27'43" assorted children

(ii) Reception

Observations in the Reception class began in the Spring term 2012. For the data collection to be as natural as that from the Year Four class, it had to be far more fluid. The Reception class was not timetabled (Chapter Two describes in some detail the organisation of each of my two study classrooms) and typically for many Reception classes at this time, children moved from task to task, adult-directed and child-directed, over the day (Aubrey and Durmaz 2008). There is a lack of clarity regarding the Early Years' terms 'adult initiated' and 'child-initiated' (DfEE/QCA 2000a :11, DfES 2007a :11). In this study, I use 'adult- or child-*directed'* to refer to whether activities are under the control of the adult or the child, regardless of who initiates them. Free-flow learning and activity was punctuated by adult-directed group or class sessions. Moreover, role play themes lasted for shorter, more concentrated periods of time and were more likely to be responsive to children's changing interests than was the case in Year Four. At the same time, the activities planned by Miss H –mathematical and otherwise – were developed over shorter timescales in order to respond to the shifting interests of the children. This made data collection in Reception not as straightforward as in Year Four, as it was not possible to be sure when a theme would begin or where children would be physically. The forward planning of fortnightly observations was not going to yield as much useful data in this class, as I would miss both the development of the role play theme and the intricacies, complexities and reality of living and working in this Reception classroom. Here is an extract from my research notebook, at the beginning of 2012 reflecting on the observation decisions I had to make:

> *"Reception* [data collection] - *queries:*
>
> *Do I sit? Or do I follow (named) children?*
>
> *What do I do if they involve me? E.g. "*[You're] *deaded* (sic)/ *frozen".*
>
> *What am I looking for? Set up video when I am not present?"*
>
> **Fieldwork diary entry, Reception, January 2012**

In addition to observation decisions, I also raise here my awareness of the likely problems regarding my role as observer/researcher in this class (see section 3.3.2 for further discussion). The 'Framework for data collection in Reception' I prepared in the Autumn of 2011 (Appendix One, ii) demonstrates my awareness of this and does not include pre-arranged dates for observation. Instead, in order to observe role play in Reception I found I needed to negotiate continually with the class teacher on when to make several observations in quite quick succession in order to plot the development of a theme or idea over a shorter period of time. Table 5 outlines my observational visits to Reception.

Table 5: Video data from Reception Class: Details of 36 videos

[' = minutes; " = seconds]

Description	**Dates**	**Video category & length**	
Scenario		**Class**	**Group**
'The Dinosaur Café'	06/03/2012 to 08/03/2012	13/03/12	6 videos: 6'35", 4'36", 4'07", 2'34", 2'32", 2'07"
Class Re-view of 'Dinosaur Café' video: 'Are you full up now?'	13/03/2012	1 video: 14' 14"	
'Ramon is Lost'	20/03/2012	One session. Class introduction and	

		free choice: 1hr 25’19”	
Rocket Making: ‘Be a teacher’	23/04/2012	1 class Re-view: 7’22”	1 video of group session: 59’09”
‘Horse Jumping’	14/05/2012 to 16/05/2012		10 videos: 04”, 22”, 34”, 58”, 1’05”, 1’34”, 2’03”, 2’51”, 3’08”, 3’30”
“Faster Than Usain Bolt’	28/05/2012 to 31/05/2012	3 videos: Day 1 Class introduction: 11’24” Day 1 discussion: 17’10” Day 2 discussion: 16’53” Day 3 discussion: 13’22”	12 videos: Day1: 6’46”, 1’37”, 1’31”, 2’32”, 3’40”, 1’28”, 59” Day2: 15’31”, 17’54”, 2’30” Day3: 11’24”, 27’31”
Re-views of Usain Bolt videos	31/05/2012		2 videos: Elliot & Mark: 11’26” Rachel & Sabina: 12’30”

Collaboration with Miss H was essential and the Reception class films have been obtained in two different ways, firstly by arranging a block of time to come and observe an area of the classroom set up for some mathematical role play, or to observe a role play 'event' (potentially fluid). And secondly, by leaving the camcorder with Miss H, to capture some activity when I was not there. Both have generated some rich data that is in keeping with how this Reception class is structured, where the larger proportion of the children's day is organised to include self-directed activity and where, in the majority of cases, the children observed had freely chosen to engage in the play. The data collected is also in keeping with the early years approach promoted nationally where self-directed activity is seen as an important part of the children's day (DfEE 2000a, DfES 2007).

After some preliminary visits for me to become more familiar to the children (Autumn term 2011, early Spring term 2012) I began with an initial visit to use the FlipVideo camera to record around an area set up for role play and thus capture any children who chose to engage in activity there. As almost all of the group activity I recorded was of activity freely chosen by the children and I simply recorded who turned up to play, in effect, the children sampled themselves. In terms of whether this 'sample' is representative of this class, my observations of the 'Faster than Usain Bolt' scenario of the summer term, revealed that 23 of the 31 children in the class were filmed over the three days, eight of these on every day. Of the four girls and four boys that were not filmed we cannot conclude that they did not ever become involved in the role play, simply that they did not become so during the time I was filming. However, two of these (one boy and one girl) were not filmed engaging in any of the three role play scenarios which might indicate that role play for these two children was not what they were interested in at that time. See Table 6 for the numbers of children involved in each scenario.

Table 6: Numbers of Reception children involved in the filmed role play scenarios:

Scenario	**Term**	**Number of Girls**	**Number of Boys**	**Total**
'Dinsoaur café'	Spring 2012	7	5	12 children
'Horse Jumping'	Spring 2012	11	8	19 children
'Faster than Usain Bolt'	Summer 2012	12	11	23 children

Evidence from the three Reception scenarios indicated that most children became involved, appearing fairly representative of the class, with slightly more girls than boys (the class comprised of 16 girls and 15 boys) and that overall involvement increased over the two terms.

3.3 KEY METHODS OF DATA COLLECTION

This section outlines in some detail the four main sources of data generated in my study school. 3.3.2 focuses on *Observational data* in the form of transcribed videos and 3.3.3 on *Interview data* with children and adults in the form of transcribed video and audio recordings. The interviews held with children were called ‘re-view’ interviews as extracts from recordings of role play were used as the basis for review in these interviews. This is explored further in 3.3.4, *Visual Re-proposal*, wherby video extracts are used as a stimulus for generating data. Finally 3.3.5 examines the fourth main source of data generation, my *field journals* in the form of hard notes taken whilst in the field and reflective notes made electronically as a ‘research diary’.

To begin this section, I consider the ethical issues relevant to the data generation of this study, including access and researcher effect.

3.3.1 Ethical issues

Ethical issues concerning any research are to do with both morality and politics, and include, for example, the purpose of the research, the interested parties, and the implications of the research for the participants, the researcher, as well as more generally (Zeni 2001).

I attempted to keep these issues at the front of my mind from the outset. I saw the purpose of my study as the advancement of knowledge more generally and my personal gain in particular. Personal gain in the sense of increasing my knowledge and understanding of issues surrounding mathematics and role play in order to speak from a position of strength. Thus, I was an interested party as it could lead to my achievement of increased standing with colleagues (or not!) both inside and outside the school. The Head Teacher of the study school also recognised the school as an interested party as there would be some gain in knowledge on behalf of the school staff as I shared my findings.

Before submitting my initial research proposal in Autumn 2010 I approached the school via the Head Teacher and the Year Four teacher (also Deputy Head Teacher) to ask if research within the school would be appropriate and possible. I had worked with both 'gatekeepers' (Hammersley and Atkinson 1983) over a number of years and they were very positive about such a project, the Year Four teacher was just completing an MA based on observations of her classroom (Ross 2011). In September 2010, having been involved over a few years in occasional mathematics support within the school, I began work part-time on a freelance basis, for the equivalent of one day per week, as 'Mathematician in Residence' (for my job description see Appendix Five, iii, a). My role as both teacher and researcher at the school is discussed in detail in 2.5.

The issue of access to the field of study is both about whether participants are told what is to take place as well as about what they are told (Hammersley and Atkinson 1983). At the beginning of the data-collection period in the autumn of 2011, I spoke to all the teaching staff of the school, teachers and teaching assistants, to explain my research and how this related to, and differed from, my role as 'Mathematician in Residence'. All staff were given a handout relating to this explaining the research process, my plans for the research and my responsibilities relating to confidentiality, anonymity, disruption, their right of withdrawal, as well as gaining the informed consent of minors (see Appendix Five, iii, b). All staff took this away for consideration and individually signed a form granting me written consent to use the information gained both from interviews and informal discussions (for completed ethics form see Appendix Five, i).

I consider consent as informed (Mason J 2012) as I continued to negotiate agreement as the study progressed (Hammersley and Atkinson 1983). For example, whilst it was clear that interview data would be used and thus obtaining informed consent was quite straightforward, data arising from informal discussions is much less clear to participants. Thus prior to my making a record of anything arising from informal discussions with staff, I checked with the person involved if they were happy for me to note and use what they had said, explaining why I thought it was useful. At no point did anyone refuse consent. I am aware that such agreement could be as a result of the unequal power relationship that exists between researcher ('expert') and participant ('amateur') where the least powerful might find refusal difficult. However, although I cannot be sure that this was not the case, over time I had built up a relationship of mutual respect with the staff of my study school and there had been occasions when people had voiced their differences with my opinion or interpretation. We had a close but not cosy relationship and I did my best to reduce the effect of an unequal power relationship by seeking their views on what I was finding as well as continually emphasising the exploratory nature of the study. On the other hand, power relationships are complex and exist in all research even if we do our best to negate these (Crozier 2003).

Negotiating the ethics of videoing children in both classrooms was straightforward as videoing was being used increasingly in Maritime School for reflecting on learning and was already becoming accepted by staff and children (since my study ended, this has progressed very quickly and in 2013 four classes used iPads extensively to record learning with open access learning blogs including films, on the school website). On enrolling in Maritime School, parents and carers were invited to discuss with the Head Teacher the educational reasons and consequences of taking still or video images of children. They then signed a document granting their consent to video being used for 'educational purposes'. Only a few families declined their consent and this was usually for unavoidable complex reasons.

I spoke to the children in both classes about my research, explaining my role before beginning observations. I explained I was interested in what they were learning when engaged in role play mathematics. I explained the term 'research', emphasising 'search', and 're' as repeatedly looking again. I outlined the process I would be going through, i.e. writing notes, recording audio and film. I asked for their consent for videoing, explaining that it was necessary in order not to miss anything and allowing me to view what happened repeatedly. I asked for questions and for them to voice any worries. The Reception children did not voice any but the Year Four children were interested in me observing rather than teaching. They asked if they could see the films and when I said they could, seemed happy to assent. After the research was complete, I showed the two example films to the children involved for their assent and obtained parental consent for these to be included (Appendix Two, iii and iv). By then the participants were two years older and the Reception children (now Year Two) were excited by their film being included in a "book".

Once observations began the children largely ignored me as I filmed, although they were clearly aware I was there and the Reception children were more likely to interact with me (see 3.3.2). Later, when the observations were well underway, some children asked more questions about what I was doing and for what purpose. These I tackled honestly as they arose. The questions from Year

Four participants occasionally related to my choice of their group to observe, this extract is a typical exchange.

YEAR FOUR EXTRACT ONE

Group 1, Observation 4: French Café

***Re-view Interview* 06/03/2012: Cam (9y 1m) and Ellen (8y 11m)**

HW prepares to introduce video clip by first running through whole clip on fast-forward. Before I start the clip – Cam asks:

Cam: *Do you only do 'Triangles'?*

HW: *Oh, yeah, we've had this conversation before, haven't we? I have to sample only some children, and so, Mrs R and the person in London I work with and me had to pick a group of children, so between us we picked the triangle group, yeah. As a sample. Do you understand what a sample is?*

Ellen is giggling, they nod.

These children's preoccupation with my choice of group is analysed further in Chapter Four (4.3) but for Cam in particular it appeared to boost his self-esteem.

As the observations entered the second term, Sean and Saul in particular became interested in who was viewing the videos. Here is confirmation that informed consent is difficult to obtain, particularly with children. It was more a case of obtaining their assent and returning to issues arising, such as privacy, respect and confidentiality, at various stages of the research process. In this case the children not only asked about what I was doing but why I was not videoing the adults who are viewing videos of them.

YEAR FOUR EXTRACT TWO

Group 2, Observation 4: French Café

***Re-view interview* 06/03/2012: Sean (8y 10m) and Saul (8y 9m)**

Sean: *So, your job is to film people?*

HW: *I'll just stop this* [film clip] *a minute while I answer that question. Well my job is a teacher, but I am also a researcher*

Sean: *So you research what we are doing?*

HW: *That's right, that's exactly*

Sean: *Where do you work? In this school?*

HW: *I work in this school and sometimes I work in other schools, but mainly this school, and I work at a university in London, that's where I do the researching*

Sean: *You do research here and*

HW: *And then I take it back to the people in London and they have a look at it*

Sean: *And then, so you, so you take this to them ...*

HW: *Yes, yes*

Sean: *... what we've been doing and they have a look at ...*

HW: *Yes, yes*

Sean: *... all the films from your Flip*

HW: *Yes, yes. Bits, bits of films, they don't watch all of them, and I talk to them about*

Sean: *They look at that Flipvideo ...*

HW: *Yes*

Sean: *... do you do any with them, or not?*

HW: / [taken aback] *I haven't got any of them filmed, no!*

Sean: *Maybe that's what you should do* [laughs]

Saul: *Yes, show us what they do*

HW: [laughing] *Yes!*

Sean: *Yeah! Show us if they work or if they're just being nuts themselves!*

HW: *That's a very good point, I'll remember that!*

I was surprised by this interaction on two counts. Firstly, although I describe myself as familiar to these children, they are asking me questions about who I was and what I do – a clear indication that whatever I think I might have explained clearly might differ to what has been received. Secondly, I was surprised by the level of interest in my research and humbled by the boys' request to see those who are watching them. I took this request seriously and filmed my next encounter with my supervisors, with their permission. In allowing in the voices and views of the participants of research it seems important not to dismiss their concerns, in this case, whether those watching the films of them were behaving appropriately! Sean took seriously the video of my supervisory meeting, as the following entry in my research diary illustrates, also making insightful comments about how teachers (in positions of power) receive our work:

> *Showed Sean and Saul* [video] *clip of myself in meeting with* [two supervisors]. *They were interested! – particularly Sean, who asked questions: "Are they telling you to do more?" "How much did you have to write?" "What is she saying now?" "Don't they like what you have done?" "What have you got to do now?" "Why do you have to do more?"*

"Which one is the Doctor?" "Does she agree with her?" "Is she writing all over your work?" "I don't like it when teachers write all over your work" "Are they both reading what you have written?" "Did she say 'reflect'? That's one of our seven Rs!" [....] (The school ethos emphasised the 'Seven Rs' of Responsibility, Readiness, Resourcefulness, Resilience, Remembering, Reflection and Respect. See Chapter Three.)

Sean: "Have you got your work here [now]*?" "Could you bring it for us to see?" (Yes, they would like to see it! – with the writing over it) "How long have you been doing this /got to do this?" "How often do you go there?"*

15 minutes we are there!

Research diary entry, 29/05/2012

During several subsequent encounters with Sean following this meeting, he referred to it in some way with comments such as, "*We watched that film of the meeting together, didn't we?".* An underlying principle of all educational research is that it is conducted within an ethic of respect for the person and here is an example of this in practice in this study (Zeni 2001, BERA 2004, 2011).

Finally, my decision to use a qualitative, semi-structured interviewing technique with both children and adults supported my ethical goals in that it allowed space for the voices of interviewees. Initial questions asked by myself would hopefully stimulate discussion that would send the interview off in directions thought important by interviewees. Skeggs (2002) asks of research whether it is possible to hear the voices of the researched. One notable example was with two Year Four boys in Group 2 who used the interview to complain about what they saw as “bossy girls” dominating the role play (this interview is discussed in 3.3.2, when I discuss the effect of the use of the camera). However, there are problems in assuming that allowing in participants’ voices in this way gave me access to what they thought, as responses are affected by the inter-relationships within the group. As far as it is possible to ascertain, for both age groups of children, the sort of discussion typified by the semi-structured interviews was not too uncomfortable as it was not so dissimilar to other classroom discussions that they were engaged in during the school week.

As described in 3.2, in relation to interviewing adults, I undertook one semi-structured interview with each of the two teachers involved during the study and one with the Head Teacher at the end of the study. I deliberately adopted a more relaxed interview structure for the adult interviews to match the learning discussions that I had observed taking place amongst staff members in order to prevent additional pressure on extremely busy full-time teachers. I audio-recorded all three interviews so that could concentrate on responding to what was being said. All three adults agreed to being recorded and reported this interview experience as both enjoyable and thought provoking.

3.3.2 Observation

As stated previously, observation recorded on film and as field notes, was always going to be my key method of data collection. See 3.2.1, Tables Four and Five for details of these. For each of the videos of small groups taken in Year Four there is a corresponding audio recording made to ensure that I did not miss speech whilst the children moved about the role play area. The Reception re-view interviews filmed were also audio-recorded for the same reason. The remaining

Reception re-view interview was solely audio-recorded due to a battery failure in the Flipvideo camera. With regard to turning the observations into manageable data, the video footage was viewed and transcribed immediately after recording.

Adopting the role of an observer indicates that the phenomena under study is observable in the sense that things that can be seen, heard or felt and thus recorded. In the beginning I set out to see if I could observe anything that was recognisable as mathematical in the actions and speech of the child-participants. In order to observe, I wished to adopt a role that both imposed the minimum of limits on my observations and that least disturbed the situation (Ellen 1984). Participant observation is one method of conducting fieldwork (Pring 2000) and so, what level of participation did I want? All research requires some degree of participation on behalf of the researcher, even minimally by those conducted through highly formal methods. In anthropological research, participation is a matter of degree (Ellen 1984) and all observation can be seen as existing on a continuum from overt non-participant observer to covert participant. Participant observation "*... is an oxymoron, a form of paradox which generates meanings as well as permitting different – indeed contradictory – interpretations."* (Ellen 1984: 216). I asked myself; What might 'participant' mean? How much do I participate? As a part-time member of the study school staff, I was by definition a participant in the context I was studying, already interacting with both children and adults. As such, access to my field of study was not the problem it can be in ethnographic research (Hammersley and Atkinson 1983, Hammersley 2002). I was already immersed in the context and wished to better understand what was going on. My role as a teacher at the school and the effects this had on my study is discussed in detail in 3.5 where I explore my positionality.

My epistemological position led me towards a form of overt, participant observation for this study (Mason J 2012). Although I might have conducted my research covertly as a pre-existing member of staff, nothing would be gained from doing so. Covert observation was neither ethical, justifiable nor pragmatic. Covert data gathering would not reveal anything that could not be uncovered more transparently. Organising covert observations of children would have been unfeasible and it would have been impossible to discuss my findings with staff and children.

Although a participant observer, I engaged in two sorts of participation in this study. On the one hand, I was more 'objective' whilst observing the children's role play, interacting with the children as little as possible, and on the other hand, whilst conducting the interviews, I participated fully by interacting with the interviewees. Whilst undertaking the observations I distinguished between my role as teacher and as researcher in order to focus on the phenomena I wished to explore without the pressure or interference of teaching. I was clear about this distinction with both staff and children. I would of course be visible (sitting on one side) but I sought to make it clear that I was not to 'be seen' as a teaching adult. I needed to interact more when interviewing in order to generate more data and the transcripts of these show more of a blurring between my roles as teacher and researcher.

My research role is best described as *non-participant* in the sense of neither being a member nor a teaching adult in the children's role play (or attempting to, as non-participation was not always successful nor practical, of which I say more later) but *participant* as an adult engaging in discussions with the children and colleagues in the two classes. Although participant observation of this nature (where the researcher is part of the context of study) lends itself to criticisms of observer bias, it also gives credibility to research findings for practitioners who can be critical of research that is undertaken by those who have little experience or knowledge of the issue they are researching (Pascal and Bertram 1997, 1999a, 1999b).

(i) Recording observations on camera

Having decided not only to observe but also to record on video, several practical issues needed to be considered. I used a FlipVideo camera, a small, handheld camcorder for digitally video recording the action as I felt this was small enough not to be intrusive. It was also portable so could be moved if the children re-located to a different space which was more of an issue in the Reception class. In the Year Four class it was relatively easy to be a non-participant observer of the children's role play. Having previously explained that they would see me sitting nearby, filming and taking notes and that I would not be saying anything, I sat to one side of the designated and quite contained, role play area with my notebook and the camera set up on a small tripod. I deliberately appeared very involved with my notes as the children arrived. In my experience this was the time they would be most aware of my presence. They seemed willing to accept me in this role and rarely spoke to me, only occasionally glancing at me or checking that I had the information I required, for example Sean (8y 6m) asked as I packed up my camera at the end of the first observation (01/11/2011); "*Any good?"* The longer the researcher is in the field, the less the disturbance will be on what is being studied (Ellen 1984) and it appears from analysing my videos that these Year Four children became more used to my role as researcher.

In the Reception Class it was different. Whilst relatively easy to video the children ‘unobtrusively’ (they were used to adults observing their play, making notes and occasionally video-recording them) the role play did not take place in one designated area and it was often difficult to observe from one position. The behaviour of the children indicated that they seemed less aware of the camera and issues of ethics and their agreement were thus more difficult to tackle. I had explained to the class why I was recording them (“to find out how you are learning”) and always answered questions directly about what I was doing when asked but I can be sure that the repercussions of what I was doing were not fully understood by such young participants. Moreover, being a non-participant in the Reception children’s role play was not always practical in that they talked to me whilst I was observing. It felt perverse and unnatural (as well as rude) not to answer in these situations. In the event I evaded eye contact as much as possible to avoid being ‘seen’ (Burgess 1984), answered practical questions immediately (such as how to operate a stopwatch) and simply ignored questions that it seemed might involve me further in the role play, by appearing to be ‘too busy’ to answer. On occasions when I felt I had to answer, I would attempt to give as minimal an answer as possible. This however, was not always successful as there were occasions when I did become involved in the play and departed from the ‘non-participating observer’ role. The Reception children were keen to watch the resulting videos, perhaps not surprisingly they enjoyed watching themselves and their friends, expressing excitement when recognising themselves and others.

The children in Year Four were aware of the camera and the camera did affect what happened. They made comments about the position of the camera and were observed ‘speaking’ to the camera as an audience. They were also aware that the resulting film would be viewed not only by myself but by their peers and their teachers as well as my colleagues outside school (see 3.3.1). As a result, I latterly included a question on the effect of the camera in the re-view interviews. Both groups agreed that the camera did have an effect. Here is Group Two's reasoning.

YEAR FOUR EXTRACT THREE

***Group 2, Observation 4: French Café,* 06/03/2012**

***Re-view interview*: Sean (8y 10m) and Saul (8y 9m)**

Extract about 11' into recording.

HW: *So that's my question I was asking, Saul, do you think the camera affects, do you think the camera affects how you behave?*

Saul: *Yeah, I think it does, because like you know that something's watching you*

HW: [laughs] *Like Big Brother!*

Sean: [to Saul] *I said to Mrs Williams that I think you've all been a little bit sillier than what you were. Because a few weeks ago, you and Cara were just nuts and now you are even more nuts*

Saul: *Yeah, I know, I don't really want to say that in front of* [...]

Sean: *Yeah, but I do think you really are nuts now!* [giggles]

Saul: *But like, if something's watching you and you like, don't know what they're going to do with the film ...*

Sean: *No, you don't know do you? But*

Saul: *... so compare* [Sean whispers to Saul]

Sean: *I think he was more silly in that, than what he was when the camera wasn't there.*

The camera could have resulted in ‘better than usual’ behaviour or ‘playing up to the camera’. Analysing the Year Four children’s comments, I can identify several threads; firstly the camera makes you ‘silly’, secondly (and paradoxically) you are aware that the film will be watched and thus it might make you less ‘silly’ and thirdly, as the research continued, worries developed about who was going to watch the films. In the extract above, Saul shows his realisation of the possible repercussions of being filmed, despite my previous explanations. Early on during the re-view interviews, the Year Four children expressed reticence about the film being shown to the class and on these occasions I asked the children if they would prefer me to stop the video being viewed publically (see Chapter Six, 6.2.1). Once I explained that the extract was chosen as an example of “good learning”, the particular child concerned changed their mind. Whether this reticence was about being seen as ‘clever’, ‘stupid’ or as ‘showing off’ is not clear but it does appear that the camera might have revealed the sense of accountability they felt about their play, in that they did feel they had to be seen as being on task.

Videoing children and viewing the films publically, including, or maybe especially with their peers, needs careful consideration and sensitivity. The respectful ethos of this school made such public displays of mathematical thinking a positive experience hence, in a study which has as its central themes children’s developing identities as mathematicians and how to positively influence their attitudes towards mathematics learning, it would be ironic if the very research methods employed contributed negatively to these attitudes. It was important that I strove continually to check the children were happy with the videos being shown.

Interestingly, in one very revealing interview, two children in Year Four made clear their awareness of the power of recording events. On this occasion Sean and Saul both made several suggestions as to how I might hide the camera to record the "bossy" behaviour of a girl they saw as disrupting their play. The 29 minute-long interview was dominated by such suggestions, culminating in this suggestion that I hid the audio-recorder:

Group 2, Observation 4: French Café Re-view Interview

06/03/2012: Saul (8y 9m) and Sean (8y 10m)

Sean: *Actually, maybe, you could hide [...] in one of us two's pockets ...*

Saul: *No*

Sean: *... one of those speakers*

Saul: *Not in mine, because*

HW: *No I <u>can't</u> do that! That's what they call unethical!*

After some discussion and my more tentative earlier refusals to secretly record the girls, I felt that a flat refusal was my only option.

The view of a camera as 'never lying' is now discredited (Mason J 2012) as a camera has only a partial viewpoint, recording what is in front of it out of context of the remainder of the surroundings. Moreover, what is recorded still has to be interpreted, just as do observations made in real time. For these reasons, I made additional notes in my Fieldwork diaries whist recording and, when possible, used a small audio recorder as back up. I found that when I listened to these audio recordings not only did I hear speech that was inaudible on the FlipVideo but also, in keeping with Griffiths (2011), I was alerted to different things, therby increasing the scope of my analysis. As well as audio-recording the Reception children's re-view interviews I also filmed them, as I felt (correctly as it transpired) that the younger children's facial expressions and body language would be as informative as their verbal interactions.

Whilst acknowledging the shortcomings of the camera, this was the only way this study could proceed with the likelihood of generating useful data about what happened when children played at mathematics. Moreover, what evolved during the research was the critical role the films played in generating evidence of children's reflection on their mathematics. This supports the findings of Robson (2010) and Tanner et al (2011) who found such video data provided a context for shared discussions about young children's thinking and learning, as well as ensuring that children's voices were heard in the research (Robson 2010). The two sub-sections that follow discuss these two aspects.

3.3.3 The re-view interviews

Semi-structured interviews with the children became an important data source as the study developed (analysed in Chapter Six). In Year Four the interviews were planned for each role play group one week after each observation, once I had had time to both transcribe and reflect upon what I had observed. Their original purpose was to corroborate what I was noticing and to obtain some insight into participants' thinking, hence, a combination of informal interview and respondent validation. The interviews were audio recorded and to minimize the effect of this I positioned the small recorder out of the line of sight of interviewees.

Rather than asking everyone the same standard interview questions I prepared a set of questions from which to select during the interview. My points of comparison were the differences and similarities in answers to similar sets of questions which in turn generated themes and possible lines of development. See Appendix One (iii) for examples of open-ended interview questions and Appendix Four for transcripts of a re-view interview with both Year Four (Appendix Four, i, a) and Reception (Appendix Four, i, b).

As the re-view interviews with the children took place in a group or pairs this affected what was said and how the interview progressed. Whilst it probably made it more difficult to control the direction of the interview and occasionally provided a hiding place for someone who did not wish to answer, the group interview had the advantage of participants prompting each other to speak (Hammersley and Atkinson 1983). The Year Four re-view interview described above (Group 2, Observation 4) is an example of a paired interview which led to a disclosure that might not have happened in an individual interview, nor in a mixed gender group interview, as the pair of boys took advantage of being alone with me to say how they felt.

My audio data consists of 18 audio recordings (in addition to those that match video recordings) ranging in length from 7 minutes and 16 seconds to one hour, eight minutes and 10 seconds. 11 of these appertain to Year Four, three to Reception and four are categorised as ‘other’. This latter category consists of three discussions recorded as a result of presenting papers on my research, recorded for purposes of triangulation and peer validation, plus an interview as my research drew to a close with the Head Teacher of the study school. Adult interviews were decided upon as the research progressed and further questions arose: ‘theoretical sampling' (Glaser and Strauss1967). The details of my audio data are presented in Table 7:

Table 7: Details of audio data: 18 recordings

Description	**Dates**	**Audio category & length**	
Year Four		**Class**	**Group**
3 re-views of 3 role play tasks 'Tide Times' 'Fish Patterns' 'Pricing Paintings'	 07/11/2011 22/11/2011 09/12/2011		Audio of each group review (6 audios)
Ordering Numbers activity (prior to auction)	07/12/2011		1 audio of 1 group
Re-view of 'French Café'	06/03/2012		3 audios of pairs from each group
Interview with Year Four teacher	22/03/2012		1 audio
Reception			
'Cops' re-view 'speed camera' footage	20/03/2012		Audio with 1 group
Interview with Reception teacher	17/04/2012		1 audio

Re-views of Usain Bolt video	31/05/2012		Audio with 3 pairs
Other			
Feedback from BSRLM paper	November 2011		2 audios
Discussion with participant of session at ATM	14/04/2012		1 audio
Interview with Head Teacher	26/03/2013		1 audio

The 're-view interviews' immediately generated unexpected information which in turn made a major contribution to both the direction of the study and its findings (see Chapter Six for an analysis of the role and development of the re-view interviews). Significantly, I had decided to select a portion of the role play video to use as a stimulus for discussion in the interviews with the Year Four children and it was this that proved to be fertile ground for generating further data, particularly on metacognition. This supports the findings of others into the role that this type of visual stimulation can play in encouraging even young children to reflect on what they have learned (Robson 2010, Tanner et al 2011, Griffiths 2011).

The process of selecting the video to use in the children's interviews is discussed in 3.3.4. I prepared for the re-view interviews by watching the recording of the role play and deciding on some open-ended questions to select from in order to encourage discussion amongst the participants. The open-ended questions were first recorded in my Fieldwork notes, dated 29/11/2011 and are reproduced in Chapter Six (6.2.1). The decision to keep my questions and approach open, sometimes merely repeating what the children had said is described in detail in Chapter Six and was based on the strategy of *re-proposal* (Malaguzzi 1993, Parker 2001) to encourage the child, rather than the questioner, to expand on what they saw and heard. After Malaguzzi (1993) my re-view interviews made use of video in what I termed '*visual* re-proposal'.

I was concerned to allow participants' voices to be heard in my interpretations as a form of respondent validation. Thus these interviews also took the role of an ongoing process of participant validation, giving participants some element of control over the research process (Crozier 2003). The questioning process was similar to 'non-directive' questioning, designed to trigger interviewees into talking more about something the interviewer identifies as important (Hammersley and Atkinson 1983). In the event I found I had to concentrate in order not to evaluate the children's comments but instead to encourage children to "say a little more" in order to obtain the maximum opportunities for data to emerge. It was not difficult to persuade the children to talk in the interviews, probably due to a combination of their enjoyment of watching themselves on video (Griffiths 2011), my familiarity (see 3.5) as well as their previous experience in small group discussions.

As the study got underway, I also used a semi-structured approach to interviewing the adult participants. For these interviews I prepared a set of open-ended questions about particular episodes, asking some similar but some different questions in each interview to generate situated knowledge and to generate discussion about potentially general issues of wider relevance (See Appendix One, iii).

Owing to my efforts to make the study naturalistic, all my semi-structured interviews remained flexible and responsive to the developing discussion, hence each is as distinctive as the participants, thereby producing a rich, deep vein of data for analysis. Both interviewees and interviewer, as is the case with any social interaction, structured all interviews (Hammersley and Atkinson 1983).

3.3.4 Visual re-proposal

A key method of data collection that emerged as the study progressed was 'visual re-proposal' (my terminology). It borrows from the strategy of *re-proposal* (Malaguzzi 1993, Parker 2001) used as part of the observations that take place in Luis Malaguzzi's Italian pre-schools in order to encourage the child, rather than the questioner, to expand on their thoughts and ideas. Re-proposing involves an adult recording a snippet of overheard speech to later re-read to the child. This is done without further comment or evaluation from the adult. 'Visual re-proposal' (VRP) makes use of a visual record for such stimulation.

As I transcribed the video recordings from both classes, I questioned whether there was anything happening that looked remotely like mathematics. I selected video extracts to use for VRP where speech was clear and where there seemed to be some discussion or disagreement the children were attempting to resolve in relation to mathematics. They were moments that I felt exemplified some mathematical activity or thinking, or a significant moment during the task. My question for the VRP interviews was whether I could corroborate what I noticed by talking with the children. As a result of my evidence gathering, further questions emerged, including whether I had evidence of the children engaging in reflection and metacognition. My first attempts at using VRP with the Reception children confirmed that the younger children were interested in and able to talk about what they could see themselves doing. This corroborated the research findings of others using 'visually stimulated recall' (Griffiths 2011) and 'video stimulated reflective dialogue' (Tanner et al 2011), later described in Chapter Six.

Although the structure of the re-view interviews was broadly similar between the two classes, the timing differed. I felt that for a re-view session with the Reception children to be informative, interviews had to take place almost immediately after the children had been filmed, rather than timetabling interviews to occur a week after the observation had taken place, as I had in Year Four. Thus I had to quickly select an extract to use with the Reception children prior to it being transcribed. Whilst not ideal, this was more enlightening as children viewed a record of their play in which they still were interested.

3.3.5 Field journals

My final data source comes from what I am broadly calling my field journals, consisting of both hard notes taken whilst in the field and reflective notes made electronically as entries into what became a 'research diary'. The making of long observations without creating time for reflection leads to data of an inferior quality (Hammersley and Atkinson 1983). My field journals reveal a continual movement between observation, reflection and recording during the period of the research. Whilst observing or interviewing I made notes in the field notebook of anything that the visual or audio recording might miss, or thoughts that occurred to me to follow up. Entries in my research diary (typical example below) reveal reflections, questions and decisions on what to investigate further resulting from my observations, discussions (with supervisors, colleagues and peers) as well as readings. Birks and Mills (2011) call these 'memos', essential records of the researcher's thinking during the process of conducting a grounded theory study (see 3.4, below). The example that follows is a record of the Year Four teacher's impressions after she had viewed the video footage of her children in the 'French Café' role play. In this example, the teacher's words are in italics, my thoughts are non-italicised:

> <u>[Notes made from a conversation with] *Mrs R, 01/03/2012:*</u>
>
> *The fact* [the] *teacher isn't there – she can't interfere so it is real 'learning at a distance'.*
>
> *The maths is in their court. Impact: talking maths, making* [their] *own maths...*
>
> *Play means there is not necessarily a 'right answer', they are confident to have a go.*
>
> *Don't use the plenary to get worried because the result is not as you expected.*
>
> Tasks – [should be] simple starters for children to develop.
>
> Why? If they are to understand and apply their maths we need to offer them opportunities and see them formulate and follow through a problem.
>
> **Research Diary entry, 01/03/2012**

Retrospective reading of my electronic research diary entries reveals a log of the development of both my thinking and my methodology as I attempted to understand more about what I was observing and to analyse the generated data in relation to the discussions that I was having, seminars and conferences I attended and readings I was completing. The entries, outlined in Table 8, chart the development of my grounded theory enquiry and link to the reflective notes I began to make alongside my transcriptions of the video observations.

TABLE 8: SUMMARY OF RESEARCH DIARY ENTRIES

Date	Content	Entries
Beginning of 2010	Initial research ideas	1
Sept 2010	Personal life history	1
October 2010	Possible theoretical perspectives	1
October 2010 - May 2011	Autobiography of my research questions, thoughts on ‘what is learning?’ Thoughts after initial Reception observation, thoughts after visit to secondary school, discussions with staff, readings, presentation to colleagues, supervisory meetings and Research Methods seminars.	19
November 2010	Main research questions, methodology, research proposal. Notes on main themes.	3
Feb/March 2011	Qualitative Research - Notes on readings	3

May 2011 – May 2012	Notes on research methods, sampling, notes on findings in Y4 & Reception, notes on staff meetings, discussions with colleagues, supervisory meetings, reflections on RM seminars and conference.	15
May 2011 - August 2012	Notes on Reflexivity, my methodological position	10
July 2011 – July 2012	Thoughts and reflections on role play	4
November 2011	Notes after presenting paper at conference of British Society for Research into Learning Mathematics	1
April 2012	Validation notes from conference of the Association of Teachers of Mathematics (ATM)	1
13/04/2012	Notes on conversation with ATM session member	1
July 2012 – End 2012	Thoughts and reflections on discussions with colleagues, supervisory meetings, staff meetings etc.	6

I also kept records of what I was reading and electronic notes on readings directly related to the main themes of my study. These diary entries only ended when my writing up begun in earnest.

If reliability is about how accurately my research methods and techniques produce rich data (Mason J 2012) then my findings can be described as reliable as this study generated a variety of data. The following section outlines the process of my data analysis although I do not see data analysis as a discrete and separate stage of the research process, but rather as ongoing throughout the project (Mauthner and Doucet 2003).

3.4 DATA ANALYSIS: Grounded theory

Grounded theorizing (Glaser and Strauss 1967, Corbin and Strauss 2008) was the most appropriate research approach for this study as opposed to the prior identification of categories or external theories to be tested and measured. A distinguishing feature of grounded theory research is that data collection and analysis are concurrent, allowing data from initial research encounters to be analysed before more data is collected (Birks and Mills 2011). This section describes grounded theory methodology in relation to this study and my research questions.

As my data collection began, I considered approaching the analysis through discourse analysis, a method of studying how the language we use links what we say to what we do and who we are (Gee 2011). Discourse analysis examines conversation, text or narrative in terms of a set of structures, such as that used by Kaartinen and Kumpulainen (2012) to unpick social interaction in two early education mathematics episodes. I could also have analysed what I was noticing against features of mathematical communities of practice (Wenger 1998) or categories said to distinguish ‘math talk communities’ (Hufferd-Ackles et al

2004). Below is an extract from my research diary dated November 2010, where I consider possible frameworks for analysis based on what I had been reading:

> *Evidence can be gathered by setting up observation schedules (Wragg 1998) based on observable items; for example 'where is my evidence for* [for example] *increased involvement (time on task without adult interference?)* [or] *an increase in the quality and nature of mathematical communication? Is there evidence of 'exploratory talk'? Or 'sustained shared thinking'?*
>
> [...]
>
> *Discourse analysis could be used to analyse written, recorded and filmed observations.*
>
> *Observations* [of] *children and subsequent de-briefings/semi-structured interviews with children (participants and observers) after role-play can be used to check observations – eg "It seemed to me that... how was it for you? What are you feeling/thinking about this?" These 'peer reviewed' discussions can also be had with staff.*
>
> **Research diary entry, November 2010**

I rejected this approach early on after making use of the involvement proforma developed by Laevers and his colleagues to classify the level of participation observable in young children (Laevers 1993). It seemed to me, that whilst confirming whether or not an identified category was evident and to what degree, discourse analysis of this sort did not allow me to be open enough to notice emerging themes that might be relevant to develop my analysis. The possible consequences of working in this way would be to restrict what I might find.

Instead, evidence of themes and categories within my accumulating data were identified as the data collection progressed. This study is a piece of grounded theorizing in the sense that my starting point was a ‘foreshadowed problem’ (Hammersley and Atkinson 1983) that maybe role play was not effective for learning mathematics. This study is based on my generating data which was scrutinised for recurrent themes, codes (Birks and Mills 2011) or categories (Hammersley and Atkinson 1983) and gradually, the development of possible theories (Glaser and Strauss 1967, Corbin and Strauss 2008). In this way, typical of much ethnographic research, it moves between the topical and the generic (Glaser and Strauss 1967).

My original stimulus was an interesting observation that in this one situation, the ‘foreshadowed problem’ might not be the case, that role play was *not* effective in learning mathematics. I set out to investigate if this was indeed so by observing in this one school context. At this point, an initial search of secondary literature revealed a lack of research into this area and my data collection began. As my observational data accumulated, a process of ongoing reflection and reading resulted in my identification of a number of potentially useful themes to investigate further. What differentiates grounded theory research from other types of research design is that data collection and analysis are not separated and data from the initial research encounters are analysed before more data is collected (Birks and Mills 2011). After transcribing each audio and video recording, my transcriptions were trawled for evidence of commonalities or surprises, with sections of the transcribed text highlighted, reflective notes added, and cross references made by colour-coding themes, or ‘coding the record’ (Hammersley and Atkinson 1983). This process is described in more detail in Section 2.4 in this chapter.

Grounded theory is appropriate to this study as I was not starting from a set of hypotheses to prove but instead beginning with a case and systematically generating theory from the analysis of the data in order to formulate more general statements. Beginning with hypotheses such as, “children learn mathematics through role play when ...” would have led to my recording instances of this or that, but would have missed those ‘somethings’ that I had not previously identified as important. The process of grounded theorizing, whilst posing initial potentially important ideas (in this study, for example, the effect of the role of the teacher and pupils’ attitudes to mathematics) allows for not only new questions and lines of investigation to be articulated but also for those posed initially to be investigated more thoroughly and systematically (Hammersley and Atkinson 1983). My methodological approach developed so that I:

- behave intuitively in open-ended situations;
- remain open-minded to what I might find but remain informed by my conceptual frameworks.

My intention was to assemble a series of written-up, annotated observations from two classrooms, which would be analysed and pulled together to build an inductive argument that here I observed something taking place and here something else happened. This argument, together with an examination of the decisions, actions and initiatives that have been taken by teachers leading up to and influencing these moments, either negatively or positively, would constitute the specific examples to be used to construct some general propositions. From both classrooms positive data enabled me to identify structures or features of role play that led to more mathematical thinking taking place and negative data (in the sense of there not appearing to be much observable mathematics) helped me address questions as to why and what might be done to alter this? This has resonances of Mason's 'noticing' paradigm (Mason J H 2002) as I observed and subsequently evaluated what happened in relation to decisions that were made.

My initial analyses focused on whether I could observe anything that was recognisable as mathematics happening at all. As the observations continued, I went on to search for other methods of data generation that were ontologically and epistemologically appropriate to this study in order to address the emerging research questions and themes, such as the children's ability to engage in metacognitive reflection. In one sense grounded theory cannot exist, as all researchers operate with ideas in their heads and thus have preconceptions of what to look out for. Some of my observations bore out the pre-conceptions that I held, but many emerged as my data was analysed, hence I framed additional questions as the research unfolded.

In all, it is now possible to identify three phases of thematic analysis during my research in both classrooms. Firstly, my watching and transcribing of each video recording with anything of note in relation to my research questions identified and, latterly, colour-coded; and secondly, the identification of video 'extracts' to re-view with participants and teachers. The third and final phase was the re-view interviews which were recorded and transcribed and which in turn led to further analysis. Retrospectively, this process can be seen as a continual movement between particular episodes and potentially general conjectures which emerged while interpreting the particulars of the activity. This has similarities to the movement between the general and the particular that occurs in mathematical knowing (Cobb and Bauersfeld 1995). In the following diary extract, also from November 2010, I am aware of both the problems and possibilities of approaches to grounded theory of this sort:

> *Neither learning nor mathematics can be 'seen'. Observations will be analysed and interpreted by all adult participants, and some children – peer review and triangulation.*
>
> *There is no such thing as an accurate interpretation. The process of acting on our interpretation of events happens every moment of every day in every classroom. Becoming aware of differing interpretations (the epistemological 'shudder' of MacNaughton (2005) and peer-checking analyses give us choices about how to behave.*
>
> **Research diary entry, November 2010**

I recorded faithfully my justifications for the decisions I made when deciding what and how to record and observe. My analysis began whilst transcribing the recordings, as is clear from comments I added to the typed transcripts (in red to distinguish these from the observation itself). These transcripts were then printed and glued into my fieldwork notebooks, where the right-hand page was left blank for analysis and where the analysis that had started during transcription was further developed. This process was ongoing throughout the entire period of the study as I read and re-read these transcriptions and notes, asking myself, 'what are the issues here?' As the observations increased, I scrutinized them for themes and systematically searched for threads of similarity and comparison and later, colour coding themes, which as the data built, gradually became theories. I was searching for what I thought the observations might mean as well as recording the route by which I came to the interpretations I made. Also recorded was evidence of methodological issues such as the influence I noticed of the camera and recording equipment on what was happening. These were preliminary analyses worked out in the field, or 'substantive memos' as identified by Burgess (1984). Birks and Mills (2011) pinpoint the keeping of what they call an 'audit trail' of memos to trace the researcher's interactions with both data and participants as key to promoting quality in grounded theory.

I was going through a process of revisiting my data (films, audio recordings and diaries) a number of times for different reasons, wearing different lenses, in order to extract the most from these. I also revisited the data with others (colleagues and children) in order to 'see' with their eyes. I derived hypotheses from my accumulating knowledge in order to describe and explain actions that I observed, testing these out against further information that I gathered (Hammersley and Atkinson 1983).

The main themes identified in my fieldwork notebook after my data collection period had been completed were as follows:

<u>*Possible categories to explore when analysing data:*</u>

- *exploratory talk, reasoning*
- *mathematics, problem solving, situated cognition - analysing complex processes - what these experiences provoke in the teachers' and children's thinking Vs identifying learning*
- *involvement, engagement, caring about maths,*

- *role play, performance*
- *culture of classroom (resources, structuring tasks, introducing tasks, teacher behaviours, group dynamics, ground rules ...)*
- *gender (identities, group dynamics, maths Vs play)*
- *metacognition.*

Research diary entry, 27/09/2012

These themes are all traceable, to varying degrees, within this final thesis. Decisions I made on these categories for interpretation can be traced to the ontological and epistemological assumptions of my research. Ontologically, the kinds of phenomena these themes represented were the existence (or not) of talk, interactions, actions and behaviours as well as the ways participants interpreted and acted on these. Epistomologically, the kind of knowledge and evidence that these categories comprise is interpretive, reflexive and based on a feminist standpoint on the primacy of participants' experience or 'voice' – discussed further in the following section.

3.5 POSITIONALITY

This section outlines how my role and my background as an experienced primary teacher bringing my own world view to the research situation has influenced this study.

> *"Assuming we understand how the presence of the researcher shaped the data, we can interpret the latter accordingly and it may provide important insights."* (Hammersley and Atkinson 1983: 112)

"*Researchers are a sum of all they have experienced*."

(Birks and Mills 2011: 11)

This piece of qualitative, grounded theory is based firmly within the tradition of feminist research (Skeggs 1994, May 1998, Maynard 1998). Not in the simplistic sense of being "*... research on, with and for women*" (Kelly, Burton and Regan 1994: 29) but rather in the sense that such research seeks to challenge an empiricist view on the organisation and validity of knowledge. Qualitative methods are not specific to feminist research, the methods themselves do not define a piece of research as feminist or otherwise. Instead it is to do with how these methods are used and the fact that feminist research is rooted in the belief that all knowledge is contestable and partial (Kelly et al 1994).

I view the researcher, the method and the data as being reflexively interdependent and interconnected (Mauthner and Doucet 2003). Feminist research rather than being based on a set of pre-determined assumptions to measure or categorise, is exploratory and investigatory (Maynard and Purvis 1994) and rather than trying to 'iron out' (Kelly et al 1994) complex social phenomena, seeks to respond to these by reproducing them as accurately as possible whilst continually reflecting on these. The feminist research tradition is a fundamental component of this study because it was important to me, first and foremost as a practising teacher, that any research I undertook spoke cogently to other teachers and thus was strongly grounded in the complexities of the modern primary classroom.

Having decided to produce a small, detailed study with participant observation at its heart, the issue was to do so in conjunction with an honest attempt at transparency regarding both the research processes and myself as researcher (reflexivity) (May 2000). Self-critical reflexivity is central to qualitative research and marks a departure from what has been referred to as "*Futile attempts to eliminate the effects of the researcher.*" (Hammersley and Atkinson 1983:17).

Moreover, as this study sought to clearly reflect the voices of those studied with an emphasis on knowledge as being generated by participation as opposed to passive acquisition (Sfard 1998) there is no longer a clear distinction between myself as the researcher who 'knows' and others who do not. As a reflexive researcher I am not discovering truth, but rather, constructing some truths. I see knowledge as always incomplete and I am merely a contributor to this developing knowledge bank. I am not working as an individual but see myself as 'standing on the shoulders of giants'.

My account is situated, partial and developmental. There are tensions between producing an authoritative account and recognising my account as one story amongst many. This is the basic tension between situated and universal knowledge (May 1998, 2000). Have I captured the voices of those I have researched? Collecting a range of data and sharing it with participants perhaps makes such 'capturing' more likely, alongside the adoption of a critical approach to data I have collected.

Reflexivity points to the limitations of any account in terms of partiality and positioning (May 2000). There are two aspects to being a reflexive researcher that I discuss here:

(i) how my previous experiences shaped both the research process and my interpretations or my ‘theoretical sensitivity’ (Birks and Mills 2011) and

(ii) the challenges and advantages of my role(s) in the study school.

3.5.1 My previous experience

I am a female, white, middle class primary teacher, consultant and advisory teacher. Being explicit about how one’s race, class, gender and history affect the research is important in any research, qualitative or quantitative (Mauthner and Doucet 2003) as what any observer sees depends upon their experience, the context and their expectations (Pheonix 1994, Mehra 2002). What brought me to my research questions and shaped my research were my experiences of mathematics as a learner, as both a primary teacher and consultant, and as a teacher-researcher in my own classroom. At the root of this was my background as a learner who found mathematics neither easy nor enjoyable. Having experienced mathematics as a learner as fragmented, de-personalised and fact-dominated, seeing it as a ‘male’ pursuit, I had decided it was ‘not for me’. Whilst teaching 5- and 6-year-old learners at the beginning of my career I began to understand and enjoy mathematics in a way I had not previously and I became a mathematics educator to attempt to counteract what I felt had happened to me.

I began this study after 30 years developing my own teaching practices and my personal pedagogy which laid emphasis on mathematics that was exploratory and inclusive. This, plus my additional personal bias of a belief in the value of play in children’s learning, influenced this study (Mehra 2002). In 1989 I completed a Masters degree researching the mathematics experiences of the young children in my class (Williams 1989). This study made use of Mason’s ‘noticing’ research paradigm (Mason J H 1982, 2002) which enabled me to document my journey towards some clarity about the influences on both my teaching practice and the learning of the children in my class. This could be described as the beginnings of my reflexivity.

Moreover, I came to this study as a politically interested teacher who had spent many years seeking out like-minded others in the mathematics education community attempting to ‘personalise’ and humanise mathematics education for the children I taught. I was affected by what had been happening nationally in the name of education, by what I saw as a narrowing of the curriculum as well as my critical view of increasing government control over education. Thus I set out to look for evidence of the effectiveness or otherwise of an approach that prioritized learners over mathematics content and teachers over curriculum diktat.

This personal history is part-and-parcel of how I collected and interpreted information and reached conclusions, a process that connects experience to understanding (Maynard 1994). What I chose to read inevitably influenced how my research developed and led to particular ways of seeing during my data analysis.

3.5.2 My role in the study school

Chapter Two (2.3) describes my relationship with the school, this section analyses how this affected the development of the study.

What were the challenges and advantages of my role as both ‘mathematician in residence’ and as a researcher (Robson C 2002)? I could not be a ‘fly-on-the-wall’ but my role afforded me a level of understanding of the research setting simply because I was part of it. For example, I was able to check out my observations and assumptions with staff that accepted me and were happy to talk to me. Many informal discussions of this nature did indeed take place, much as many do between school colleagues in the normal school day and I made note of these after they took place in my fieldwork diaries. Although this could be criticised in terms of my being drawn into the teachers' perspectives with inevitable bias, it would have been difficult and problematic to avoid such conversations in a school day. They provided insights into what was happening that I would not have otherwise had and I carefully documented these, auditing the trail (Birks and Mills 2010) to keep track of where the interpretations had come from.

This study draws on my strengths as a teacher and as a teacher in a school where I am known (Robson C 2002). My relationship with staff was close but not cosy in that I had been brought in to analyse and develop the mathematics teaching within the school. Although entering the school as a 'mathematics expert', by teaching alongside staff it was possible to work through the initial stages of wariness, occasional hostility and doubt, and, as far as anyone can, I know what the staff thought of me. I was familiar to staff and children and my gender and age reflected the predominant staff profile which might have made me less threatening, affording me maximum access to the setting. Having already invested something of my own personality into the school setting, relationships with participants were less hierarchical (Birks and Mills 2011). All this must have a significant bearing on the kinds of relationships established and the data collected (Hammersley and Atkinson 1983). Maintaining genuine relationships of trust were critical to me in both my teaching and my research and I worked on these continually. By the time this study had begun, trust and respect were mutual between myself and other teaching staff. For example, I had shared the Reception class with Miss H during the summer term prior to my research beginning, which established an atmosphere of candid discussion. This was developing with the other adults in the school who knew me less well, so that when introducing my research project, I was able to be honest enough to say that I was not even sure I would find anything worth finding. As the study progressed, there was a degree of what Birks and Mills (2011) refer to as reciprocal-shaping in relation to the study with both teachers of the classes observed. My approach regarding my research with both children and adults was straightforward, answering any questions directly.

In addition, it helped that I was known to the children, in a situation where a researcher is in a particularly powerful position in relation to a child. It was a challenge on occasions to remain in the observer's role when observing (especially in the Reception class) but my familiarity meant that the children were more able and willing to ask as well as to answer questions, as evidenced later in this study. There is some evidence that the Year Four children in particular did not me see me as a teacher, which might have led to some of the more candid discussions occurring in the re-view interviews.

Another advantage of working in the setting was that gaining access was not a problem which it can be in ethnographic research where the researcher generally has little power and people have little reason to co-operate (Hammersley and Atkinson 1983). Moreover, I could be flexible about the observations, interviews and discussions in a way that an outsider could not have been. This led to a more equal sharing of power as interviews, discussions and observations were scheduled according to what suited participants. This made the research process almost seamless in relation to my teaching work from the perspective of the school and the two classrooms directly involved hence less of an intrusion. However, this advantage from the school's point of view was a complication for me as I constantly sought to separate my two roles which often took place at different times during the same day. In this situation, the issue of potential crossover in my roles of teacher/researcher is complex and although I sought to separate these as much as I was able, it is not possible to say that the two roles remained clearly defined throughout the study. Rigorously maintaining my fieldnotes and reflective diary helped me to remain alert to potential crossover and therefore more able to retain some distinction between the two roles.

Another problem with my dual role could be the very familiarity, in that this might have made it difficult for me to suspend pre-conceptions and to see what was going on when everything seemed obvious (Hammersley and Atkinson 1983). I cannot be sure that this has not indeed been the case. I worked with the knowledge I had whilst recognising it might be erroneous and that it was definitely partial. My strategies for minimizing this effect were to stay close to the phenomena, to continually examine my relationship with my research, and to adopt a style of writing to reflect partial truths (Maynard 1998). I went through a process of revisiting my data (films, audio recordings, diaries) over the period of the study looking at these differently for different reasons in order to extract the most insights. Sometimes I revisited the data with others in order to 'see' what they might see. I tested out my interpretations at conferences, with colleagues and with my supervisors. In order to 'hear' participants, I transformed what could be a dry script by interspersing analysis with sections of transcripts and descriptive data. This structure was an attempt to unpick the passive third-person voice of authority, the dominant convention of research and to allow the voices of my participants to be represented and heard.

IN CONCLUSION

All educational research is a political activity, a moral responsibility as well as an intrusion into the social and cultural lives of people (Freebody 2003). Reflexivity is a framework that helps the researcher to be more sensitive to the power relations in a piece of research. Ethics and power remained at the heart of my research from negotiating access to classrooms, collecting data and to writing up. Questions I continued to ask myself as the study developed included: Do I think I am being ethical in doing this? Am I attending to my prejudices here? Am I clear about how this particular information may be used? Whilst aware that any research process is obviously complicated by the privileged position of the researcher in relation to the researched, how people respond to the presence of a researcher may indeed be as equally informative as how they react in other situations (Hammersley and Atkinson 1983). Colleagues continued to be supportive, curious and interested as the study developed. I continually sought to maximize the benefits for them and reduce the costs, and such discussions were easier and more candid as we knew each other better. Researcher expertise, methodological congruence and procedural precision are all requirements for a piece of research to be credible (Birks and Mills 2011) and as shown in this chapter, I attempted to remain focussed on these three elements during the development of this study.

The result is a situated, partial and developmental piece of research, based on case study and constrained by its historical context (Mauthner and Doucet

2003). Such research is useful if it engenders in readers a feeling of recognition which they can use in their own situation. In this way, classroom-based research, growing from practice, can guide further practice (Cobb and Bauersfeld 1995).

Interpretivist qualitative research views people's interpretations as a primary data source (Mason J 2012) and this was important to me, believing in knowledge as being constructed and situated. Moving from the local to the more generic (and back again), my findings can be used to draw attention to some key issues in mathematics education to do with participation and involvement as well as what might constitute mathematical understanding.

The following three chapters are my data analysis chapters.

CHAPTER FOUR

CAN MATHEMATICS BE LEARNED THROUGH ROLE PLAY?

INTRODUCTION

This chapter on mathematical learning is the first of my data analysis chapters. The following two are Role Play (Chapter Five) and Re-view and Reflection (Chapter Six). There are overlaps between these and this is clearly signposted.

The purpose of this chapter is to establish if the children in both classes have been observed engaging in mathematics during role play and to pinpoint the mathematical learning taking place.

The data that I draw on in all three data analysis chapters are as follows:

- Transcripts of the 12 videos recorded in the Year Four class between November 2011 and March 2012 and the 36 videos recorded in the Reception class between March and May 2012.
- Transcripts of six audio recordings of 're-view' interviews with Year Four children and three audio recordings of 're-view' interviews with Reception children (Chapter Two, discusses the nature, role and purpose of these 're-view' interviews which are analysed in detail in Chapter Six).
- Fieldwork notes (hard copies) made between November 2011 and May 2012.
- Audio recordings of semi-structured interviews undertaken with the Year Four teacher (Mrs R) on 22nd March 2012 and the Reception teacher (Miss H) on 17th April 2012.

- Research Diary notes made between the beginning of 2010 and August 2012.

This chapter is divided into two main sections and is structured as follows. Firstly, I consider whether any mathematical learning and thinking can be seen taking place when children role play in each class in turn (4.1). I discuss the teachers' role within both these classrooms and examine what conditions and adult actions positively contribute to mathematical thinking taking place. In 4.2, I examine engagement in mathematics learning in both classrooms in terms of participation in a community of practice, as defined in Chapter One (Wenger 1998, Lave and Wenger 1991) and in 4.3, I consider ways in which this might contribute positively to learners' mathematical identities.

The key research questions I will be dealing with in this chapter are as follows:

- What mathematics can be learned through role play?
- What does mathematics learning look like in different role play contexts?
- To what extent might role play affect the development of mathematical resilience, involvement and a positive attitude to the subject?
- What particular classroom conditions positively affect mathematics learning through role play?
- What adult intervention helps or hinders such mathematical learning?

I examine what is understood by the term 'role play' in relation to the literature in Chapter One, and in Chapter Five I explore this in detail in relation to my data. My working definition of role play is of someone temporarily 'walking in another's shoes' (Williams 2006).

As described in Chapter Three (3.3), data presented here as verbatim extracts from transcriptions of video or audio recordings, fieldwork notes or diaries is clearly indicated, headlined and dated, with extracts from observations numbered consecutively through the chapter separately as Reception and Year Four extracts.

4.1 OBSERVED MATHEMATICAL LEARNING

The key question in this section is whether or not there was any recognisable mathematics observable in these role play scenarios set up by the two study teachers specifically for mathematics to take place. Chapter One examines aspects of mathematical learning in detail but, to summarise here, by ‘recognisable mathematics’ I refer to both evidence of mathematical knowledge and mathematical thinking processes. Ollerton (2010) distinguishes between ways of thinking mathematically such as gathering, ordering and analysing information, seeking patterns, making conjectures and offering generalities, as well as learning qualities such as resilience, independence and collaboration. When analysing the extracts in terms of mathematical processes, I will refer to these categorizations.

In this section, data from the two classes are considered separately and conclusions are drawn from both. 4.1.1 considers evidence from the Reception class, and 4.1.2, the Year Four class.

Whilst separate role play tasks drew on differing areas of mathematics, by chance children in both year groups were observed tackling the notion of *exchange* in role play cafés as well as *reading and interpreting times* and *applying time as a measure* in two other scenarios.

4.1.1 In the Reception Class

Data from the 36 videos recorded over three months in Reception are of three scenarios, considered here in date order:

- Spring term 2012, ‘The Dinosaur Café’
- Summer term 2012 , ‘Horse Jumping’, and
- ‘Faster than Usain Bolt’.

Descriptions of all role play scenarios can be found in Appendix Two. For details of role play recordings made in Reception see Table 5 (Chapter Three). Except where I draw from observations made of class ‘carpet’ discussion sessions, all the videos referred to here are of children having freely chosen to engage in these tasks. After considering the mathematics observable in the first two scenarios, I examine the final scenario in more depth to draw out some key factors in the Reception role play.

Scenario: ‘The Dinosaur Café’

Of the seven videos recorded of the ‘Dinosaur Café’ scenario, six are of child-chosen play and one of the class re-viewing one of these videos. At the time of recording the class had started a role play café which ‘explorers’ visited. Once an explorer had spotted some dinosaurs, the focus moved onto finding out about dinosaurs. When a ‘dinosaur’ went into the café, children started to make them food, so the idea of a dinosaur café grew from this play. 4.2 examines this process in more detail.

The extract from one video chosen here (Reception Extract One) is typical of the sort of play engaged in by these children, that of ordering, serving, eating and sometimes paying for food. It is an interesting example because the mathematics the children become involved in is not payment but *accurate communication*. This took place a few days after the café for dinosaurs had been set up indoors. It consisted of tables acting as a 'counter' containing various plastic foodstuffs, purses and bags, as well as plastic coins and Numicon 1-10 shapes being used as 'Dino pounds'. 'Numicon' is structured number apparatus linking coloured, plastic shapes to number values. Numicon number lines (referred to later in this section) display numbers 1-20 in order together with each coloured shape. On a large whiteboard at the back of the café, children had vertically listed the numerals 1 to 10 under two headings written by the teacher, 'Hunters' Menu' and 'Dinosaurs' Menu'. The numerals indicated the menu number associated with each item. On the right hand side, under 'Dinosaurs' Menu', written in children's handwriting, can be seen:

1 meat, 2 chicken, 3 pears, 4 fish, 5 ice cream, 6 (illegible), 7 choclat (sic), 8 (illegible), 9 big chicken, 10 (illegible).

In Extract One a group of children play waiting staff and (dinosaur) customer. The dinosaur (Luke, 5y 2m), being unable to speak, indicated what he wanted to eat by tapping two sticks together a number of times to match his chosen menu item. The waitress (Lucy, 5y 1m) had to interpret the taps and serve the dinosaur to his satisfaction. Ice cream (5 taps) was a popular order.

RECEPTION, EXTRACT ONE 06/03/2012

'Dinosaur Café', Video 1: "Are you full up now?"

Children involved: Luke (5y 2m), Lucy (5y 1m), Edie (4y 11m), Sabina (4y 10m), Cathy (4y 6m) and later Tilly (4y 6m).

Total length of recording: 6' 35''. This transcript is the first 2' 30".

As the recording starts, Luke and Edie are customers. Cathy, Sabina and Lucy are serving them. Luke is ‘eating’ an ice cream. Edie is standing to the right carefully watching Lucy serving Luke. Cathy and Sabina are in the background.

1 Lucy: *Are you full up now?*

Luke shakes his head. Lucy roars at him. Luke picks up two sticks, holds the two sticks apart, ready to hit them together.

2 Sabina: [holding up a coin] *Lucy, our, this is* <u>*our*</u> *money*

Luke strikes the two sticks together firmly 8 times. Lucy is listening to Sabina and then glances at Luke.

3 Sabina: *Only one explorer’s, that’s one bit of money [...]*

4 Lucy: [to Luke] *Is that nine?*

Luke nods and Lucy turns to fetch him something.

5 Lucy: [....] *ten. It has to be one of these* [laughs and hands plastic chicken to Luke]

Luke ‘eats’ the chicken. Edie is smiling.

6 Lucy: *Are you full up?* [laughs]

Luke shakes his head (no) and holds sticks to signal, strikes them 10 times. Lucy can be seen counting alongside.

7 Edie [Smiling to adult out of shot] *He’ll eat all the food in a minute!*

8 Lucy: *Ten?*

Luke nods. Cathy shows him a pineapple, Luke doesn’t take this.

9 Lucy: [consults the price board, laughing] *Sweetcorn*!

Lucy hands Luke a corn on the cob. Luke ‘gobbles’ the corn.

10 Edie: *Are you full up now?*

Luke shakes his head and Lucy laughs. Cathy offers him something, which is 'eaten'. Luke strikes the sticks together seven times. Lucy can be seen concentrating on counting.

11 Lucy: *Six?*

Luke nods. Lucy consults board, then searches for something. Sabina is holding the telephone in the background.

Luke is looking in the food boxes.

[...]

12 Luke: *I want this [...] one*

13 Lucy: We *haven't got a, we haven't got any [...]. We need to get some [...]*

Tilly appears on the right hand side, next to Edie. Lucy offers Luke something flat.

14 Edie: [back to camera] *[...]*

Luke takes the item out of shot and 'gobbles' it. Edie claps. Luke returns with the sticks. Sabina is saying something unheard to Lucy whilst Luke strikes the sticks together seven times. Cathy is putting a sandwich together and offers it to Luke.

15 Cathy: *I made this sandwich*

Luke roars and shakes his head.

16 Cathy: [to Edie] *Sandwich?*

Edie takes it and drops it into the box. Luke roars and strikes the sticks twice, then carries on striking them 15? times.

17 ?: *What do you want there? //*

18 Cathy: [with bread] *I've got all of this*

Lucy puts her arm around Edie and watches. Luke strikes sticks. Lucy checks number with him, he shakes his head and roars, tapping sticks six times.

19 Lucy: *Is that 5?*

Luke nods and Lucy goes to board and to fetch food.

20 Edie: *Are you full now?*

Luke roars and shakes his head to say no. Lucy and Edie smile.

This is the opening two-and-a-half minutes of a six-and-a-half minute video. It continues in the same way with Edie then Tilly taking over the role of a dinosaur customer ordering by tapping sticks a number of times. The mathematical understandings these children exhibited in this extract are as follows. Firstly, they were operating with notions of fair exchange, but exchange that did not involve money. Luke decided what to order and attempted to communicate these in terms of a numeric code with varying degrees of accuracy and success. Luke, Lucy and Edie counted something unseen, sounds of the tapping of sticks. They named the final amount of taps and associated this amount with a written numeral 1-10. Knowledge accepted as critical in learning to count by Schaeffer, Eggleston, and Scott (1974) and Gelman and Gallistel (21978) includes the 'one-to-one principle', the 'stable-order principle', the 'cardinal principle', the 'abstraction principle' and the 'order-irrelevance principle' (Gelman and Gallistel 1978) all of which these children are applying in this context.

Is this section of the established Reception core number curriculum knowledge these children would be expected to know already? It is clear from this and the other 'Dinosaur Café' observations that participants did not always count the taps accurately, nor match these correctly to the numeral or item on the board. Lucy can clearly be seen concentrating and counting silently just after each of Luke's taps, consistently appearing to count one fewer tap than he made. Miss H on first viewing the video was concerned about Lucy's counting mistakes as she had considered her an accurate 'counter' to 10. Lucy may well be counting accurately in other contexts, but the role play context is providing her with a level of challenge in which she is learning mathematically as well as developing her fluency and competence. Counting is complicated and counting something that can neither be seen nor touched is more difficult. Aubrey identified nine necessary sub-skills in order to be able to apply counting knowledge successfully, including keeping track of what is counted and knowing when to stop (Aubrey 2003). Here, children in the spring term of their Reception year practised counting in an unusual scenario and in a more difficult context than counting touchable and moveable objects without adult support.

Ollerton's (2010) learning qualities of *resilience*, *perseverance*, *independence* and *collaboration* were evident in the 'Dinosaur Café' extracts. For example, Lucy and Luke independently persevered in trying to understand each other, using number to communicate a message. In addition to applying their developing understandings of counting quantity, lines 5 and 9 are examples of reading and analysing information using personal recordings. Lucy and Luke attended closely to agreeing the total of taps and the correct food item. Their focus on reaching agreement is interesting in relation to Howe et al's research (with older pupils related to science learning) which indicated that the existence of contradiction and having to agree an answer 'primed' content being retained after the event, even if an answer was not agreed (Howe, McWilliam and Cross 2005).

It is my experience that café scenarios are often popular choices for mathematical role play (later in this chapter I explore Year Four's 'French Café' role play). However, my experience also indicates that these do not always seem successful in terms of developing mathematical learning but instead become sites for power-play, where the most important issue is who controls the opening and closing of the café, who is allowed in to eat and who is allowed to serve. Sabina and Cathy appear most interested in the social side of the café, such as tidying up, answering the telephone and serving (Cathy, L 16) as well as who has control of the money (Sabina, Lines 2 and 3). The mathematical potential of this task is increased by firstly, handing the children control over recording the menu (I return to this later) and the intriguing constraint of the dinosaur not being able to speak and thus having to find another way of communicating and in the process setting up a mathematical challenge.

In another video recorded a day later (‘The New Menu’) Lucy and Sabina played in-role to organise the café before it opened. They collaborated in writing up a new menu, writing 1-10 in order next to Numicon shapes. Later they had to agree which menu item corresponded to which numeral and in doing so, they *collaborated* with *perseverance* whilst they *gathered* and *ordered* information (Ollerton 2010). At the same time Sabina was concerned that Lucy did not open the café before the menu was completed to her satisfaction. Children in all the videos can be observed successfully moving between the social and the mathematical components of the task, some children on some occasions attending to the mathematics whilst for others, and at other times, the social component of the task was more interesting. The task itself, if completed successfully, was mathematically quite challenging for these children. Maybe for some, too challenging. In complex situations, one element becomes the focus at the expense of others, which Mason (2002) has referred to in mathematics as ‘stressing and ignoring’, arguing that only over time do actions become more automatic and attention can then focus on learning something new. According to this analysis, Cathy would have to return to this, and other scenarios over time to be able to integrate the social aspects enough in order to pay attention to the mathematics.

<u>Scenario: 'Horse Jumping'</u>

The suite of ten 'Horse Jumping' videos was recorded over three days in May 2012 in the outside area. One of the Teaching Assistants in the Reception class kept horses and children had been asking questions and playing at 'being horses' by 'cantering' around the outside area. Miss H had the idea of using this interest for some counting practice. The scenario built up over a couple of weeks and the mathematics developed from jumping and counting small hurdles, to numbered hurdles (1 to 10 or to 20) to be 'cleared' in order, and to recording a number of jumps cleared as a final score. Finally, as seen in Reception Extract Two, children counted 'faults' (jumps not cleared) to subtract from a starting total of 10.

RECEPTION EXTRACT TWO 16/05/2012, 'Horse Jumping', Video 10

Children involved: Rachel (5y 7m), Sara (5y 7m)**,** Lucy (5y 3m), Hannah (5y 1 m), Jon (5y 1m) and Hamish (4y 9m).

Total length of recording: 3' 09''. This transcript is the first 2 minutes.

Children are in the outdoor area. Numbered jumps are arranged in order from 1 -10. They are taking part in a jumping competition on child-made hobbyhorses (cardboard tubes and card-painted heads). A scoreboard is positioned covered with children's writing of names and scores as horizontal subtractions e.g. 10 – 1 = 9, 10 – 3 = 7. At the point recording starts, Lucy and Hamish are seated on a bench with hobbyhorses and Rachel is holding 2 half-coconuts.

1 Rachel: (in teacher mode) *(...) you've been very naughty to tell me how to make / all you have to do is* (...)

Jon sits on the bench with his hobby horse.

2 Rachel: *So, sit very nicely and looking this way, Lucy*

3 Lucy: (holding a Numicon 10-plate) *Umm, I, it was seven /*

4 Rachel: *Umm, yeess. //* (To Jon, who goes to scoreboard) *Right. So, so, so, now you need to / Who's next? / Introducing Hannah. / What's your horsy called?*

5 Hannah: *Amy*

6 Rachel: *Amy and what's (...)? // Is? (...)*

Jon, writing on the scoreboard, has recorded 10 – 3 =

7 Rachel: *That's the end of the course*. // *Oh yeah, this is the last one*

(...)

8 Rachel: *Are you ready and off you go! You only got 2 minutes Hannah!*

Hannah goes around the course with Rachel clapping the half-coconuts together.

9 Rachel: [To Jemima, who has finished] *Oh, you only got 2 faults, now on the board*

10 Sara: *Can I have a go doing the horses?*

11 Rachel: *Well, you can do the next line, yeah?*

12 Sara: *OK*

13 Rachel: *So you're doing the next line*

14 Sara: *After Jemima*

15 Rachel: *Err, Jemima is (...) / There's going to be a queue right, and you are going to say the names and send them off and you say how many times they got to do it, right?*

Hannah has written her name and is recording '10 – 1 ='.

In this observation, the last of a set of 10 recorded over three days, I noticed that despite the lack of involvement of an adult the children demonstrated the learning qualities of *independence* and *resilience*. Alongside this the children showed a willingness to engage, mostly successfully, in a difficult mental calculation task and gave attention to the accuracy of the formal recording of subtractions. Counting on or counting back to solve calculation problems is internationally recognised as difficult for children of this age (Secada, Fuson and Hall 1983, Suggate, Aubrey and Petit 1997, Thompson 1997, 2008, Nunes, Bryant and Watson 2009, Sarama and Clements 2009). Counting back to subtract is more challenging than adding by counting on, as subtraction requires counting backwards whilst keeping track of how many to operate with (Thompson 2008). In this context it was particularly challenging in that one number, that is, the number being subtracted can neither be seen nor touched which resonates with the example of the dinosaur not talking (Extract One, above).

In 'Horse Jumping', children can be seen using with understanding the conventional horizontal formal notation for subtraction, although formal recording when taught to children may not be associated with a practical context for addition and subtraction (Hughes 1981, 1986). On this occasion these children were confidently making successful use of some complex, taught mathematics in another ‘world’ of their fantasy horse jumping scenario. What went on beforehand to make this happen?

Miss H invested energy and time researching and developing some of the children’s current interests. She provided suitable props including structured mathematical resources (e.g. Numicon materials) and allocated time to the play. Over the 10 ‘Horse jumping’ videos, 20 children in total were involved at some stage, with 10 children showing a high degree of involvement in that they returned to, or remained with, the play over time. Over three days, the recordings show a development from children simply enjoying running and jumping over the jumps, to children calculating confidently within 10 and recording this (with the intermittent involvement of the teacher). Miss H placed value on the resulting play by talking with the children and directing children’s attention to some mathematics she wanted them to explore, supporting them in doing so. Extract Three is a typical example of these discussions.

RECEPTION EXTRACT THREE, 14/05/2012, ‘Horse Jumping’, Video 2

Children involved: Ricky (5y 3m), Cali (5y 3m), Mark (4y 11m) and Oliver (4y 9m).

Total length of recording 1’ 05”. Transcript in entirety.

Mark, in a knight’s outfit, is cantering around the outside area, jumping over the jumps. Cali, in a dragon suit, is running around beside him. Oliver and Ricky (also in knights’ suits) wait behind the start line.

1 Mark: *Oliver!*

2 Cali: (pointing to a jump) *He got one wrong*

// Children’s voices can be heard.

3 Ricky: *Go on Mark, go on Mark* (repeatedly)

As Mark finishes the course, Ricky cheers and claps. Oliver starts immediately.

4 Cali: *Now Oliver's turn*

5 Miss H: *What, what does Mark need to do? What does Mark need to do?*

6 Mark: *Oh yeah* (Mark moves towards the score board, but stops and listens to Cali and Miss H)

7 Miss H: *How many faults did he get Cali?*

8 Cali: *Pardon*?

9 Miss H: *How many faults did he get?*

10 Cali: *One*

11 Miss H: *One, one fault Mark*

12 Mark: *Do I put 10 then zero then one?*

13 Miss H: *Do 10 take away 1, have a look at what's on the board already, see if you can work it out. /* (Oliver is beginning the course) *I think maybe Oliver needs to start again. What do you think, Cali?*

14 Cali: *Yes*.

Having modelled the task of counting the number of faults and subtracting this from 10 as a class activity, the teacher joined the children in their play to support and prompt the children to use this mathematics. This is clearly at a challenging level for Mark and Miss H scaffolded his learning by focusing attention on examples (Lines 11 and 13) as well as modelling mathematical processes such as *refining* and *clarifying* (Lines 5, 7 and 9). Eventually, as Reception Extract Two demonstrates, a child took over the teacher's role, keeping participants' attention on what is important.

The mathematics the ‘competitors’ engaged in had a number of stages. Each child, beginning only when instructed, took a turn to jump over the jumps in order from 1 to 10, they agreed their number of faults, mentally subtracted this number from 10 and finished by recording their score as a formal equation. Many children often chose to do this over and over again. In this context, formal recording made sense and in subsequent videos children can be seen using this independently. It was clear from the scoreboard that not every child’s recording was accurate (e.g. Video 5, Carla recorded: 10 – 3 = 7, 10 – 2 = 7) and sometimes children recorded simply the number of faults (Kaiya recording 4 as Mark’s faults in Video 3). Finally, the children compared their scores, discussing the two numbers generated, the number of faults and the final score of cleared jumps hence exploring the difficult notion that the *smallest* number of faults leads to the *greatest* score. ‘Zero faults’ quickly became the desired score and the scoreboard included many recordings of 10 – 0 =10. In so doing, a popular calculation could become a known fact.

Miss H introduced different elements of mathematics for the children to explore over a few days. In a class ‘carpet’ session prior to Extract Three she introduced the idea of a “*checker*” for the children to use to support their mental subtraction. The “checker” was a Numicon 10-shape and children placed their fingers in the holes in the shape to match the number of ‘faults’ in order to calculate what was left, They did so before and after recording their subtraction sentences. The careful introduction of a piece of structured mathematical equipment into the play and giving this an appropriate name, a jump ‘checker’, seemed to positively influence these children’s success and confidence in calculating effectively.

It seems likely that the children were focussed on the mathematics because the teacher was focussed on the mathematics. They engaged in the mathematical play because it was highly valued in this class. As demonstrated by the 'Dinosaur Café' and 'Horse Jumping' scenarios, the focus on mathematics was maintained by the teacher:

- continually referring to and developing the mathematics during 'carpet' sessions;
- periodically 'eavesdropping' on the play to observe children's actions and attention;
- providing uninterrupted periods of time over several days for the children to play with these (and other) ideas;
- handing control to the children to manage the activity themselves;
- emphasising the mark-making to create a semi-permanent mathematical record that stimulated numerical comparisons, checking and discussion.

Miss H was (largely unconsciously it seemed, from interviews with her) building a community of learners, all legitimate participants: "*... carrying out activities with purposes connected explicitly with the history and current practices of the community."* (Rogoff, Goodman-Turkanis and Bartlett 2001: 390)

Significantly, members of this community were motivated to talk mathematics and whist young children may not possess its formal language, they can be seen creating their own in order to do so. A good example of this is Kaiya, the youngest member of the class (Reception Extract Four).

RECEPTION EXTRACT FOUR 14/05/2012, 'Horse Jumping', Video 6

Total length of video: 1' 34". This transcript is the first 30".

Kaiya (4y 9m) is standing by the scoreboard, facing the camera and holding a Numicon 10-shape.

Kaiya: *You get eight when you take away this. Two. //*

(Turns away and loudly calls out) *This is the number board! This is the number board! /*

Alesha, all line up for the take aways!

The idea of the creation of phrases which form part of a mathematical dialect, by which I mean language peculiar to the members of a group, e.g. 'the number board', that are picked up and used by other children is discussed and illustrated further in 4.2 (Mathematics as participation).

Whilst analysing the last observed Reception scenario, I consider further the issue of the role played by the teacher and the class 'carpet' sessions in the mathematical role play of this class.

<u>Scenario: 'Faster than Usain Bolt'</u>

These last observations took place when Olympic interest was high due to the London Olympic and Paralympic Games taking place that summer. This Reception class was no exception. Miss H had noticed the children racing against each other outside. To stimulate some number discussion she borrowed digital stopwatches for an adult to use to time runners around the circular track painted on the ground. They found that one circuit took children, as it transpired conveniently, approximately nine seconds.

When I came in to observe on the first morning, Miss H had found a YouTube clip of Usain Bolt setting a new world record for the men's 100 metre sprint at the Berlin World Championships in 2009, with a time of 9.58 seconds. She had decided to use this clip as a stimulus for the children's play. She was excited and unsure about what would ensue. Reception Extract Five is taken from her initial class 'carpet' introduction, at the start of the morning session after the register had been taken.

RECEPTION EXTRACT FIVE   28/05/2012

'Faster than Usain Bolt', Day One, Video 1A, Class introduction

Total length of recording: 12' 24". This transcript is the first 3'.

Class seated on carpet with Miss H facing them.

1 Miss H: *You know we are in training as well this week, yes?*

2 Child: *Yes*!

3 Miss H: *And we're going to see if we can run just as fast ...*

4 Child: *As fast*

5 Miss H: *... or even a little bit faster than the* ***fastest man*** *in the* ***world****. Do you think we can do that?*

6 Children: *Yes! No!*

7 Miss H: *Do you thing we're going to be able to do it?*

8 Children: (quietly) *Nooo. Yes*

9 Miss H: (slightly louder) *Do you think we're going to do it?*

10 Children: (loudly) *YES!!*

11 Miss H: *OK, let's have a look then. See if you can work out what's going on in the video first of all, so all eyes and ears have to be on the whiteboard. Are we ready?*

On the IWB a YouTube clip of the men's 100m final in Berlin 2009, plays. Usain Bolt sets a new world record and at the end stands alongside the large digital display displaying his time of 9.58 seconds.

All children in rapt attention. Some clap, a few make running movements with arms as they watch. They point at the video and talk to each other as video commentary ends.

12 Miss H: (pauses video on digital stopclock showing "NWR 9.58") *Look / look. Usain Bolt. My turn, Usain Bolt. Your turn ...*

13 All chorus with Miss H: *Usain Bolt*

14 Miss H: *He has just broken <u>the world record</u>. The world record for running* (moves her arms) *for a hundred metres, OK?* (points at scoreboard) *And who can tell me how fast Usain Bolt ran the 100 metres in, how fast, what numbers can you see at the bottom? Oliver?*

15 Oliver (4y 9m): *Nine, five, eight*

16 Miss H: *Good boy, well done. Nine point five eight. That means he ran a hundred metres in 9, just over 9 seconds, let's count to 9 shall we ...* (Miss H taps her fingers on her hand as she counts with the children to nine)

17 All: *1, 2, 3, 4, 5, 6, 7, 8, 9* (on "9" Miss H swipes her arms apart to indicate 'stop') *OK, that's how fast Usain Bolt ran a hundred metres in, OK?*

The teacher was aware that this class loved to be outside and to be active. In introducing the stimulus for the role play Miss H challenged her class to 'train as athletes' and beat Usain Bolt's time, beginning her introduction by saying (L1) "*You know we are in training* [...] *this week, yes?"* Here, Miss H invited the class into the scenario, suspending reality, to all 'be' Olympic athletes in training. By using 'be' here, I am referring to a movement into role – into someone else's shoes. This is discussed further in Chapter Five, Role Play.

Having watched the clip, Miss H linked an understanding of nine seconds to what the class already knew (counting from one to nine, L16ff, above) and shortly after this extract, introduced the mathematics in the independent task by saying:

"*Tell the person sitting next to you, what number you are going to need, umm, what number is going to be faster than Usain Bolt? Are you going to need a bigger number or a smaller number?"*

Speed is not a measure that you would expect most five year-olds to understand in any depth and does not form part of any recommended mathematics curriculum for this age of child. Time is intangible, continuous and calculated using many different scales (Merttens 1987) and its measurement involves the two features of position and duration (Gifford 2005). Speed is a complex measure as it links time with length (Lister 1970). However, these are areas of mathematics that occur frequently in the world outside the classroom and children could be expected to have met them already. A complex measuring instrument involving whole and part seconds was used in the YouTube clip. The question in both the teacher's and my mind was, what mathematical sense would these Reception children make of this?

Serendipitously, Bolt's record-breaking time was close to the time it took these five year-olds to run around the class track. This linked the time to something that was significant to them (Gifford 2005) and made the task a perfect pitch, at a physical level, an interest level and at a mathematical level. A clip of any race might not have produced the same effect but Bolt's nine seconds was achievable in the sense of the children being able to 'beat' this on their track, but also mathematically achievable in the sense of numbers to apply and operate with.

> *"... I had a sense of this problem being initially tantalisingly out of reach. It needed to be out of reach, otherwise it would feel too easy; and it needed to be tantalising, otherwise it would feel too impossible.* [...] *So although this problem felt initially out of reach, there were ways in which I could manoeuvre my own thinking so that it became within my reach."* (Hewitt 2000: 3) (Author's emphasis)

Hewitt seems to be implying that pitching a task involves consideration of what might capture interest (be tantalising) as well as the likely mathematical expertise (reach). These two aspects of pitch – interest and expertise – came together in this episode. Based on her observations of their play, Miss H had found something that she thought would interest her children and used this to draw them into some extremely challenging, but interesting mathematics. She made links to what they already knew (numbers to 10) and included the recognition, reading and comparison of whole and part seconds. In her introduction (Extract Five, L16) Miss H simply referred to the decimal point by name and from then on drew children's attention to comparing whole seconds.

She modelled reading the number to the left hand side of the decimal point and commented only on this number. This meant that the children gradually, to a lesser or greater degree, did likewise.

It is worth noting that comparisons of time are counter-intuitive in that, similarly to the ‘Horse jumping’ task, it is the smaller rather than the larger number that is the ‘winner’. How did these young children interpret the stopwatch times and cope with reading and comparing timings where the times appear with a troublesome decimal point?

On the first morning I observed the independent, self-chosen play (immediately after the class introduction) the outside ‘Olympic track’ was busy! In total I recorded eight video clips over two hours of 14 children choosing to run and time themselves. From the outset, they began to comment on and record numbers. In my reflective notes written as I transcribed the video the evening after the recording, I noted:

“*What strikes me is they are running one at a time and writing their scores on the scoreboard immediately.”*

Central to the activity over the three mornings was a fascination with the digital display on the stopwatches. The following excerpt from day three (Extract Six) is typical. Outside, the play area now included start and finish markers, benches for spectators, a podium with 1st, 2nd and 3rd positions marked and coloured bands and vests painted by the children to represent different countries.

RECEPTION EXTRACT SIX, 30/05/2012

'Faster than Usain Bolt', Day 3, Video 14

Children involved: Jack (5y 8m), Ricky (5 y 3m), Jemima (5y 3m), Mark (5y 1m), Elliot (4y 11m) and Oliver (4y 9m).

Total length of recording 11' 2". This transcript starts at just over 4 minutes in and lasts until 5'49".

Children are on the 'running track' with score board and stopwatches. A large Numicon number line is taped to a bench alongside the track. Elliot, Mark, Ricky and Oliver are running and timing each other and spending lots of time recording on the board and discussing their times.

Elliot: (Running up to the scoreboard*) I got five hundred!* (stopwatch showing 005 or 5:00?)

? *Hey!*

Elliot: *[...] five hundred [...]*

Oliver is writing on the scoreboard.

Mark: *Oh, Oliver, you scribbled. [...] Ricky - Oliver's scribbling!*

Oliver: *No I wasn't*

Elliot: [writing on board] *I got one hundred. I got one hundred!*

Mark: [referring to writing] *Oliver does it bigger and we do it small*

Oliver throws pen down, runs off.

Mark: *Get out!*

Elliot: [writing] *I'm one hundred!*

Mark: *Oh! One hundred!*

?: *One hundred! I'm going to write my age*

Elliot: *One hundred*

Jemima is at the race start, on a chair with a stopwatch, Jack and Oliver are waiting to race.

Oliver: *No, just before Jack.*

Jemima: *On your marks, get set, go!*

She starts Oliver. He comes to her when he finishes one circuit and looks at stopwatch.

Jemima: *Two hundred!*

Oliver: *Two hundred?! And a million?* [Puts his hands in the air, triumphantly]

Oliver goes towards scoreboard.

Oliver: *Two hundred and dollars!*

Elliot?: *One hundred?*

Jemima turns to someone off camera behind her and says quietly, "One hundred million".

As the play developed each day, the scoreboard filled with children's recordings of numbers, single digit as well as two and three-digit, zero-something and zero-zero-something numbers, e.g. '3' '05' or '008'. All were taken from their readings of the stopwatch. Children were comparing single digit recordings of whole seconds, for example, one being bigger than the other. They were trying to make sense of multi-digit numbers or whole and part seconds such as 3:00 or 001. As can be seen in Extract Six, the stopwatch display zeros often stimulated discussion about big numbers. Miss H, instead of worrying that these young children would not understand the numbers the stopwatch produced, allowed them to play with them. She responded to their questions and comments at a level that made sense to them, not *teaching* them about decimals, but responding within their level of understanding, as seen at lines 15-17.

Although these children had not appeared to have heard of Usain Bolt, within minutes and repeatedly over three days, they lined up to compete against him and each other. They did so, not by direct comparison, i.e. all running at the same time to see who crossed the line first, but indirectly by using an instrument of measurement, where whole and part-seconds have to be interpreted to establish a score that could be recorded and compared later. Participants were fascinated by the stopwatch display and could be seen repeatedly trying to make sense of this, as Extracts Six, Seven and Eight in this chapter illustrate. In this sense, the stopwatch acted like a calculator, providing an endless supply of fascinating numbers to discuss and interpret (Williams and Thompson 2003). Whilst the stopwatch allowed children access to some mathematical information, it seems that the scenario provided a context for them to collect and significantly, record, data which could then be used for *discussion* and *analysis,* as well as *prediction* and *generalisation* (Ollerton 2010). At this stage of the year the class needed only a gentle reminder to mark-make. The presence of the whiteboard or flipchart and pens for ‘scoring’ had become a ‘taken for granted’ practice in this classroom and placed strategically every day. It could be argued that this gathering of information, with an under-emphasis on ‘correctness’, made the recording and numerical discussions accessible to all. Moreover, these children had learned that adults were interested in them mathematically, as is evident when children invited me to “*Look at the numbers!*” or *“Look at my score”.*

During the second morning the activity seemed to reach a peak, with much noisy activity on the running track. Video 14 lasts nearly 18 minutes and so much is happening that it is difficult to analyse all the activity. Evident is the obvious enjoyment, involvement and engagement of the children. Over the three consecutive mornings that I observed children's self-directed play, most children demonstrated they understood it was the smallest number that was 'best'. For example, in Reception Extract Seven, Oliver (filmed on all three mornings) verified that the smallest number was his fastest time. Later in this extract he talked to me about one of his scores.

RECEPTION EXTRACT SEVEN 29/05/2012

'Faster than Usain Bolt', Day 2, Video 12

Children involved: Sara (5y 7m), Carla (5y 6m), Sabina (5y 0m), Oliver (4y 9m) and Cathy (4y 9m).

Total length of recording: 17'54". This transcript is in two parts, the first beginning at 7' 12".

Oliver, Sara and Sabina are running, Carla and Cathy are standing by the scoreboard, starting and timing the runners and supervising the recording of the scores. Carla starts Oliver and other children cheer him on by chanting his name.

Oliver: [Finishes running one lap and goes to the scoreboard] [...] *seven*

Carla: *That's good Oliver*

Oliver: *Yeah, that's my fastest one*

Carla: *That's your fastest one.*

Sabina runs a lap and is cheered around. As she finishes, Carla begins timing Sara's lap.

Sabina: (To Carla) *How much numbers did I get?* (Carla shakes her head, spectators are cheering for Sara). (To Cathy) *Do you know how much numbers I got?*

Cathy: *Zero*

Sabina: *Zero?! It must be eight not zero!*

Cathy is smiling. Sara comes to look at Cathy's stopwatch.

Sara: *Zero?!*

Sabina: *Zero!*

Sara and Sabina are recording their scores. Sabina is smiling as she finishes writing her time.

Oliver and others spend the next seven minutes, racing, timing, cheering each other on and recording their times. At 14' 50" Oliver points at the scoreboard and talks to me:

Oliver: [pointing to the scoreboard where he has written "08"] *Mrs Williams, look at my score*

HW: *Is that you down there, Oliver, the 8?*

Oliver: *It's zero-ty eight*

HW: *Zero-ty eight?* [Oliver nods and runs off to race again].

Here Oliver displayed the beginnings of his sense-making of place value and multiple digit numbers by generalising "something-ty" when reading a two-digit number, although on this occasion he read this in reverse, not unusual at this age. Over the three days, just as 'zero faults' was of interest in the 'Horse Jumping' observations, zero seconds became of particular interest. The exchange between Sabina, Cathy and Sara in Extract Seven is typical of many. Sabina can be seen trying to make sense of zero as a time and rationalises that it may be 8 not a 0 on the stopwatch. Both her and Sara's facial expressions and body language indicate a realisation that zero is not really an option as a running time. During a re-view interview with Mark and Elliot two days later (analysed in Chapter Six, Re-view and Reflection, 6.2.2) the two boys displayed a complex understanding of what 'zero seconds' might mean. This corresponds with Hughes's studies of young children's number understanding where he found that contrary to popular belief, pre-school children were both fascinated by the idea of zero and adept at using it to represent 'nothing' (Hughes 1986).

Children's discussions around the scoreboard had already been about faster and slower and sometimes, how much faster. At the end of day two, after discussing with me what I had been noticing when filming, Miss H made a decision to use the scenario to introduce the class to the idea of difference, as in, '*how many seconds faster* are you than Usain Bolt?' On the carpet at the end of the first morning, Miss H had already referred to the children's recorded times to discuss which times had beaten Usain Bolt. She did not choose to leave the mathematics as a discussion of faster and slower but instead drew the children's attention to comparing the two numbers to establish the difference. In my experience this is not an easy concept to teach and research illustrates that it is not easy for children of this age to understand (Thompson 1997, 2008).

In a similar way to intorducing Numicon 'checkers' for the horse jumping, Miss H photocopied small 1 -20 Numicon number lines which she referred to as "*time checkers*" to help children work out how many seconds faster. She introduced the checkers in a class 'carpet' session on the third morning, handing one to each pair of children who immediately started counting along them. this

Miss H continually referred to these number lines as "*athletes' time checkers*" and after some exploration, she modelled using the lines to count on and back between small numbers and nine. The pairs practised this and those children that were asked correctly answered her question, "How many seconds faster... ?" Miss H then suggested they recorded their difference as an "*athlete's code*" of '3sf' standing for 'three seconds faster', an extremely complex process.

Miss H had placed a large Numicon number line next to the running track, which matched the individual 'time checkers'. In the following extract (Extract Eight) children were seen referring to the number line. Some seemed unsure how to use this for counting back whilst others moved their fingers along counting 'jumps' between numbers.

RECEPTION EXTRACT EIGHT 30/05/2012

'Faster than Usain Bolt', Day 3, Video 14.

Total length of recording: 11' 24". This transcript begins just over 3 minutes into the recording and lasts until 4'10" (Extract Six follows on from this Extract)

Children involved: Ricky (5y 3m), Mark (5y 0m) and Oliver (4y 9m).

Mark and Ricky are at the scoreboard

[Off camera]: *One! You got one, didn't you?*

Mark: One*?! No!*

Ricky: No*, I counted down from 9 to 1*

Mark: I *actually got 9. I got to five and four* [finger on 5, 'jumps' finger two jumps backwards, Ricky watches] *1, 2, 3 [Sits and looks at Ricky]* [Indistinct] *How many jumps to one?*

Mark: *One, two, three jumps to five.*

Mark and Ricky look at the number line [missed speech]. Ricky repeats Mark's finger jumps along the line. They are smiling and Mark laughs. Oliver arrives and they all look at the scoreboard.

Oliver: *I got a bigger number than you*

Mark: *There's those pens down the back* [picks them up]

Ricky: *You know what I did? I actually [...] I did the same as Usain Bolt, Nine. Nine.*

Here two children used the number line to work out the difference between one number and another as modelled by Miss H earlier, not a trivial task as research shows (Thompson 2008). Looking at the scoreboard it is clear that they and other children have used the nomenclature '3sf', an example of a mathematical community adopting its own dialect and symbolisation (see 4.2 for an examination of this). What is also clear is that whereas some children, such as Ricky, recorded the difference in times as their score (not always correctly) others continued to record their time, simply adding the nomenclature 'sf' to that. Not surprisingly only a minority of children were successful in this complex task, which involved: holding both times in their head as whole numbers, finding one of these on the number line, accurately counting back (or forward) to find how many jumps it takes to reach the other, stating this as a whole number difference and finally, making reference to the original question 'how many seconds faster?'.

The mathematics evolved from day one and over the three mornings there was an increasing concern with accuracy evident in children's attempts to synchronise runner and timing as well as in recording precisely. All participants by day three were observed making numerical comparisons of something intangible, i.e. their score and Usain Bolt's score and made statements and occasionally, predictions, about their scoreboard recordings. Moreover, some used resources independently to calculate the difference between two small numbers. They were engaged, by choice and unaided, in a complex mathematical problem; 'How many seconds faster can I run than Usain Bolt around our track?' and they remained focused and clear regarding this problem. Over the three mornings a total of 24 children became involved in the activity, often for long periods of time, with eight of the 24 children returning repeatedly over the three days.

4.1.2 In the Year Four class

This section examines the evidence for mathematical learning taken from video data from 12 videos recorded over five months (two school terms) in Year Four. The two scenarios forming the basis of my observations were 'Hemy's floating studio' in the Autumn term of 2011 and 'The French Café' in the Spring Term of 2012. Appendix Two contains a description of the scenarios. I deal with each of these in turn in this section. Excerpts from transcriptions of Year Four video recordings are presented here as 'Year Four Extracts' and numbered consecutively through the chapter. Table 3 (Chapter Three) outlines the details of my video observations. Except where I state otherwise, the extracts in this section draw from observations made of the 'Triangle group' of seven children tackling role play tasks in two smaller sub-groups (Groups One and Two) comprising the third of the four mathematics groups in the classroom flexibly based on mathematical attainment. For details of how these children were selected plus the organisation of the class groupings see Chapter Two. Group One consisted of Ellen, Cam, Callum and Nancy; and Group Two, Sean, Fleur and Saul.

The role play tasks were planned and designed by the class teacher to engage children in working collaboratively and independently on a mathematics problem for a defined length of time (approximately half an hour, once each week). In addition, I recorded a class role play, 'The Auction', at the end of the Autumn term.

> *"If you want to sell role play, then you sell it through using and applying".*
>
> **Mrs R to HW, semi-structured interview, 20/03/2012**

The Year Four teacher (Mrs R) stated that the role play area gave her children the opportunity to apply their developing mathematical knowledge. Is there evidence of the children doing so from my observations?

Scenario One, 'Hemy's Floating Studio'

Hemy's floating artist's studio was agreed for their role play by the children based on the class local history topic for the term. After visiting various local historical sites linked to their topic, Mrs R held a class session to decide on the role play scenario where the class separated into friendship groups to list ideas for the role play. This took place on 12 September 2011 and I observed and took field notes during this discussion.

Mrs R reminded the class that the role play was to be used for mathematics work and asked them to "*argue the case*" for their chosen scenario, as well as to draw a plan and to list likely equipment and props that they might need. From these group ideas, one shortlist of likely scenarios was compiled and a final decision on the scenario was voted on. After this, adults and children collaborated in constructing the space for the role play. My context chapter describes the planning of the curriculum in Maritime School and this class. The emphasis on collaborative decision-making seems important in terms of the subsequent ownership and involvement felt by each child and may be a contributory factor in the building of a Year Four mathematical community (4.2). Despite the fact a child's individual idea might not emerge as the final role play scenario, the children felt that they had input into, and involvement in, the end result. School reviews of the role play in 2010, 2011 and 2012 (where a small sample of children were interviewed from each class) demonstrate that children of all ages appreciate it is 'their' role play. It was notable that in the one year group where the scenario was chosen by the teacher, the children voiced dissatisfaction with the role play and were not as keen to engage in it (see Appendix Seven for an example of the annual review questions).

At the point I undertook my first observation, my field notes show that Mrs R and the class had discussed "*where we are up to so far"* in the story of Hemy. To begin with, Hemy had equipment to order and purchase for his studio and now this was stocked, he was ready to set sail to paint. The idea of a developing a story on which to hang the role play tasks was new for this teacher and has links to how the role play was developed in the Reception class.

For the first task I observed, the children were given a photocopied section of a tide timetable to use (Appendix Three, ii). Immediately prior, I observed the teacher introducing the task to the class and engaging them in a discussion of key elements with questions such as; "*What might stop a boat going out whenever it liked*?" The children suggested storms, waves, weather and tides. Mrs R asked what they knew about tides and what 'going aground' might mean. She explained they had to decide when best to put to sea, reminding them that Hemy did not want to "*get stuck"* anywhere. She also pointed out that "*this chart has those numbers with the dots in that we were learning about*" (Fieldnotes: 01/11/11), checking they could remember learning about times shown as 08:36 and distinguish between these and decimal numbers. Some mathematics had been taught and the teacher was constructing a task for the children to apply and make sense of this knowledge. She was curious to see what sense they would make of this information as well as what understanding of clocks and times they would bring to the task.

My observations of both Groups One and Two engaging in this task of reaching an agreement about when to leave and return to port given certain tidal information, seemed mathematically rich in terms of the quality of mathematical discussion it generated amongst the children. There was evidence of children attempting to make sense of the mathematics integral to the task, interpreting data by reading the graph and chart, discussing, comparing and estimating times and duration and relating 24-hour and 12-hour clock formats, as well as communicating their information and ideas. The extracts that follow from Group Two (Saul, Sean and Fleur) are an example.

YEAR FOUR, EXTRACT ONE, 01/11/2011: GROUP 2: 'TIDE TIMES'

Children involved: Saul (8y 5m), Sean (8y 6m), Fleur (9y 1m).

Total length of recording: 28'41"

The children have been in the 'boat' for a couple of minutes as I change the batteries in the camcorder. The tidal information is shown both as a chart and a graph where times for high tide on November 1st were shown as 08:36 and 21:07, and low tide as 02:54 and 15:21. At the top of the chart Mrs R has written '*What information can Hemy learn from the tide timetables?'*

They start immediately. The task sheet has been read by the two boys, whilst Fleur listens and watches as they start talking. At the point the recording begins, all are standing, Fleur holding the clock, Sean with the paper, Saul fiddling with the easel.

1 Sean: *Read that through with us and we'll listen to you [....] Who wants to read? OK, Saul here you are, here's the tide...*

[....]

2 Saul: *No, no, no, no, 15:21*

3 Sean: *You just said 15:25*

4 Saul: *No, 15:21*

5 Fleur: *No that's the low tide so we can't go out*

6 Saul: *Yeah, we can't go out on the low tide...*

7 Sean: *That's when we have to go, when we have to leave*

8 Saul: *No, if we go on the low tide, we'll be stuck*

9 Sean: *Alright, alright*

10 Fleur: *So we have to leave at high tide...*

11 Sean: *By 8:36, by 8:36*

12 Fleur: *Yeah, but why would you want to go out at night? Is that p.m.?*

13 Saul: *No*

14 Fleur: *Is that a.m.?*

15 Sean: *8:37 I think, 8:36*

16 Fleur: *8:36*

17 Sean: *8:30*

18 Fleur: *8:30?*

19 Sean: *Yeah*

20 Saul: [holding bulldog clip] *What's this meant to hold?*

21 Sean: [indicating paper on easel] *That! /*

22 Fleur: [with clock] *8:36, 8:30, half past*.

Here the three children tried to reach some joint understanding about when is a good time to leave from and return to port, as well as what each other understood by the information shown on the two charts. These children live by the sea and the motions of tides are likely to form part of their everyday knowledge but I was not aware if they have consulted a tide timetable before. Fleur read the times correctly and the group seemed to agree that 08:36 referred to the morning. In terms of thinking mathematically, they *analysed* the presented information, seeking *order* (L 5-14) (Ollerton 2010). The following extract follows on from that above.

YEAR FOUR, EXTRACT TWO, 01/11/2011: GROUP 2: 'TIDE TIMES'

23 Sean: *Everybody dress up* [puts on waistcoat]

24 Saul: *Don't like dressing up... stupid. / Don't want to / Don't want to*

25 Sean: *Alright* /

26 Saul: [to Fleur] *8:36* [...]

27 Fleur: [with clock to Saul] *No, 5, 10, 15, 20, 25, so 36 is there, in the middle* [Saul nods] /

28 Sean: *Let's get moving shall we?* /

29 Fleur: *There, that's right. Jon, Sean that's right* [shows Sean clock showing twenty to seven]

30 Sean: *Yeah that's right*

31 Fleur: *'Cos look, 5, 10, 15, 20, 25, 30, 36*

32 Sean: *Very good Fleur, very good. Well done, well done. Cool*. [F sits and glances at camera]. *So do you know when 15:21 shows up?*

33 Fleur: *At 15:20*

34 Sean: *Yes, we have to leave before 15:21 otherwise we'll get stuck*

35 Fleur: [with tide chart] *No, 15:21*

36 Sean: *Yes, we have to leave before then,* [points to time on chart] *see, 15:21 low tide*

37 Fleur: *We have to leave, we have to get back by* [....]

38 Saul: *For the fishes. When I go out at high tide that's when the fish come in. So if you want to go fishing, so if you have to be back by high tide ...*

39 Fleur: *Wait, wait, I need to see when 15 is...* [head in hands, counts on fingers]

40 Sean: *I know, it's high tide now. / Let's get going. Saul, Saul, Saul, you're ready enough to leave yet?*

41 Saul: *No* [...]

42 Sean: *No, I know... we're sailing on the sea*

43 Fleur: *3*!

44 Sean: [pointing to chart] *No! 15*

45 Fleur: *Yes I know, but that's 3:21 in the afternoon.*

In this extract, each child's attention was on different things. Fleur's attention was on displaying their agreed departure time accurately on the analogue clock provided, using the clock face to count in fives from 12 to reach 8:35. She understood the analogue convention of minutes being in blocks of five although the clock face numbers do not reflect this. Although Sean was aware there are two eight o'clocks in one day, he was not able to convert between 12- and 24-hour clock (L44). His attention seemed to be practical, as did Saul's, Sean argued that returning at 15:21, the predicted *lowest* point of tide, would be too late (L34). This might have provoked Sam to share his information on tides and fishing (L38). Meanwhile Fleur was focussed on the fact that 3:21 looks the same as 15:21 on an analogue clock.

Time is a complex measure with more units of measure than any other (Merttens 1987). Here, peers shared various understandings such as clock notation and time duration, relating this to events such as setting sail and fishing, each enhancing their own and each others' understandings. This is evidence of social interaction playing a part in perceptual learning (Howe and Mercer 2007) for example L10 - 15 in Extract One, Fleur was corrected from reading 08:36 as in the evening and in Extract Two, Fleur explained to Sean how to find 36 minutes past the hour on the clock face by counting in fives. In our re-view interview a week later, Sean was clear that he had learnt this from Fleur as evidenced in the extract that follows.

YEAR FOUR, EXTRACT THREE, 07/11/2011

GROUP 2, RE-VIEW INTERVIEW 1: 'TIDE TIMES'

Children involved: Saul (8y 5m), Sean (8y 6m) and Fleur (9y 1m).

Total length of recording: 11' 28".

82 Sean: *Fleur was showing me ...*

83 Fleur: *8:36*

84 Sean: *... because I was telling Fleur that I am very good at time but on the handed clock it's not as easy as a digital clock for me, I find digital more easy.*

Extracts One and Two, above, are also examples of the complexities involved in 'mathematics in context', or in applying some mathematical knowledge (in this case, reading and interpreting times) to a context. Whilst it is helpful to be accurate when reading the time in any format, the application of that information involves making a judgement and oftensome approximation, in this case, 'coming back into port *any time before about* 15:00 will be safe'. This requires an understanding that 15:21 exists between the hours 15 and 16, how 08:36 and 15:21 are positioned in relation to one another on a mental number line, that 15 is only just before 15:21 (even though 15:21 looks a lot 'larger') and some idea of the distance between 08:36 and 15:21. The application of this understanding takes the necessary mathematical knowledge one step further than simply the reading and recording of times on a clock face. The three children remained with the task for the 28 minutes of the role play, trying to reach an agreement on the times to leave and return. During this time, Sean's frustration built as he wished to play at, or act out, putting to sea (see Chapter Five for an analysis of this).

In my interview with Mrs R in the spring term, she argued that the role play tasks gave her children the opportunity to practise and apply taught mathematics independently. She saw it as a consolidation area rather than somewhere they were working at the ‘leading edge’ of their mathematics:

> “*This isn’t the place where they push themselves to the nth degree.*”
>
> **Mrs R to HW, semi-structured interview, 22/03/12**

However this group did engage in independent, sense-making mathematical discussions that might not have happened without their involvement in a scenario such as this. Such discussions did draw upon mathematics that was outside what might be expected for this age group and contained key elements of ‘exploratory talk’ (Mercer et al 1997, 2007). Such exchanges were typical of the talk that occurred during this scenario in both groups where knowledge is challenged and justified, as illustrated in the following extract.

YEAR FOUR, EXTRACT FOUR, 01/11/2011: GROUP 2: ‘TIDE TIMES’

Children involved: Saul (8y 5m), Sean (8y 6m) and Fleur (9y 1m).

Total length of recording: 28’41”

145 Sean: [referring to peaks on tidal graph indicating the high point of the 08:36 tide to be nearly 5 metres in height] *Woah! Look at our high tide, look, that high!*

146 Fleur: *No, that's, that's the waves. / Sometimes say, this is how far the sea can go up to you, sometimes it's quite low and sometimes its really high. So like this, the sea can be that deep I think, 4 or 5 metres deep*

147 Saul: *That's quite deep tides, that's, when you go to* [name of local beach] *Sean, there's a big orange buoy, sometimes you can't, you can't, you just have to like, go out ...*

148 Fleur: [swimming motions] *Swim over to it*

149 Saul: *... swim over, and sometimes you can like walk, stand up*

150 Fleur: *So that's right*

151 Saul: *Some of the port's run out of water because it's gone out and that means its gone low. / So does that make sense?*

152 Sean: *Yeah, that makes sense now*

153 Saul: *Good, cool.*

In this extract, Saul and Sean *shared* their knowledge of tidal movements on the local beach and Fleur *challenged* this but the diagrammatic presentation of tidal movement over time, as a wave-like 'hump', confused her. However, she continued (L146) to *evaluate* the chart and read the depth of the high tide correctly. All these responses were *reasoned and equitable*. The mathematics involved in this task, i.e. reading and making sense of two different presentations of the same set of data and relating to this to reading time and calculating duration, was challenging for this group of children and yet they continued to tackle it with resilience and to struggle to express their reasoning. This is something that Ofsted reports have pinpointed as problematic in mathematics teaching (Ofsted 2008).

As my first observation of Group Two drew to a close, the three children began to play at being at sea, drawing on the mathematics of tide and time that they had previously been discussing (Extract Five).

YEAR FOUR, EXTRACT FIVE, 01/11/2011‘TIDE TIMES’: GROUP 2, OBSERVATION 1

Children involved: Saul (8y 5m), Sean (8y 6m) and Fleur (9y 1m)

Length of recording: 28’41”

191 Sean: *Quick! We have to leave <u>now</u>*

192 Saul: *Oh yeah, we have to leave*

193 Sean: *We got to leave* [fetches clock and changes hands]

194 Fleur: *Right OK*

195 Sean: *No actually, let’s stay out for a bit*

196 Fleur: *Yeah but then we’ll be in* [....] *because of the tide*

197 Sean: *I’ll look at this* [consults tide chart] *Right* /

Saul is sitting and ‘rowing’ using a ruler.

198 Fleur: [holding clock, with some urgency]. *Look, look, look, if we left at 8 o’clock in the morning, now look what time it is, it’s half past two, we’ve got* [....]

199 Sean: *Oh no! / Oh dear!* [takes ruler from Saul] *Anchor please* [puts ‘anchor’ over side of boat and brings it in again, quickly]

200 Saul: *You just lowered it*

201 Sean: *No we’ve highered it.* [To Fleur] *No, let’s go back in, let’s do it all again, let’s do that all again*

202 Fleur: [shows clock] *That’s 3 o’clock*

203 Sean: *Oh no! 3 o'clock!*

204 Fleur: *What is it, quarter to?* [grabs tide sheet] *Oh, 20*

205 Sean: *15:21*

206 Saul: *Make it lunch time*

[...]

207 Fleur: *No it's actually 3 o'clock so, yeah we need to get back [....] few minutes away and we've got 6 minutes.*

In this extract, Fleur made *suggestions* (L198, 207) and *justified* her point of view (L202, 204) whilst the children pretended to be people at sea, drawing on their understandings of the mathematics that they had discussed collaboratively earlier in the session. For discussion of this sort to occur it is likely that there needs to be a mathematical puzzle to wrestle with, as well as the group feeling some joint responsibility for its solution. This would require the task to be structured as a group task requiring one agreed outcome.

The second and third role play tasks I observed were developments of 'Hemy's floating studio'. For 'Fish patterns' no role play took place amongst either group of children although they did engage in some mathematics that they found challenging (Extracts Six and Seven), whereas in 'Pricing Paintings' there appears to have been some play but little mathematics (Extract Eight). Both examples are characteristic of what happened in each group.

For the 'Fish Patterns' task, Mrs R introduced the idea of using caught fish to create a painting using a repeating pattern. The task sheet is reproduced in Appendix Three (iii). Props included a collection of rubber fish and a stills camera to photograph the patterns. The extract below is typical of both groups in that firstly, the stills camera distracted the children from the mathematics and secondly, they did some mathematics, a little collaboratively, but not in role. The teacher had intended this task to be collaborative but the provision of more than one recording sheet seemed to result in the children recording individually.

YEAR FOUR, EXTRACT SIX, 15/11/2011:

GROUP 1, OBSERVATION 2 'FISH PATTERNS'

Children involved: Ellen (8y 7m), Cam (8y 9m), Callum (8y 3m) and Nancy (8y 3m)

Total length of recording: 35'45"

99 Nancy: *Callum, what's that one?*

100 Casper: *What is it, what does it mean?*

101 Nancy: [pointing along line of 11 fish] *11 times 15*

102 Cam: *Easy*

103 Ellen: *I should have learnt this before*

104 Cam: *11 times 15 isss*

105 Callum: [...] [Callum and Cam are play-fighting and pulling faces]

106 Ellen: *You know that if you, if you speak and make a noise* [...]

[...]

107 Ellen: *Just write I don't know*

108 Cam: [stands and waves to camcorder] *I'm sorry camera*

Boys giggling. //

109 Nancy: [...]

110 Ellen: [frowning at Nancy] *That's 35*

111 Nancy: *That's 35.*

Boys are suddenly focussed on calculation, 11 fish repeated 15 times. All four bend over fish and sheet.

112 Cam: *That is, now hold on, a hundred and eleven, I think*

113 Callum: *Add times 5 to that, so that makes* / *110 that is*

Ellen writes.

114 Callum: [correcting her answer] *No, that's 25, one hundred and* ***twenty*** *five*

Ellen pauses, frowns at sheet but corrects her paper.

115 Callum: *15 is 125.*

Although clearly not role playing, the children in both groups persisted in attempting to answer the question 'How many fish will Hemy paint if he copies the pattern 5, 10 or 15 times?' In both groups they attempted to recall and apply some multiplication facts, Callum understood that although they might not know the answer to 11 x 15, it could be derived from 11 x 10 (L 113) but he then made a mistake when calculating 11 x 15 as 125. It is not clear what Ella's 35 referred to (L 110). In the second group, there was an interesting moment when Sean explained multiplication to Saul, as follows.

YEAR FOUR, EXTRACT SEVEN, 15/11/2011:

GROUP 2, OBSERVATION 2, 'FISH PATTERNS'

Children involved: Saul (8y 5m), Sean (8y 6m) and Fleur (9y 1m)

Total length of recording: 23' 13"

38 Saul: *OK, what does the times mean, Sean?*

39 Sean: *Like, how many times, oh* [grasps something and Saul objects] / How many were there?

40 Saul: [counts fish] *1, 2, 3, 4, 5 6, 7*

41 Sean: *OK, put seven*

42 Saul: [with pen] *Two?*

43 Sean: *Yes, no, not there, there you Dodo!* [...]

44 Saul: *I'm not a Dodo!*

45 Sean: *Now think, how many times, five times,* [hitting paper with pen] *how many if this was repeated five times, how many, how many fish would you need if that pattern was repeated five times?* [reading pattern of fish L to R] *2, 1, 2, 1, 2, 1, 2, 1, Wait a minute!* [...] *It'll be 1, 1, 2, 1, 2 !* [sighs] *Great.*

This was a rare moment of collaboration during this task and my evidence from both age groups indicates that, perhaps not surprisingly, providing opportunities to *jointly* read and record (rather than to do so as an individual) is more productive in terms of stimulating mathematical discussions of this nature.

'Pricing Paintings' was the third observation and took place after the class had painted seascapes in the style of Hemy. These were displayed on a wall as a gallery. The role play task was to agree a value for each painting in order they could be auctioned. The children were art consultants in the gallery and had one clipboard containing the list of paintings. The constraints were that no painting could be valued the same as another and the highest value was to be 100 guineas. (In a class 'carpet' session there had been discussion about guineas and children wanted to value the paintings in guineas). Mrs R saw this as an opportunity for the children to compare, order and discuss numbers to 100 and was interested to see how the group would attribute and agree on a numerical value for a painting. Each agreed value was to be recorded on a group sheet (an example is included in Appendix Three, iv) and these were to be the limit the group would pay for each painting in a forthcoming auction. The following extract of Group One tackling the task is typical of both groups in that they focussed on establishing their favourites and took ‘turns’ in allotting values.

YEAR FOUR, EXTRACT EIGHT, 29/11/2011

GROUP 1, OBSERVATION 3, ‘PRICING PAINTINGS’

Children involved: Ellen (8y 7m), Cam (8y 9m), Callum (8y 3m) and Nancy (8y 3m)

Length of recording: 20’55”

63 Nancy: *So, which pictures do you like?*

64 Ellen: *Cam likes 30, so maybe we should put a little, maybe we should put a little tick ...*

65 Cam: *OK, tick*

66 Ellen: *... and write Cam on it*

67 Nancy: *Oh put, umm*

68 Cam: *Just tick*

70 Ellen: *Oh no, no*

71 Nancy: *We need to write how much*

72 Ellen: *Yeah, we need to write, Cam, Cam how much you think you should put the price?*

72 Callum: *It’s very* [...]

73 Cam: *100 guineas*

74 Ellen: *100 guineas?*

75 Callum: *Yeah!*

76 Cam: *Oh yeah! That's a lot!* [laughter]

77 Ellen: *Ok, nobody else, nobody else is allowed 10* [100?] *guineas now*

78 Cam: *You could do, you could do 99 guineas*

79 Ellen: *Do you, do you want 99 guineas?*

80 Cam: *Nah. Oh 99 guineas then* [Nancy writes '100 gns']

81 Ellen: *100 guineas. Umm Nancy your turn*

82 Nancy: *Callum, which one do you like?*

83 Callum: *18*

84 Ellen: *You like 18, where's 18? Callum likes 18*

Cam, Nancy and Ellen look for painting numbered 18.

85 Cam: *Yeah, we like 30 and 18*

86 Nancy: *How much do you want that to be?*

In this extract, the children had just begun to price the paintings after agreeing the opening and closing times of the gallery. Ellen and Nancy organised this as the taking of turns to price your 'favourite'. Both groups found the task quite hard because there were 30 paintings to value (each child in the class had painted one) and they found agreeing a value for each difficult, hence they saw the task as taking a long time. At one point early on, Ellen remarked: "*Oh God, this is hard*" which appears to refer to the scale of the task and the difficulty in working collaboratively to agree an answer rather than referring to the mathematics. It is clear that although discussions were constructive in the sense that children jointly considered each other's ideas, knowledge was not shared or evaluated and neither were ideas and challenges explained or justified, meaning that this could not be described as exploratory talk (Wegerif and Mercer 1997). Neither was there much mathematics learning taking place on either occasion although it could be argued that the participants were applying their knowledge of whole numbers under 100 in a social situation. The group's attention was on reaching agreement on a price for every painting, to complete the sheet according to the rules (not to duplicate a price) and recording this correctly to everyone's satisfaction, paying attention to the spelling of 'guineas'. They did not complete the task that session. In both groups children allotted values according to whose painting it might be (the paintings were unnamed) rather than artistic criteria, the boys not wanting to grant status to paintings that they thought were painted by a girl. Unusually, Saul in Group Two made one reference to how the waves were depicted but was overruled by Fleur who, with the pencil, controlled the final decision. In Group Two Fleur tried to insist on a reason for valuing the paintings, saying: "*You have to think, you have to think why it is, not just because*" (Group Two, Observation 3, L134). However, this was not developed further.

Om reflection, the issue of constraints as discussed in relation to the Reception examples, seems critical in whether or not a task 'works' mathematically. When 'Pricing Paintings' with no criteria to discuss to value the paintings and too many to value, the job became one of getting through the task in the set time. With four children all making three 'Fish Patterns', the completion of the sheets filled the time.

In my interview with Mrs R in March 2012, she talked about what she thought was important about her role play which was not necessarily being about correct mathematics but rather about creating a place where children can try things out, make mistakes, discuss these and, later justify their answers:

"I think that's another reason why I don't worry what comes out at the end. Because I / it's not about have they got it right, did they do, did they do this task right? You know? Did they /that's not about what that's about at all. It's much more about process. How did you try it, right?" **Mrs R to HW, semi-structured interview, 22/03/2012.**

There was evidence of some children applying some mathematical knowledge in both 'Fish Patterns' and 'Pricing Paintings' but the important thing for Mrs R was that children had a go, independently. By tightening up the tasks, maybe by trying the same task again but with some additional constraints, we would be able to target more specific mathematics for them to have a go at. Perhaps one use of role play is to generate subsequent class mathematical discussions. Pooled knowledge or misunderstandings that arise in scenarios such as these could provide starting points for new work and new understandings (as happened when the video was reviewed in the re-view interviews). For such discussions to be pertinent, the teacher would have to keep in tune with what was happening in the role play. This depends upon 'eavesdropping' by either using a camera or as an observer for brief periods (Mrs R referred to this as "being a fly on the wall" in our interview) or by knowing the task or the mathematics so well, that it would be possible to predict what was likely to happen with this age group.

Two aspects of pitch – interest and expertise - were discussed in relation to the Reception class tasks and seem key to a successful task. The challenge for this teacher was to pitch these tasks in these terms when observation did not and could not form a core part of her mathematics provision, in the same way as in Reception.

At the beginning of December 2011, I referred in my research diary to the significance of the development of the story thread throughout the Autumn term in the Year Four class in relation to developing the mathematics:

> *Re. the ongoing story– Mrs R says* [this idea] *has made* [the role play successful] *this term* [by] *dipping into a story to hang/centre the maths. Is this like children going out into playground to continue the game they played the last playtime? Maybe* [this] *links to the 'sustained uninterrupted periods of time' (Rogers & Evans 2007).*
>
> **Research diary entry, 01/12/2011**

The function that story might play in learning mathematics is to stitch the learning together over time. This challenges the dominant pedagogy of mathematics being broken up into bite-sized pieces and delivered as separate, disconnected lessons (Brown and Millett 2003, Hodgen and Kuchemann 2012). By the end of the Autumn term 2011, various tasks set within and connected to 'Hemy's floating studio' had been tackled by this Year Four class both within and without the role play. Mrs R had the idea of ending the term's work by holding a role-played auction of their paintings. This was held during one afternoon in the penultimate week of the Christmas term with all the other distractions this term contained. Despite this, I observed the class engaged in the auction for the duration of the afternoon. When told to pack up to go home, they asked if they *had* to do so. This clearly indicates a high degree of involvement and enjoyment but did any mathematics take place? The following extract is transcribed from the beginning of the afternoon.

YEAR FOUR, EXTRACT NINE, 07/12/2011

CLASS 'AUCTION OF PAINTINGS'

Total length of recording: 42' 18", this extract is of the first minute and a half.

The class are sitting in their role play groups, in rows facing the auctioneer and the auctioneer's 'spotter'. Each group has the list of paintings they had priced (being the maximum bid they have agreed for each painting) and 100 'guineas' in plastic and paper money (multiples of pounds). At the back of the classroom are a group of children (cashiers and treasurers) ready to take the payments from purchasers using 'ready reckoners' they had prepared previously to calculate how much goes each to the vendor and the auction house. Some children are ready to take telephone bids from (invisible) bidders. A couple of children are filming the proceedings on camcorders. Whilst the recording is taking place, although Mrs R is present, she is at the back of the room watching what is happening but clearly involved in other jobs as the children 'play'.

The recording starts as lot 1 is being bid for. The class is quiet and attentive, watching the auctioneer who stands in front of the wall of paintings.

Auctioneer: *10 guineas* (2 hands go up) *12 guineas* (3 different hands go up – all from Group One's role play group!) *15 guineas / 20 guineas* (some quiet laughter)

//

Mrs R: [To auctioneer] *Have you seen the person there?*

Auctioneer: [As she spots bidders] *25 guineas / 30 guineas* //

Hands continue to go up, mainly the same children. Some children can be seen consulting their pricing sheets

Auctioneer: *36 guineas / 38 guineas / 40 guineas* //

One boy's hand stays up at the front. His partner in the same group is also bidding. Children are smiling and looking around at who is bidding, some very quiet talk. Mrs R makes a hand movement for the Auctioneer to hurry up.

Auctioneer: *Thirty, no, 40 guineas*

Child: *You've already said that*

Auctioneer: *No, 50 guineas*

Ellen indicates boy with his hand continually up at the front and says something to the auctioneer.

Auctioneer: *Going once, going twice, SOLD* (bangs gavel)

Mrs R: *With you*

Auctioneer: *With you* (points at boy in front, who looks pleased)

Mrs R: *So, take your money and go and pay*

Ellen's hand is over her mouth in surprise. Boy walks to treasurers' table at back of room and class begins talking. Mrs R quietens class.

Auctioneer: (To child in front row) *It's sold for 50 guineas!*

Mrs R: *Lil, lot number two. Shhhh*

Auctioneer: *Lot number two. / Going for 5 guineas.*

Mrs R prepared the class immediately prior to the auction in several ways. She began by showing a YouTube clip of a Picasso painting entitled 'Nude, Green Leaves and Bust' being sold at auction in 2010 for 95 million dollars. This created great interest in the class and clearly has strong parallels with the way Miss H captured her Reception children's interest using the film of Usain Bolt's world record. In a similar way, Mrs R then used mathematics sessions prior to this role play to visit both some of the mathematics and the social aspects necessary for the auction to take place. The social aspects included discussion with the class on positions (roles) required for the auction, such as treasurers, cashiers, bank tellers, auctioneers, bidders and the recognition of auctioneers' vocabulary and terminology. Mathematical preparations included:

- a taught class session organising and ordering a range of prices from 0 – 100;
- counting and organising notes and coins for each group to the value of 100 and,
- higher attaining children working with a Teaching Assistant to calculate 5% of different prices (the auction house 'cut') producing a ready-reckoner to use during the auction.

Mrs R's role during the auction was then similar to that of Miss H in Reception role play, as she observed what happened, reminded and focussed the children's attention on various aspects of the play. However, in contrast to Miss H, on the whole, these were organisational rather than mathematical comments, Extract Nine (above) is typical.

What mathematical knowledge were these children using whilst role playing the auction? As the different auctioneers gradually increased the bidding, children can be seen linking what is being called out to the amount on their pricing sheet. A few children made bids based on how much they could afford, i.e. how much they had left in their money box which involved mental addition and subtraction within 100. Ellen's expression when the gavel struck in Extract Nine, as well as the Auctioneer's comment, indicated they both realised that 50 guineas was a large portion of the group's total budget.

What did the use of the word 'guineas' detract or add to children's mathematical understanding? Rather like the decimal point in the Reception class extracts, Mrs R glossed over 'guineas'. Children had observed the Picasso as priced in whole guineas, however the children operated with a decimal system. For this age group to calculate within a budget using £1 and 1 shilling as the unit of payment would clearly make this too difficult a task. The word 'guinea' functioned here as the word 'dino-pound' did in the Reception class's 'Dinosaur café': a fantasy currency.

As the auction proceeded, discussions between the children were mainly about the cost of paintings and whether individuals in the same group were, or should be, bidding against each other. The issues of bidding against oneself and bidding to an amount they could not afford were not resolved that afternoon. Mrs R used these as a focus for a class discussion another day after re-viewing some of the video with the class. In my re-view session with Group One two days later, I played a clip of the auction (Extract Nine) and drew the children's attention to Ben who appeared to be bidding against himself as well as his group, as follows.

YEAR FOUR, EXTRACT TEN, 09/12/2011

Group 1, Observation 3 Re-view Interview

Children interviewed: Ellen (8y 8m), Cam (8y 10m), Callum (8y 4m) and Nancy (8y 4m)

185 HW: *Was he doing that? Because he had his hand up and she said 45 or something, and he kept his hand up and she went 50*

186 Ellen: *Yes*

187 HW: *And then she went 55!*

188 Ellen: *Yes. Yes so he could have got it for lower if he'd put his hand down*

189 Cam: *Yeah, so he could have got more, he could have got more*

190 Ellen: *He could have got more*

191 HW: *He paid too much you mean? I think you're right*

192 Nancy: *Yeah but ...*

193 Ellen: *He could have got more money if he'd stopped*

194 HW: *Yeah*

195 Nancy: *... yeah but if he put his hands down, she would have put the prices lower and then more people might put their hand up because it's a lower price*

196 Ellen: *Oh no. No Nancy, because once you've bid you have to put your hand down to see if somebody bids higher and if they don't, you get the painting /*

197: Cam: *You don't leave your hand up*

198 HW: *Yeah*

199 Ellen: *You don't leave your hand up* [...]

200: Cam: *Because it might be the [...]. You can't go like this*

201 Nancy: *You put your hand up if you can have [...], but then if you can have 10 you like leave it up or put it down*

202 Ellen: *No, you put it down until the next bid ...*

203 Cam: *No, umm ...*

204 Ellen: *... or somebody else's bid gets it*

205 Nancy: *Oh!*

206 Cam: *No, you shouldn't go like this, you shouldn't go like this / Because it might be, it might be*

207 Ellen: *You might be the only body, you might be the only person left, then you'd just be bidding against yourself*

208 Cam: *Yes, you'd be going like that ...*

209 Callum: *And you'd be bidding, bidding, bidding, gone! 500!*

[...]

210 Cam: *... you'd go like that, and then you'd go like that again and then, um you wouldn't get the painting because, you might of thought it um, was the one next to you 'cos you did it twice*

211 Nancy: *So like, umm, if when, like when there's a bid, like he put his hand up and then, but if you put your hand up and you're the only one left, do you like put it back down, so then you would have the painting, or do you leave it up* [...]?

212 Ellen: *No, no you take it down and then if nobody else is doing anything, they'll go 1,2,3 gone.*

This re-view discussion revealed Nancy's misunderstanding about bidding. Ellen's explanation was lucid and the group's response to Nancy non-judgemental. Nancy continued to ask questions until she satisfied herself that she understood. A little later, when I asked the group what they had learned from taking part in the auction, Nancy was very clear:

217 Nancy: *Umm, something about, well, um / I never knew you had to put your hand down before, like [...]*

218 HW: *You've just learnt that*

219 Nancy: *Yes* [laughter]

220 Ellen: *I thought you knew that!*

221 HW: *Well*

222 Nancy: *Umm, nooo.*

The auction as an event was complex just as when the Reception children ran against Usain Bolt. When the mathematics was presented as part of a social context there were a lot of conventions to remember, a lot of things to do and to understand. Mathematically these included the application of the following knowledge and skills: deciding on an amount to bid, paying attention to the numbers being called out by the auctioneer, mentally calculating or estimating if you had enough money (left), raising (and lowering) your hand at exactly the right time whilst listening to a string of (irregular) numbers, counting out the correct sum and adding up your remaining money using mixed coins and notes. It also entailed these elements of Ollerton's (2010) ways of thinking mathematically; *gathering and ordering information, analysing information,* and *making conjectures*; as well as learning qualities such as *resilience*, *perseverance*, *independence* and *collaboration* (Ollerton 2010). The mathematics was not simplified but supported in the sense that these children had been prepared for particular elements. As discussed with reference to the Reception observations,

this is a model of learning and teaching sharing some features with an apprenticeship model (Collins 2006). At the same time, there were the social demands of the auction context such as, decision making, taking account of everyone else's bids in a continually changing situation, comprehending unusual terminology and negotiating with their group.

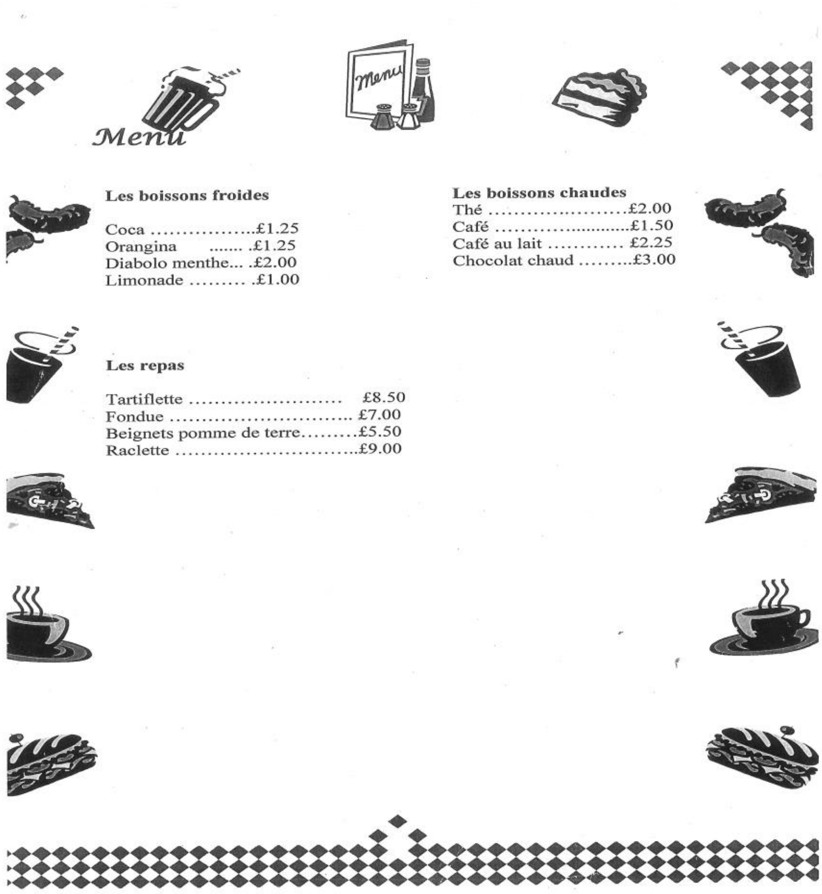
The final Year Four scenario I observed was a café role play.

Scenario Two: The French Café

Extract Eleven is characteristic of my two observations of the play in 'The French Café'. Previous to this observation, each group had named the café (Group One, "Les Marmottes", Group Two, "La Chapelle") and priced their own menus of French food items in sterling. Previous group tasks had involved working out the cost (in sterling) of one serving of each item on the menu and agreeing what they would charge for one portion; how much to charge for different drinks given the price of a large bottle, as well as the imminent arrival of the Trading Standards Officer to check on the accuracy of the café's weighing scales.

For this task the children had available their menus and reproductions of Euro notes and coins, along with food made from paper and card. They had to order and pay for food as customers with waiting staff adding up orders and taking appropriate payment. The menu is reproduced below (Figure 1).

Figure 1: ‘The French Café’ menu



In what follows I look at this data in terms of, firstly, what participants’ behaviour suggests they are attending to and secondly, what they appear to understand mathematically. Comparisons are made to the Reception ‘Dinosaur Café’.

YEAR FOUR, EXTRACT ELEVEN, 28/02/2012

GROUP 1, OBSERVATION 4: The ‘French Café’

Children involved: Ellen (8y 11m), Cam (9y 1m), Callum (8y 7m) and Nancy (9y 0m)

Total length of recording: 23’ 50”. This extract begins 18 minutes in.

Participants have just changed roles and the girls are now customers (C) and the boys, waiters (W). The price of each menu item is shown in brackets.

[...] In what follows, girls are discussing menu and counting out money a small box of coins and notes for items they have chosen. Boys in kitchen.

210 Nancy (C): *I want some Coke* (£1.25*), so that's one twenty five for me* [...]

211 Ellen (C): *One twenty five* [...]

212 Nancy (C): *Then I'm going to have a tartiflette* (£8.50)

213 Ellen (C): *This is a five pounds* [...]

214 Nancy (C): *And then I need three pounds*

[...]

215 Ellen (C): [To Callum with pad] *That's for the drinks*

216 Callum (W): *What drink would you like?*

217 Ellen (C): *Nancy wants a Coca* (£1.25) *and I wanted a lemonade* (£1.00)

Callum writes order.

218 Nancy (C): [...]

219 Ellen (C): [With 100 Euro note] *I'm giving I'm giving you this, I'm giving you this so you need to go and get change*

Callum refers to menu for price of items.

220 Ellen (C): [...] *Nancy* [glances at camera]

221 Callum (W): *OK, so let's see / that's / OK so that's*

222 Ellen (C): *Here's the money for the drink, for my drin*k

223 Callum (W): *OK, and we need another one twenty five.* [Turns to Nancy, who counts it out] //

224 Callum (W): *That's one twenty, one twenty one*

225 Ellen (C): *No, one twenty five [...] and mine is*

Callum looks at camera //

226 Nancy (C): [Holding a 500 Euro note] *And I'll have a tartiflette* (£8.50), *so you can take it out*

227 Ellen (C): *Ummm /*

Callum writes. Cam arrives, they look at menu. Nancy glances at camera.

228 Ellen (C): [Hands Callum 20 Euro note] *This is for the beignets* (£5.50)

229 Callum (W): [With menu] *So beignet / so that one / pomme de terre*

230 Cam (W): *That will be 10 pounds ...*

231 Ellen (C): *And yours is tartiflette* (£8.50)

232 Cam (W): *... 10 pound 50. 10 pound 50. No, yeah*

233 Nancy (C): [...] *10 pounds*

234 Cam (W): *Yeah, no yeah, hang on yeah, 8* [Calculating mentally from menu]

235 Callum (W): *OK* [Gathers money and pad]

236 Cam(W): 2*OK, that's, can I, I know that, I want to, give us that* [Takes pad and adds up] *5, 8 [...] / 15*

237 Nancy (C): *What's 10 pound 50?*

238 Callum (W): *Thank you very much! OK* [Takes money to shop counter]

239 Cam (W): *15, no! I <u>know</u> it, look listen, 15, 15, 18, 18 pounds*

Cam sits at the till.

240 Ellen (C): *Cam*[Girls are putting coins into the 'tips' pot]

241 Cam (W): *Did you give us 18 pounds?*

242 Ellen (C): *We gave you lots of money*

243 Nancy (C): *We gave him a 10 for the tartiflette and we gave* [...]

244 Ellen (C): *You have to give us*

245 Cam (W): *Oh, no, no, no, sorry*

246 Ellen (C): *You have to give us some food.*

The group had been in the café for 18 minutes when this extract took place, a note made in red in my transcription at line 225 states: "*All completely engaged*". The length of the observation was just over 23 minutes during which all talk was directly related to their roles as customers and staff in a French café whereby they demonstrated learning qualities such as *resilience, perseverance, independence* and *collaboration* (Ollerton 2010). Setting up the role play for that week, Mrs R had modelled likely in-role talk and impressed upon them that how one behaved and spoke when either waiting or being waited upon, was important. After the success of the auction in the previous term, they were working towards an 'end product' this term thus the 'French café' was to open for families at the end of the term, serving real food. This morning the groups had been told to "*practise*" waiting and serving to prepare for this real café event. The children's attention moved in and out of the mathematics and the social aspects of serving correctly. The combination of expectations in terms of the mathematics and the 'performance' for families alongside the organisational issues (e.g. resources including Euros and Sterling) prejudiced some of the mathematics that took place.

What does Extract Eleven demonstrate in terms of the children's ability to apply their knowledge of money and exchange? In both observations children refer indiscriminately to pounds, Euros and even on one occasion, to dollars. They realise Euros are the currency used in France but it appears these terms were shorthand for 'money'. Having the menu priced in pounds and providing Euros as the play currency probably confused this further. During Extract Eleven the girls as customers began by trying to total what they were spending but then handed over a note before ordering (L 215). Callum (waiting) added what they ordered in his head (£1.25 for Coca, £1.00 for Limonade) and asked for "*another one twenty five*" indicating that he may have seen the €100 Euro note as 100 pence. Nancy then tried to pay for a tartiflette (£8.50) separately using a €500 note (L 226) and Ellen a beignet (£5.50) using a €20 note. All this was very confusing for customers and waiting staff (and observer!). Casper focussed on writing the order accurately. Cam persisted in adding mentally all four ordered items, one limonade (£1.00), one coca (£1.25), one tartiflette (£8.50) and one beignet (£5.50), together totalling £16.25. His initial total was £15, the correct total for the whole pounds, he then adjusted this to £18, it was unclear why.

Another difficulty that arose was how much change to give when a customer paid with a large note and ordered a small item. In this earlier exchange during the same observation (below) Cam as a customer and Ellen as a waiter made it clear that they found change difficult:

11 Cam: (Stands, goes to girls waving a 500 Euro note) *I'll make it tricky for you actually. It's only nine pounds for all of that, how much change do I get?* (Laughs)

12 Ellen: (takes note and puts to one side, smiles) *No, you can't do that*

Cam laughing, sits.

13 Ellen: (Comes to table) *You get [...] one that we can't actually do.*

Interestingly, in a similar way to the pricing of the paintings by Group Two in Observation 3 (analysed previously) this task became competitive rather than collaborative: boys versus girls, waiting staff versus customers. Why did this happen? Even when attention is paid in a classroom to how a group works together, with emphasis being given to mutual respect and collaboration, it seems that issues of gender separation and banter can override this.

The calculation required for Cam's order was 500 – 9, perhaps out of reach for him. Later Nancy and Ellen successfully calculated 20 – 17 = 3 when giving change (Group 1, L 107 - 111).

The teacher's dilemma is to provide an authentic task whilst pitching and structuring a complex task such as this. All menu items were in multiples of five and ten pence as it was expected that this age of child would be able to add in fives and tens but the decimal point made this a difficult task when mentally adding several items. Moreover, the rather unruly customers made it more difficult as they paid and ordered indiscriminately often using large notes requiring complex change calculations. Extract Eleven is a good example of 'maths in a muddle' but on this occasion, a muddle that is not resolved as the complexity of both the context and the mathematics (for example, two waiting staff in the same role, two customers each with money, notes in too high a denomination) made it impossible for them to total and pay accurately. This was typical of other transactions with both groups in the café that day.

Comparing this recording to those taken in the Reception café where the task was more structured with clearer expectations, several things emerge. To increase the potential for learning to calculate with money, some constraints are necessary. Waiting staff could control the ordering, for example, by taking each customer's order in turn. Customers could be served with food and given a receipt to pay at a till, where one person takes payment for each receipt. In order to practise adding accurately several small items, a budget of €20 (or pounds) could be put in the customer's wallet in coins only. Providing only one note in the wallet and perhaps the provision of some structured support such as a 'change checker' offers a separate learning opportunity: giving change. Whilst the amounts might have been realistic and manageable in terms of calculations, having an endless supply of coins and large denominations of notes made the prices meaningless and prioritizing choices unnecessary.

Decisions such as these are based on knowledge about what these, and other, children do and are likely to find difficult, just as the Reception teacher's are based on her continual observations of their play and knowledge of their mathematics. In this Year Four class as in most others, observation at this level is not possible. The challenge is to structure tasks to take account of this. Potential mathematics tasks, having been generated by discussion between the class and Mrs R were often begun one week, returned to the following week and used as a focus during other mathematics lessons, as well as during class 'review' time. This allowed children to engage in some mathematics over an extended period of time and to return to the task with the benefit of discussion and thinking time. Thus, even when less successful mathematically at the time, the role play in Year Four operated as a site for playing with some mathematical ideas that were tackled with more structure in other mathematics sessions. My evidence illustrated that reviews with participants of what went well and not so well helped structure and develop future tasks. This is discussed further in Chapter Six.

In summary

"This is maths with their whole bodies."

(Laurinda Brown, in discussion, April 2012)

The purpose of this chapter has been to establish if children were observed engaging in mathematics during role play and to pinpoint any mathematical learning taking place. Role play mathematics is messy in the sense that it can provide a muddle that children, in both age groups, were willing to persist in sorting out. Children's success in doing so seemed linked to the structure that was provided. The Reception teacher made some difficult mathematics both accessible and attractive to her Reception children. A learning environment was created that encouraged exploration and experimentation, questioning and disagreement, where difficulties seemed to be welcomed by both adult and child as stimulating. In such an environment, a new idea introduced (for example regarding comparison) might well conflict with a previously held understanding (that the larger number always wins) and such a conflict helps construct some new learning. This model of learning and teaching shares some features with an apprenticeship model (Collins 2006) where a knowing adult supports a learner in learning side-by-side as they engage together. There was some known mathematics that the children applied to different situations whilst they constructed further (complex) mathematics as they played.

The three Reception scenarios can be described as successful in terms of numbers of children involved in attempting to solve different mathematical problems, independently and confidently, at a high level of challenge. As discussed, there appears to be evidence here of these Reception children engaged in elements of mathematical thinking as well as exhibiting positive learning qualities (Ollerton 2010).

The scenarios recorded in Year Four were more variable in terms of mathematical learning. However, where a mathematical muddle was not resolved (e.g. giving correct change in the French Café) the role play gave participants access to a common experience, a problem in an understandable context that could be followed up. The 'man (sic) in a muddle' approach draws from the process drama of Heathcote (Heathcote and Bolton 1995, 1999) in which students collaboratively work to find a solution to a dramatised context. This is examined both in Chapter One and Chapter Five.

In both classrooms, an environment for the learning of mathematics was created where exploration, experimentation, discussion and disagreement were valued and encouraged. Role play provision was one site for this to occur and the opportunities for uninterrupted time and the handing of control to learners nurtured its' development. The focus on mathematics in Reception appeared to be maintained by actions taken by the teacher that both reified the play and closely structured the tasks. It was particularly difficult to create effective mathematical role play tasks from scratch in Year Four where opportunities for the teacher to play alongside the children and influence what took place (as happened in the Reception class) were unusual and difficult to maintain in an educational climate that emphasises 'results'. Where ongoing observation is not an option, it is much more difficult to structure and support the play. In this sense, the role play operated differently in each classroom: in Reception, as a centre for what happened mathematically and in Year Four as a stimulus and context for some mathematics with the potential to be capitalised upon in other classroom tasks and mathematics lessons. Where the task did not result in any role play (notably, for example, in Year Four's 'Fish Patterns') the given task was not sufficiently different to other classroom tasks for something different to happen. What took place was mathematics but not in role.

Analysing the mathematical role play activities in these two classrooms, it is clear that the activities confront difficulties in applying mathematics rather than smooth them over. Mathematics becomes a complex, social activity with a clear purpose and is used as a tool to solve problems that begin to make ‘human sense’ (Donaldson 1978) to the particpants. This is in contrast to mathematics that is presented as a set of fragmented, focussed questions for pupils to complete. In both classes role play appeared to provide children with the space to make sense of some mathematics in an environment where they were allowed to get into a muddle and trusted to sort it out for themselves.

Stories or contexts such as these provide shared experiences and can be a source of mathematical controversies or incongruities requiring sense-making. Perhaps one important element of role play is that it might make the mathematics and the struggle to resolve this memorable, placing it in learners’ episodic memory (Goswami and Bryant 2007) and giving the mathematics an emotional association.

Watson et al (2003) point out in their study of secondary teaching that deep progress was made when students engaged in extended tasks over time, allowing time for progression, repetition and exploration. There appears to be little research into the effects of extended mathematics tasks with primary age pupils. Rogers and Evans (2007, 2008) research into role play in Reception classes found that when this made a significant contribution to learning it was given significant amounts of continuous time. This is a dilemma in a timetabled classroom, nevertheless, one key factor in planning mathematically valuable role play might be that it is planned as part of a ‘mathematical story’ that is developed over longer periods of time and that integrates different areas of mathematics. Although I have some evidence of progression, repetition and exploration (Watson et al 2003) in my Reception observations, I do not have enough evidence to support a claim for this in Year Four.

The following section examines in what ways these two classrooms might constitute mathematical ‘communities of learners’ (Lave and Wenger 1991, Wenger 1998) and whether engaging children in mathematical role play might help build such a community.

4.2 MATHEMATICS AS PARTICIPATION AND CLASSROOMS AS COMMUNITIES OF PRACTICE

In this section I tease out what I mean by a ‘mathematical community of practice’ (Lave and Wenger 1991, Wenger 1998) where a process of sharing information and experiences within the group contributes to participants’ learning from each other. I examine if and how the two learning environments in my study encourage children to actively construct their mathematics as part of a community of learners.

Stemming from Vygotsky and increasingly since 1990 (Vygotsy 1978, Kritt 2013) academic discourses in mathematics education have located themselves in notions of children constructing their own mathematical understandings with others. Constructivist learning theories shift learning and learners to being active: from mathematics as a discipline of facts, procedures, formulae and proofs transferred from teacher to learner, to the creation of environments that encourage exploration and experimentation, questioning and disagreement. Communication is a critical component as learners work through confusions and errors, constructing understandings. Within a mathematical learning community and here is an emphasis on the adult changing their behaviours in order to increase students' confidence enough to participate and to take risks (Edwards and Mercer 1987, Hufferd-Ackles et al 2004).

However, Klein (2007) argues that for the past 20 years, educators have talked about students actively constructing their own mathematics but have taken no account of how the learning environment might support or suppress this. In this section I explore the power relationships and participatory mechanisms underlying the mathematics practices of these two classrooms. I examine whether the main strands of what might constitute a mathematical community of practice exist, particularly in relation to Hufferd-Ackles et al's (2004) analysis, which identifies the following key features of discourse in an effective mathematical community:

- questioning;
- explaining mathematical thinking;
- varying the source of mathematical ideas, and
- taking responsibility for learning.

The responsibility and source of all four features transfers from the teacher to the student who then become co-learners in a community (Hufferd-Ackles et al 2004). In this analysis, the teacher's role becomes one of monitoring learning and assisting mathematical thinking rather than pursu3ing answers to questions. What might this look like in practice? In the examples, 'Tide Times' (Year Four Extract Four) and 'Faster than Usain Bolt' (Reception Extract Eight) new ideas conflict with previously held understandings, disequilibrium occurs and dealing with these shifts the learners' thinking and generates new ideas. The key features of Hufferd-Ackles' (2004) mathematical discourse community correlate to the five teacher actions I have previously identified as significant in the Reception class (see 4.1). In the section that follows, I analyse my video and audio data in terms of these features, exploring how the community of practice is supported (or otherwise) by adults, firstly in the Reception classroom (4.2.1) and secondly in the Year Four classroom (4.2.2).

4.2.1 In the Reception Class

In Chapter Five (5.4) I analyse the role of the adults in structuring the role play in order for mathematical activity to occur. In this, overlapping, section I examine the role of the adults in my study school in building a community of learner mathematicians.

As demonstrated in 4.1.1, observations of role play recorded in the Reception class demonstrated occasions when children sought out a role play activity planned by the teacher to involve them in some mathematics. They were keen to participate. For example, during the summer term scenario, 'Faster than Usain Bolt', three quarters of the class were filmed over three consecutive mornings, the first group of children arriving immediately after the class introduction. What are the contributory factors that sustained the engagement of these children in both this scenario and in the mathematics over the three consecutive days that they were observed?

In all three scenarios over the two terms, Reception children were observed negotiating and participating as members of a social community, engaging in a complex set of interactions that might involve participants in some mathematics. My analysis indicated three main ways in which their teacher created and supported the development of what might be described as a community of learners. Firstly, Miss H actively encouraged and integrated her children's ideas into her mathematics curriculum. Secondly, she was willing and ready to change her plans according to what developed. These relate to Hufferd- Ackles et al's (2004) math-talk category, '*Source of mathematical ideas*'. Finally, all children were expected to make a contribution, correlating to Hufferd-Ackles et al's (2004) category, '*Responsibility for learning'*. I provide examples of each of these in this section. Later in this section I identify speaking 'as if' as a key feature of her practice (returned to in Chapter Five).

'The Dinosaur Café' is one example of a scenario building collaboratively from the interests of children. Whilst a café might be a common role play scenario, the idea of a café for dinosaurs is not. It began as children playing explorers who followed maps and identified animals; developed into somewhere for them to stay and eat (a hunters café) and then later still, when dinosaurs were spotted, a child suggested that the dinosaurs also might want somewhere to eat. The children thought that dinosaurs would need a different menu to the hunters and probably to visit the café at different times. It was also generally agreed that dinosaurs could not talk. In an interview held in April 2012, the Reception teacher explained further how child and adult pooled their ideas for the 'Dinosaur Café' tasks to emerge.

> "*I suppose, umm, we did a bit of, umm, we did a bit of what dinosaurs would sound like and came up with them* (taps), *and then we talked about*

it in the staff room as well and there was a bit wasn't there? [sic] *And* [the children] *did it, but when they actually did it in the role play, we did a bit on the carpet, but when they did it in the role play it was a similar idea but the way they did it was different."*

Miss H to HW, semi-structured interview, 17/04/2012. Excerpt starts at 12' 28"

Based on discussions with the children, Miss H asked a question in the staff room - how might a dinosaur order something in a café? A colleague had an idea that they might send a message by banging. Miss H took this idea to the children, modelling tapping to signal an amount with the class. Numbers of taps were then associated to food items, numbered 1 to 10 with the children. The children were left to play with this idea independently. In the same interview, Miss H explained how she viewed the children's ideas, more generally:

> " [...] *well, they just take their ideas as absolute, like read, like, its absolutely acceptable that with the dinosaurs, they would go into a café, they would never question that at all, whereas, to an adult that just doesn't make sense at all, but they were like 'yeah, a dinosaur café' because they were doing about cafés and the dinosaurs went to the café and they started to make them food, so the idea of a dinosaur café made absolute sense."*

Miss H to HW, semi-structured interview, 17/04/2012. Excerpt starts at 2' 55"

In this excerpt, Miss H made it clear that the process of setting up the scenario was always one of collaboration which she later referred to as, "*Feed(ing) their imaginations, or they feed my imagination*". Miss H continually affirmed the children's ideas as she believed that activity was always more successful and constructive if rooted in the children's ideas.

Increasing participation of students at all levels of mathematics is an important element of Hufferd-Ackles et al's (2004) math talk learning community. Having set up and built interest in a mathematical context for all her children to explore, Miss H supported her community of learners over time by modelling the necessary mathematics in which she expected them to engage (counting beats of the sticks in the 'Dinsosaur Café', using the 'jump checkers' when 'Horse Jumping' and reading a stopwatch as they raced against Usain Bolt's time) and crucially, by providing time and space for the children to play with these ideas without adult interference. In addition, a key factor for the mathematics to remain a focus and for the children's confidence and mathematical skills to develop seemed to be the adult playing alongside and drawing attention to the mathematics. Miss H dipped in and out of the role play, observing her learners (legitimately as a spectator, in the case of two scenarios) and periodically intervening in their play, mainly to ask questions, to clarify an idea or to remind them to do something previously discussed. In class sessions following the play, she expected all members of her community to have something to contribute, even if they had not been observed on that particular occasion taking part.

Notably, rather than dealing with misunderstandings at the time she allowed the children to play with the ideas she had introduced, to experiment, question and disagree, gathering items of interest to discuss with the class as a whole later. In these carpet discussions, Miss H continually re-drew children's attention to the task and to any mathematically critical moments that had emerged. Thus the class focus remained on the mathematics. As a result it is possible to observe a gradual movement away from social concerns, such as lining up, taking turns or who is in charge on day one of the 'Faster than Usain Bolt' scenario, towards more mathematical concerns such as which is the fastest time, how to record accurately, together with a gradual concern over precision regarding measurements and comparisons, on day three.

As described in 4.1.1, movement to and fro between the mathematics and the pretend scenario was typical. This appeared critical in helping the children connect the two and in building both children's interest and confidence in the activity. One example of this movement was Miss H talking from the outset 'as if' both she and they were taking part, as can be seen when Miss H drew the introductory session to a close in what follows.

RECEPTION EXTRACT TEN, 28/05/2012

'Faster than Usain Bolt', Day One, Video 1A, Class introduction.

Total length of recording: 12' 24". This transcript is the final 3'

Miss H: [...] *Right, OK, we have to get busy then, so our challenge today is to try and be faster than the fastest man in the world, who can remember what his name was?*

Children (shout): *Usain Bolt!*

Miss H: *Usain Bolt, OK. Now it just so happens that we have already prepared, like Usain Bolt who's got his country's flag around his shoulders* [points at video still]*, our running, our official, real athlete's running vests, OK* [holds up French ‘vest’ made of card]. *Now, you did these on Friday with K and these are going to help us be like real athletes and run even faster, OK* [...]

OK so, we’ve got lots of different flags and lots of different countries and you will be running for your country that you decided on Friday, and we’ll see who can beat the fastest man in the world! Do you think that is a good thing to do?

Children: *YES! ... NO! ... Usain Bolt!*

Miss H: *My goodness me I think we’d better get busy, so outside, I am just going to be there with the races like all of the crowd just here* [indicates crowd watching Usain Bolt in frozen video clip]. *That’s what I am going to be doing*

Boy 1: *I’m going to be outside*

Miss H: *Good boy, fantastic*

Boy 2: *I am going to go outside*

Boy 3: *So am I*

Miss H: *OK, wait. Everybody, if you think that running faster, if you think you will run faster in your trainers that you’ve got, umm, in your PE kit you can put them on to help you run even faster, OK? / Other things this morning that we’re going to do, Lovely listening Sara, well done, thank you, super athlete listening/ super athlete listening Sara. We are going to be running outside, Mrs V is going to be doing some practising some score-taking with you on the carpet, Mrs H is going to be doing some clay, we might need some Olympic torches. Right. / Who thinks that we can go and get ready for the races?*

Class sessions pre-empting as well as reviewing what took place in the role play played an important part in establishing the pretend mathematics world in which they were all to engage. Here Miss H established joint ownership by saying "<u>*our*</u> *challenge today is ...".* She ensured everyone was included in her 'community of runners', by asking the children (repeatedly in the complete transcript) "*Who thinks they can ...* ?". Moreover, she allowed the children plenty of paired discussion time, what Hufferd-Ackles et al (2004) call '*explaining mathematical thinking*'. Miss H established her part in the play (a spectator) and made clear the value she placed on the play. In addition, the final paragraph reveals that the play was part of something much larger, as she made links between this and the clay modelling and scoring activities. Whether Miss H did this 'on the hoof' or whether this was planned is not clear but in our interview (that took place before this scenario was filmed) Miss H referred to "*... the whole class being a role play*", in the sense of both naming activities in terms of the role play and introducing additional activities linked to the role play context. In our interview Miss H explained this and its effect:

Miss H: *Like when we had the police station, err, we had a police / like an office, which was the writing table and that wasn't, wasn't, it didn't look like an office, it was just decided that that was the office. So, (when) we called it the office, like together, loads more children went to the table than if you just put police stuff, like, the passports, no not passports, identity badges, like the wanted poster, [...]. It was real, I think, even though we didn't do anything to make it look like a 'real' office [...]*

It was just, it was just like automatically accepted that, like, oh, so we are in a police station, so that is just an office, there was just no question [...]

Miss H to HW, semi-structured interview, 17/04/12. Excerpt starts at 24' 58"

Here Miss H made a significant point about how calling something something else – pretending - increased the children's participation. She also comments that effective role play is not always about providing complex props and dressing up. Instead effective role play involves responding quickly and sensitively to children's ideas and habitually behaving and speaking 'as if' something is something else. Speaking 'as if' creates a shared language particular to that community. The over-use of realistic props has been criticised (Rogers and Evans 2008) as not requiring the same degree of negotiation between players as more open-ended props. Such negotiation is typical of the building of a community of learners.

Contributory evidence of the Reception mathematical community can be seen in the children's use of shared language to talk about collective experiences in all three scenarios. The 'Dinosaur Café' recordings show the children handling and talking about 'dino-pounds' (Numicon shapes used as money), the 'Horse Jumping' riders use 'checkers' (Numicon 10-shapes) and athletes racing Usain Bolt use 'time-checkers' (1-10 number lines). In the latter scenario, a code (3sf' where 'sf' stands for 'seconds faster) developed for recording this, introduced by Miss H and adopted enthusiastically, if not always accurately, by the children. Miss H referred to these recordings the following day, asking which children had "*broken the athlete's code*".

There does appear to be the development of a joint, shared vocabulary: the discourse of a community at work. The success of this teacher's invitation to the children to join her in the role play community is evident in the level of involvement of her class which increased over the two terms. This might be due to the scenarios being more, or less, attractive to children, or it might point to an increase in the class's confidence in mathematics over time and to this teacher's increasing effectiveness at sustaining a mathematical learning community.

4.2.2 In the Year Four class

Can the Year Four classroom be described as 'engaging in a community of practice' (Lave and Wenger 1991) in a similar way to the Reception class? Both adults and children were well aware that the role play was to be a focus for mathematics work, as the children's comments revealed through the school's role play review across all year groups in 2010, 2011 and 2012 (see Appendix Seven for questionnaire):

> "[Role play] *is fun maths and it's good for your learning*" (Y2 boy, April 2012),
>
> "*It's best if the teacher teaches you a bit about* [the maths] *first and then you go into the role play*" (Y4 girl, April 2012),
>
> "[Role play] *makes the maths more real*" (Y6 girl, April 2012).

Hufferd-Ackles et al's (2004) criteria for establishing a math-talk learning community relocates responsibility for learning from adult to child and knowing *why* one is doing something, whilst not a sufficient component, is a necessary element of this process. During discussions and our interview Mrs R described an important shift in how she approached mathematical role play. This shift was from the teacher identifying the learning objectives to be 'covered' every couple of weeks and constructing role play tasks to fit the objectives, to discussing the possible mathematical activities connected to the agreed role play theme *with the children*. Mrs R had become interested in what mathematical activities might engage her children, instead of what mathematics she had to cover with these children. She shared this approach with the Reception teacher. This was a move from what could be described as, mathematics as being 'done to' learners towards mathematics being done *by* learners and correlates with Hufferd-Ackle et al's (2004) category 'source of mathematical ideas' being relocated away from the adult.

In an interview held with Mrs R on 22 March 2012, it was this shift from teacher-planned to jointly-planned role play mathematics that she pinpointed as significant describing this as: "*... an enormous learning curve*". Mrs R went on to say that the unforeseen result of this shift had been that she was able to trust her children to remain on task without adult support, as we see below.

> *"I trust them. / I hope that because I have listened to them and what they are interested in and what they want to do, that what, what's set up in there, they've got / a sort of underlying desire that they wanted to find that out anyway."*

Mrs R to HW, semi-structured interview, 22/03/12. Excerpt starts at 33'

This is significantly different from the emphasis in many Key Stage Two classrooms at this point in time, as well as an important element in building a mathematical community where responsibility for learning is shared (Hufferd-Ackles et al 2004). It is evident from all the Year Four observations that children were aware that they were all expected to make a contribution to what happened, and class ‘reviews’ of the role play authenticated this.

The role play of the Year Four class differed considerably from that of the Reception class in that it was not self-chosen. These Year Four children were timetabled for role play for half an hour each week and could not opt out. Nevertheless, the interviews with the children provide clear evidence that they felt an ownership and control over this aspect of their mathematics that they did not feel in other mathematics lessons. Taken from the 2012 interviews, this statement is typical:

> “*It’s different. You work with other people to work problems out. There are different opinions to hear*.”
>
> **Year Four Boy, annual mathematics interviews, summer 2012**

Children in Year Four appeared to both recognise and welcome independence from an adult when working in the role play. Over my twelve observations of role play there were only two occasions where the help of the adult was sought and these occasions were to do with procedural issues such as how to decide whose turn it was to be a waiter. Despite sometimes significant difficulties (typified in Year Four, Extract 3, Chapter Five) participants struggled on without seeking adult help (and despite the fact I was sitting alongside) to sort out the muddle themselves. This would seem to indicate that these children recognised and welcomed the role play as being their responsibility.

Moreover, participants acknowledged joint ownership of the task and continued working on the task to an agreed answer or resolution. For example, in Extract One, where the three participants were trying to reach a shared understanding of what the times actually meant by pooling pre-existing knowledge to construct some meaning from the resources provided. When this group were interviewed one week later and shown a clip of this role play (see Chapter Six for an exploration of the re-view interviews) two of the participants acknowledged the importance placed on them "*sorting it out*" (Extract 12).

YEAR FOUR EXTRACT 12, 07/11/2011,

Group 2, observation 1, Re-view Interview

Saul (8y 5m), Sean (8y 6m) and Fleur (9y 1m)

73 Sean: *There you go! You're arguing against each other, just, like*

74 HW: *Oh! Let's just pause it. What's going on there, Fleur?*

75 Fleur: *[...] the time*

76 Sean: *Because I wasn't quite sure how*

77 Saul: *Yeah, because he was like, wandering around*

78 Sean: *No, I wasn't, just because you two were arguing!*

79 Saul: *We weren't arguing, we were sorting it out.*

Here, Saul seemed to appreciate how discussion is central to 'sorting things out' as a group, and coming to some joint agreement or understanding as opposed to 'getting through' or completing a piece of work. A little later in the same interview as we discussed whether they found digital or analogue time harder to understand, Fleur added to this:

100 HW: *So did you say, did I understand you to say, Saul, that you thought digital is harder?*

101 Saul: *Yes.*

102 HW: *Now that's interesting then, that you find that, you are different to each other, then*?

103 Fleur: *I don't, I don't really, umm / I think Mrs R mixed us up, if Sean knew digital and not the clock thing and Saul knows clock but not the digital, so we can help each other*

104 HW: *So that's why she, that's why you think she put you together? Ahh, yes, yes.*

As well as realising that understandings can be jointly constructed in collaboration with her peers who may be more knowledgeable or competent, Fleur also stated here that she understood this to be the reason the teacher put them together in a working group.

Hufferd-Ackles et al (2004) also pinpoint student questioning as an important element in establishing a math-talk community where student-to-student talk is not dependent on the teacher. On examining my observations for evidence of children jointly constructing mathematical understanding, Year Four Extracts 1 – 4 of the scenario 'Tide Times' (4.1.1) are particularly potent. Here children can be observed engaging in a substantial amount of exploratory talk (Wegerif and Mercer 1997) hence evidence of collaborative knowledge construction as described in Chapter One. The hesitant interaction observable in the 'Tide Times' extracts is typical of the data I collected across all tasks in this age group.

In common with the Reception teacher, Mrs R appreciated the importance of spending time interesting her children in the role play scenario (the pretence) prior to introducing the mathematics. Time spent doing this was the biggest change she had made over the previous three years, referring to the process as building "*the story*" of the scenario to bind the work together.

> "*I think* [the role play] *is an asset to the classroom. For one thing it provides a focus, for all of the learning, not just the mathematical learning. So its really good just to motivate and, and just get that initial impetus into the topic.*"
>
> **Mrs R to HW, semi-structured interview, 22/03/2012**

By the time my observations took place, Mrs R had become more flexible both about the areas of mathematics her learners encountered and in planning how the scenario might develop, doing this in collaboration with the class as the work developed. Although the role play groups were the usual mathematics groupings based flexibly on attainment, rather than differentiating tasks in terms of any perceived mathematical attainment, a role play task was chosen for its appeal and accessibility to as many children as possible (typified by the 'Tide Times' task). The result was that class discussions of mathematics took place and having taken part in similar mathematical experiences, all the children were able and expected to play a part. Setting a common mathematical task that enables all learners to discuss the mathematics is essential in sustaining a community of mathematical learners (Hufferd-Ackles et al 2004, Sfard 2011). Mrs R called these problems 'real':

> *"When the problem is real to them, then the results are so much better".*
>
> **Mrs R to HW, semi-structured interview, 22/03/2012**

In other words, as discussed previously these are authentic mathematics problems that 'made human sense' to children (Donaldson 1978) because time had been spent involving learners in the context in which they were set. The story helped to stitch the mathematics together and it also stitched the children together into a community, all sharing the same language. This has similarities to the mathematical work set in a story context used by Twomey Fosnot and Dolk et al (2001a). Mrs R used a range of strategies to bring her children 'into' the Year Four scenarios, such as reading a letter to the class 'written' by a scenario character; speaking 'as if' she was someone in the story, and visiting local places relevant to the scenario. In addition, Mrs R's view was that linking other activities to the role play scenario, not just those that were mathematical, helped sustain children's interest.

In a similar way to Miss H's class carpet sessions, Mrs R periodically used what she referred to as 'role play plenaries' for her to 'keep tabs' on what was developing mathematically and to maintain children's focus on and interest in, the mathematics. An observation of one such plenary (reviewing the progress of the task 'Fish Patterns') revealed Mrs R focussing children's attention on some mathematics and asking questions such as, "Do you agree with ...?", "What do you think?”. This correlates with Hufferd-Ackles et al’s (2004) analysis of teachers in a math-talk community monitoring what occurs with students’ ideas as being central to what takes place.

In summary

In this section I have outlined the actions of the two teachers that contributed to establishing mathematical learning communities in their classrooms. To summarise, the following actions increased pupils’ collaborative participation in the mathematical role play:

- involving children in developing both the scenario and ideas for some mathematics;
- providing tasks which potentially could involve or engage everyone and thus provide scope for the development of a shared language for discussion with an expectation that everyone would make a contribution;
- allowing children independence, responsibility and importantly, time to work at the problem, and
- encouraging joint solutions.

Moreover, problems that included some incongruity and that did not have a foreseen conclusion encouraged debate and co-learning. Who knew who would be able to beat Usain Bolt or whose painting would fetch the most money in the auction in advance?

There were of course, clear differences between the two teachers’ practices. The Reception teacher was more able to observe and participate in the pretend scenario to develop the mathematics alongside the children whereas the dilemma for the Year Four teacher, constrained by time and curriculum, was to discover what was going on when her children role played. This she tackled by observing intermittently (eavesdropping) and by asking them. This led to more structured Reception tasks and much looser, open-ended Year Four tasks. Whilst the involvement of the Reception teacher might have led to her children having less control over what they did, this did not appear to happen, as Miss H listened and remained sensitive to what the children were interested in, not over-correcting and not taking over. The lack of involvement of the Year Four teacher in the role play led to her children claiming ownership and responsibility for the tasks, which they relished, even in the face of significant difficulties. Occasionally this led to some competition rather than collaboration, particularly between genders. Rather than this approach being laissez faire or, role play being used as a reward for work completed, or 'time off' work (Rogers and Evans 2008) both teachers valued role play by embedding it in the centre of what went on in the classroom. The Reception role play in particular was a community where mathematics was central, it was to mathematics that Miss H continually drew the children's attention and thus they attended to the mathematics when they played. During class sessions, she modelled some mathematics and spoke in role, 'as if' she was part of the joint fantasy. The approach to working with both groups of children could be described as negotiated or co-constructed pedagogy:

> "*Rather than see herself as the teacher-in-charge she relinquished some of her control in order to listen to the children and genuinely draw their ideas into her approach*."
>
> (Rogers and Evans 2008: 62)

In the final section of this chapter, I turn to the issue of how participating as a member of a mathematical community of the sort evidenced in these two classrooms might affect a learner's view of mathematics, of themselves as mathematicians and as learners.

4.3 LEARNERS' MATHEMATICAL IDENTITIES

> "*There is a danger that mathematics is seen by children as something in which they learn about other people's ideas, particularly yours, and it has little to do with them.*"
>
> (Straker 1993:10)

Straker (1993) highlights the common experiences of learning mathematics shared by many. As described in the previous section, my two study teachers whilst establishing a learning community also contributed to their children's ideas about mathematics including its relevance. The previous sections in this chapter have explored how mathematics can be seen as being about both competency *and* participation. In this section I draw on examples from my research where the community of mathematicians in the two study classrooms appear to contribute to the formation of a positive 'can do' identity and to the learners' positive view of themselves as mathematicians. I do not reproduce the discussion in Chapter Five (5.2.2) where I examine the ways that adopting a role other than one's own, and role play in particular, might make a positive contribution to children's mathematical identities.

Referring to her own as well as children's desire to be liked by peers, Paley (1990) states:

> "*The question of identity is every child's most serious occupation."*
> (Paley 1990:31)

Rather than identity being a person's 'core' being, I use the term 'identity' to refer to the ways in which we are in the world at different times and in different places. As members of society we take on multiple, situated identities (Askew 2008, Sfard 2011) using language to continually build these identities (Gee 2011) and these alter according to our purposes. In Chapter One I discussed how a social constructivist such as Lave (1988) sees the relationship between knowing and being, in short, the learning of knowledge cannot be separated from the learner. What we learn affects and changes us, and how we see ourselves as learners affects how we learn. In common with Walshaw and Anthony (2008) I consider mathematics as both a capability and as an identity. Whilst participating in mathematics, students (at all ages and stages) position and evaluate themselves as learners of mathematics, these identities being continually negotiated (Kaartinen and Kumpulainen 2013). Here I examine my evidence for arguing that involvement and engagement in mathematics as described above contributes positively to learners' identities as competent mathematicians and whether these two study classrooms develop:

"*... a classroom context that supports students' growing awareness of themselves as legitimate participants in the production of mathematical knowledge ...*"

(Walshaw and Anthony 2008: 540).

My interpretation of my video data reveals a focus on maximizing participation and this is tied up with my perception of myself as a young, unsuccessful mathematician who felt excluded from the school mathematical community and only came to enjoy mathematics later in life as part of a community of mathematics teachers. As reflected in my own mathematics learning, learners do not see mathematics as relevant, doable or enjoyable then, when given a choice, they will increasingly opt out of participating in mathematics. Evidence of this can be found in the U.K.'s poor take up of mathematics beyond the statutory age of 16 (Askew and Wiliam 1995, Smith 2004, Boaler 2009).

Participation, even if fleeting, is important, as without taking part, we cannot work on the mathematics. In both classes, the teachers can be seen working hard to encourage all members of their classes to engage in and take responsibility for the mathematical role play (e.g. Reception Extract Five). In our interview, I asked Miss H if she saw participation as important when considering whether or not a role play task was successful.

" *[...] but it might be that the children we filmed are in the Dinosaur Café, but then other children are role playing outside the structure. The structure, that's just one part of the role play, like, the whole class is a* *role play really, isn't it?* (laughs) *Like, they're outside being hunters, or, like Mackenzie, he was using chalk to draw bigger and smaller dinosaur bones on the courtyard and measuring them using his hands, so he didn't really go into the Dinosaur Cafe, but he was a hunter and he was doing really good maths measuring, using really good language (...)."*

Miss H to HW, semi-structured interview, 17/04/2012. Excerpt starts at 17'49"

In this excerpt Miss H recognised that by extending the role play over the whole setting, she maximised the chances of involving as many children as possible. She was successful in that nearly all children were observed taking part over the three scenarios recorded over two terms. Given that this was freely chosen, such a high involvement rate would seem to indicate a positive attitude towards the mathematical activity in this classroom.

As examined in 4.2, the Reception class role play helped form the mathematics community in the classroom and was central to all the other work taking place. To an increasing degree, this was also the case in the Year Four classroom. Participating in the mathematical role play in the Year Four classroom differed in that children could not physically opt out in the same way as in the Reception Class. However, away from the gaze of the teacher, instead of taking the opportunity to opt out of the mathematics, the Year Four children participated in the mathematical problems on offer, even when these caused difficulties (analysed in 5.2.2). Children in both age groups in this study felt positive about their mathematics hence they actively chose to engage in a way that is not indicated in previous research (Devlin 2000, Boaler 2000, 2009, Ashby 2009, Hoyles 2009).

Finally, during our April interview Miss H said watching video clips of the role play with her class increased their interest and participation:

> “ *[...] and actually when we showed the video* (of the role play) *they, more of them went in there / as well as the children that were going in there all the time.”*
>
> **Miss H to HW, semi-structured interview, 17/04/12**

The influence of viewing role play video recordings with particpants will be discussed in Chapter Six.

With both year groups I used semi-structured ‘re-view’ interviews of the role play to probe the children’s mathematics as well as how they felt about themselves as mathematicians. In doing so I was party to some, occasionally contradictory, comments from children that indicated their attitude towards mathematics. The re-view interviews are analysed in detail in Chapter Six, here I make reference to a few typical responses in relation to the question of whether or not the children seemed to be developing a positive ‘I can do mathematics’ attitude.

The day after the three mornings spent filming the scenario ‘Faster than Usain Bolt’, I interviewed pairs of Reception children whilst together we watched excerpts from my recordings of them engaged in their mathematical play (Extracts Eleven, Twelve and Thirteen).

RECEPTION EXTRACT ELEVEN, 31/05/2012

'Faster than Usain Bolt' Re-view interview

Rachel (5y 7m) and Sabina (5y 0m)

HW: *What are you learning about the numbers when you are doing that? Teach me what you are learning about the numbers when ...*

Sabina: *Agh! I'm going to fall off!* (Leans backwards on stool. Rachel watches her)

HW: *... you're doing that. What are you learning about the numbers when you are doing that? Sab? Teach me about them*

Sabina: *Errr*

HW: *What did you learn?*

Sabina: *Err, Rachel knows*

Rachel: (immediately) *The time, the time and when it stops you know what the time is how much you did it, so like, if you got the smaller number than Usain Bolt, that means you're faster than Usain Bolt and if you're, and if / there's a bigger number that means / you haven't beat Usain, that means it's a bigger number*

(As Rachel is talking, Sabina is making noises at her and leaning backwards on her stool).

Rachel answered confidently in this interview. In conversation, she was viewed as confident by staff and by children and they behaved 'as if' she was capable, for example in organising their racing (Extract Two). She was so confident in the situation above that, rather than answering immediately herself, she was able to allow Sabina time to answer, encouraging her to do so, for example, later in the same interview:

> HW: ... *what can you see on there?* [both girls smiling]
>
> Rachel: [puts a hand on Sabina's head and directs her attention to the screen] *Answer Mr Puppet* [referring to camcorder case on my hand].

Here it appears that Sabina, although taking an active part in the role play at the time, did not feel able to answer my 'difficult' questions about what she was doing mathematically. This is not that surprising as my evidence has indicated that when I asked very young children questions such as, "what are you thinking?" or, "how are you doing that?" these did not often result in an answer. However Sabina appears to identify Rachel as someone who could answer that sort of difficult question.

Other comments seem to point towards children's developing an inner sense of their own agency in their mathematical learning. The following extract is typical and occurred three minutes into the interview with Sabina and Rachel, immediately after re-viewing a clip of the racing.

RECEPTION EXTRACT TWELVE, 31/05/2012

'Faster than Usain Bolt' Re-view interview

Rachel (5y 7m) and Sabina (5y 0m)

HW: *What were you doing all of you?*

Rachel: *We are writing down my scores*

Sabina: *And my scores*

Rachel: *And some people are timing*

HW: *Ummm, / they were, weren't they?*

Sabina: *And some people were ...*

Rachel: *And some people were being the crowd*

Sabina: *... and some people were watching and some people were doing nothing*

HW: *What, umm were you learning about?*

Rachel: *We were learning about trying to, beat Usain Bolt*

Sabina: *Yeah, racing that means.*

Rachel: Can *we watch more?*

Here, the use of 'our' and 'my' by both girls indicated their identification with and ownership of the activity. During the re-view interviews I attempted to find out participants' views of themselves as mathematicians. One question I drew from Griffiths (2011) was to ask if they could tell me when they were doing anything that was "clever". Extract Thirteen is one example.

RECEPTION EXTRACT THIRTEEN, 31/05/2012

'Faster than Usain Bolt', Re-view interview

Ed (5y 5m) and Olivia (5y 6m)

Ed: *There's me*

HW: *Oh, there you are Ed. Are you being really clever there?*

Olivia: *Yeah, writing his score down*

HW: *What are you being really clever doing there?*

Ed: *Writing my right score down.*

Here, I asked Ed but Olivia answered and both children were clear about what it was that Ed was doing that was clever. Ed followed this by qualifying Olivia's statement to say that what he saw as clever was writing the "*right"* score, or writing the score correctly. Whilst this question seemed to result in examples of Reception children's positive view of themselves as learners, when using it with the Year Four children, it elicited negative responses, such as, "*I'm not clever*" (Fleur, 7/11/2011). Whilst this may be discomfiture at describing themselves as 'clever', it does seem that by Year Four, other classroom discourses might be working against the formation of more positive identities, for example, the practice of grouping children in similar attainment groups. Ofsted (2012) commented on this practice in both Key Stages One and Two:

> "*Pupils were always aware of the hierarchical nature of these groups and could explain to inspectors which group found mathematics easy or hard and whether the groups got the same or different work to do*."
> (Ofsted 2012: 63)

Despite substantial evidence that these children in Year Four were keen to engage with the mathematics offered, there does appear to be evidence indicating that some Year Four children saw or described themselves as not 'good' at mathematics in relation to other pupils in the class. One example took place as Sean and Saul struggled to answer the multiplication 7 x 15 ('Fish Patterns', 15/11/2011). On this occasion, Sean went to ask two members of the 'Pentagons' group (the highest attainers) the answer. On another occasion, as I ended the re-view interview with Group One of the first observation ‘Tide Times’, the following happened.

YEAR FOUR EXTRACT THIRTEEN, 07/11/2011

‘Tide Times’ Re-view interview with Group One

Ellen (8y 7m), Cam (8y 9m), Callum (8y 3m) and Nancy (8y 3m)

223 HW: *OK? ‘Cos that’s where I’ll be tomorrow and I’ll be back again the following week. Brill, thank you, Group One!*

224 Cam and another: *Group <u>One</u> ?!*

225 HW: *You’re Group / One, I’ve got you Group One ...*

226 Cam: *Cool!*

227 HW: *... ‘cos I saw you first. And um, Group Two are the group I saw second so they’re Group Two* [...].

Here Cam was pleased at being seen as a member of a mathematics group known as Group One, probably seeing this as a ‘top group’ which was not his usual group. Cam had transferred to the study school partway through Year Three and so his responses might have been prompted by previous experience of hierarchical groups elsewhere. In relation to my research it appears that although role play tasks as described in this chapter can offer an inclusive mathematical experience with space for children’s mathematical ideas (Straker 1993), in terms of older learners’ identities, this is juxtaposed with the possible negative effects of attainment groupings.

According to Klein (2007) authority is at the root of a classroom culture and teachers ‘feed’ students information that they control, ‘stealing’ the learning process from learners, disabling and disengaging them. Where particpation of the sort described in this study is valued, the key issue is *author*ity – the state of being an author (Klein 2007: 317). As described in 4.1, both teachers used YouTube clips to begin a mathematical exploration. They started with something they thought would interest their children but could not have been sure what would develop. This is an example of planning for "*foreseen possibilities*" (Bird 1991: 133). Here a teacher considers what *might* happen when planning an activity but does not let that restrict what happens in practice. Both teachers were attempting to hand their young learners authority over their mathematical learning and children can be seen in the process of gaining authority and ownership over what could be challenging mathematics.

In summary

> "*The key to be able to do mathematics is wanting to.*"
>
> (Devlin 2000: 254)

Klein (2007) refers to what she calls the 'taken for granted stuff' in teaching mathematics, arguing that much more research needs to be done into how it is that many young learners do not want to do mathematics. I am exploring whether the practices these two teachers employ affected their children's attitudes towards mathematics. Perhaps, as Noddings (1984, 2003) suggests is significant, the children in my two study classrooms were aware that they are more important to their teacher than the subject matter and thus, as can be seen in Year Four Extract 13 above, were becoming aware of themselves as learners in control of their learning.

In line with early years' pedagogy (Garvey 1977, Bruce 1991, Moyles 2005, Broadhead et al 2010) the Reception teacher used children's interests to encourage participation in a learning task. She also saw her role as entering her children's world(s) and moving towards a shared imaginary world in which they could all participate. Both teachers structured tasks taking account of children's interests as well as curriculum requirements, planning what took place in collaboration with the children. This approach sustained a level of interest and enhanced participation and ownership. Identities are formed as part and parcel of everything that happens in a classroom, and over time this moulds how learners see themselves in a wider sense (Sfard 2011). In turn this will affect how, and whether, learners choose to become involved in mathematics at all. As learners are expected and encouraged to take more control over their learning, this changes how both learner and teacher see themselves and the parts they both play in the learning of mathematics (Tanner and Jones 2007). Moreover, in these mathematical scenarios wrong answers are not subject to public scrutiny as they would be in more traditional mathematics lessons, either because of the teachers' acceptance of all responses or her absence. This might allow them to be worked
on rather than avoided. A way of working such as that described here is empowering for students, changing their attitudes to mathematics (Hodgen et al 2012). In both classrooms, it was ongoing collaboration and discussion between teacher and children that seems to be key in drawing the children into the scenario and them reacting positively to the mathematical challenges.

IN CONCLUSION

The key questions I have dealt with in this chapter are:

- In what circumstances can mathematics be learned through role play?
- What might mathematics learning look like in different role play contexts?
- What might role play look like in the context of mathematics?
- To what extent might role play affect the development of mathematical resilience and involvement as well as a positive attitude to the subject?
- What particular classroom conditions positively affect or inhibit mathematics learning through role play?

In both study classrooms, the teacher was learning as well as and sometimes alongside the children. Children were observed learning about the mathematics, communicating this to others and relating to others as they jointly solved various problems. In the Reception class, this always involved aspects of adopting the role of another. In the Year Four class this occasionally involved 'walking in another's shoes'. The two teachers were feeling their way both in terms of how and where to develop the mathematics of their children's role play and learning how to behave effectively to enhance their children's role play mathematically. Clearly there is no single way to organise role play that supports mathematical learning. Such learning is messy and to some degree unpredictable but the results of this study highlight three common strands that seemed to lead to more effective role play mathematics in both classes.

The first of these was the provision of authentic, collaborative problems to solve. By authentic I mean purposeful and relevant to these children's lives and interests (Heathcote 1984). These two classrooms explored the learning and teaching of mathematics underpinned by a socio-cultural approach, where emphasis was on mathematics being collectively negotiated within the group of learners. Sometimes, particularly in Year Four, the problems were, or became, unfocussed and the mathematics unclear. However, the emphasis was on the learners themselves making some sense of the problem and taking responsibility for what played out. The children embraced this in both classrooms. Some of this was down to established working habits such as effective listening and discussion, effort, an expectation that everyone will be thinking and working, as well as an appreciation of continuity in their work (Watson et al 2003). These aid learners' mathematical development in the long term and all of these work habits are connected with the ethos of this school (see Chapter Two).

Role play and story problems allow children to explore complex situations where mathematics is integral. Although children's attention in both classes fluctuated between the mathematical and the social, it was rare for their conversations to be completely off-task. In order for the scenario to operate successfully and for it to make sense, participants needed to move between the social and the mathematical components. Mathematical activity was interlaced with the social interactions necessary for the children to engage in the play, such as whose turn it was, who was in charge of what, or what behaviour was appropriate. Thus, the children moved in and out of the mathematics. For
Twomey Fosnot et al (2002) context is used to create thinking spaces to make sense of some mathematics. The results of my study suggest that role play scenarios can also provide spaces to explore some mathematics without the emphasis on correct answers and a more knowledgeable adult. Where role play did not appear to lead to mathematical learning at the time, particularly evident in Year Four, the task was insufficiently structured or supported mathematically

(although learners might have been benefitting in other ways or at other times). However, Pratt (2006), following on from Fielker (1997), suggests that vagueness is one strategy for turning mathematical work into a problematic context where children are allowed the space to interpret the mathematics presented. Perhaps role play is one opportunity to experience ‘vagueness’.

In Reception, the integration of familiar structured resources such as Numicon, into the children’s play contributed positively to these young children’s ability to manage the mathematics. Whether this would be useful with older children requires further research. Other resources that were particularly mathematically productive in both classes, such as the stopwatch in Reception and the tide timetable in Year Four, suggest that there are some resources that in themselves provoke mathematical discussion and sense-making.

The second strand of what appears to work is the linking of the mathematical role play with other classroom mathematics. Whereas projects such as ‘Maths in the City’ focus on constructing a “*landscape of learning*” (Twomey Fosnot et al 2002: xix) in which context is manipulated in order to teach some mathematics effectively, role play appears to work in another way. Here, the context provided a rich mix of mathematical opportunities to pick up and develop in mathematics teaching elsewhere in the classroom. Role play may begin with some clearly focused teaching to introduce learners to some mathematics that might be encountered in the scenario, to both direct their attention and to establish some confidence and interest. Alternatively, observation (and observation at a distance by re-viewing and discussing role play with participants) is an effective tool for auditing what happens during role-play and in revealing some mathematics that can be worked on retrospectively. Both these methods were used effectively by both teachers.

The third strand is adults working at co-creating inclusive communities and improvising together with learners to create mathematical spaces for children to work at some mathematics. The two study classrooms exhibited elements of a math-talk learning community as defined by Hufferd-Ackles et al (2004). An interview with Miss H contained widespread references to shared understandings that were set up as part of a collaborative, organic story developed together and particular to each group of children (e.g. excerpt reproduced in 4.2.1). Joint ownership of the task was clear in both age groups as they worked together in the role play (Reception) and persisted to reach an agreed resolution (Year Four). In Year Four evidence of collaborative knowledge construction was seen in their exploratory talk (Wegerif and Mercer 1997, Howe and Mercer 2007). This is in contrast to mathematics classrooms where groups of learners engage in diverse tasks owing to a perceived difference in ability and thus the building of a community with a common point of interest is difficult.

Approaching mathematics in the ways described in this chapter appeared to contribute to the learners' view of mathematics as being something they *do*. Studies conducted suggest that school students view mathematics as disconnected from real life and as not meaningful (Buxton 1981, Askew and Wiliam 1995, Klein 2007, Boaler 2000, 2009 Askew et al 2010). My analysis suggests that role play can be used to counter such a view. Lambirth (2006) talks of 'proper literacy' as opposed to "*following words across a page*" (O'Neil, cited in Lambirth 2006: 68) which has echoes of 'acting mathematically' or mathematizing (Twomey Fosnot and Dolk 2001a) as opposed to completing a mathematics task. Rather than asking whether pupils enjoy mathematics, why not ask if they care about it? (Hodgen and Kuchemann 2012).

In this chapter I have identified the following actions taken by both teachers that sustained the role play in these two classes:

- continually referring to and developing the mathematics during class ‘carpet’ sessions;
- periodic ‘eavesdropping’ on the play;
- the provision of uninterrupted periods of time over several days for the children to play with mathematical ideas;
- handing control to learners whilst they played with ideas;
- an emphasis on joint, purposeful recording, with pupils making decisions about how they record, creating a semi-permanent mathematical record to stimulate further discussion.

Whilst children in both classes would have clearly learned mathematics without role play opportunities, my data suggests that what made the difference to their learning was how they felt about their mathematics. This can be affected by an approach to mathematics that is more dialogical in nature, as illustrated in these two classrooms. One of the benefits of role play might be that learners meet mathematics in all its complexity and become more confident in tackling mathematics without this being simplified for them. This challenges some current notions of what mathematics should be like with a particular age group, for example, organised into areas of learning and learning objectives as typified in the primary framework for mathematics in common usage at this time (DfES 2006) and curriculum documents since (DfE 2013). The challenge for teachers in this climate is to remain flexible and creative about the mathematics that might be encountered. My evidence seems to indicate that this is more difficult in classrooms with older learners. Children in the Reception class tackled mathematics beyond the norm for this age group in school and in both classes children were observed taking mathematical risks, in other words, tackling some complex problems appearing unafraid of making mistakes. This is significant and something that would seem to need ongoing attention:

> *"The learning isn't mathematics itself; it's the confidence to make use of mathematics in the outside world, and that confidence comes and goes ..."* (Wilson, Winbourne and Tomlin 2008: 346)

In this chapter I examined whether, and under what conditions, role play might allow children to explore mathematical ideas; whether it is possible to engage children in mathematical problem solving and reasoning whilst role playing; and what effect this may or may not have had on adult and child participants. The strength and effectiveness of the role play in leading to mathematical activity appears related to the value placed on the role play along with the learners' awareness that they themselves and what they do are as important to the teacher as the subject area. What needs further research is whether it is possible to identify some areas of mathematical content that are more (or less) useful for role play and that may be integrated into to a range of role play scenarios. One example might be analysing and communicating using different sorts of data.

The following two data analysis chapters examine whether what the children were doing can be construed as role play (Chapter Five), and Chapter Six, whether the children were aware of what they were learning (Black and Wiliam 1998).

CHAPTER FIVE

WHAT CONTRIBUTION DOES ROLE PLAY MAKE TO LEARNING MATHEMATICS?

INTRODUCTION

This chapter is the second of my three data analysis chapters and examines what, if any, role play is taking place when children appeared to be engaging in and learning mathematics in both year groups. It relates directly to both the data and the arguments presented in the earlier chapter on mathematics learning (Chapter Four) as well as to the following chapter on re-view and reflection (Chapter Six). The data that I will be drawing on in this chapter is drawn from the same data pool listed in the introduction to Chapter Four, consisting of videos and transcripts of role play; fieldwork and diary notes, and semi-structured interviews recorded with staff and children.

The purpose of this chapter is to assess how engaging in role play might contribute to children's learning of mathematics and their developing sense of themselves as competent and confident mathematicians. The related research questions in this chapter are as follows:

- In what circumstances can mathematics be learned through role play?
- What does mathematics learning look like in different role play contexts.
- What does role play looks like in the context of mathematics.
- To what extent does role play affect the development of mathematical resilience and involvement, and a positive attitude to the subject.

And also:

- What particular classroom conditions positively affect and inhibit mathematics learning through role play?
- What adult intervention helps or hinders?

To begin, I summarise what is understood by myself and others by the term 'role play' and also rehearse some pertinent issues regarding play in relation to current day United Kingdom classrooms. A fuller discussion can be found in Chapter One, Literature Review, 1.2.1, 1.2.2, 1.2.3, 1.2.4 and 1.2.5.

Definitions of role play encompass a range of activities characterised by participants imagining themselves or others as another person in simulated circumstances (Yardley-Matwiejczyk 1997) with participants involved in a 'suspension of literalness' (Garvey 1977). Whereas similar play-types, such as fantasy or make believe might be individual, role play is seen as having a strong social component (Garvey 1977, Rogers and Evans 2007) with differing and overlapping role-types adopted by children, for example those of stereotypical and fictional characters (Hendy and Toon 2001). For the purposes of this study I define role play as temporarily 'walking in another's shoes' (Williams 2006). By this I mean players temporarily assuming another identity or another social position and as encompassing both everyday activities and imaginary scenarios.

In an educational context, role play has close connections with drama and is usually associated with the development of language as well as social and problem-solving skills (Heathcote and Bolton 1999, Montgomerie 2009). See Chapter One, 1.2.3 and 1.2.4.

What we consider to be 'play' is contextually and culturally dependent and for many years, particularly in Western society, play has been positively associated with children's early learning (Chapter One, 1.2.2). This has been reflected in national documentation since 2000 (DfEE 2000a, DfES 2007, DfE 2012). Recommendations have been made for learning experiences, particularly in Year One, to build upon the practical approaches and structured play opportunities provided in Reception (Ofsted 2004, Sharp, White, Burge and Eames 2006, Tower Hamlets 2008). The observations of my two study classrooms took place in the context of two teachers building play into their mathematics curriculum (see Chapter Three, Context). At the heart of this chapter is whether my observations in the Reception and Year Four classes can be said to be role play and whether such play helps or hinders the children's mathematical learning.

This chapter is structured as follows; firstly (5.1) I examine the various guises that role play assumed in Reception (5.1.1) and Year Four (5.1.2). Then 5.2 considers episodes where role play seems to be making a contribution to children's mathematical knowledge and understanding (5.2.1) and in terms of their mathematical identity (5.2.2). Subsequently, 5.3 analyses how the observed approach differs to other mathematical approaches such as those emphasising problem solving. Finally, 5.4 examines the actions of the adults in my study where role play appears to make a positive contribution to children's mathematical learning.

As previously (described in Chapter Three, 3.3) data presented here as verbatim extracts from transcriptions of video or audio recordings; fieldwork notes or diaries is clearly indicated, headlined and dated with extracts from observations numbered consecutively through the chapter separately as Reception and Year Four extracts.

5.1 IS THIS ROLE PLAY?

In this section I consider what role play might look like in the context of mathematics in these two classrooms in terms of the following features of role play found in educational literature:

- there is an assumption of a separate, temporary, identity;
- it involves pretence; a suspension of reality, and
- has a social component, being about membership and belonging with communication at its heart.

As in the previous chapter, I consider the Reception and Year Four classes in turn, as the organisation within these two classes is different from each other, leading to separate issues and some distinct findings.

5.1.1 Is this role play in Reception?

All three scenarios recorded in the Reception class as explained in Chapter 4 (and described in Appendix Two, ii) were developed from adult observations of the children's play and with the involvement of the children. Some of the key features of play in general, that is:

- it involves *active engagement*;
- is *enjoyable and freely chosen*;
- is often *repetitive*, and
- is *engaged in for its own sake*,

were all identifiable during all three Reception scenarios. Although the class as a whole regularly sat together to discuss the play, and at times Miss H invited named children to join her for a more structured role play task (for example, encouraging a chosen group to use number lines to find the difference between two small numbers, 29/05/2012) the children observed had freely chosen to engage in the play. Whilst not all children chose to become involved in the play, a majority did and those that did not, whilst not playing an active part, sometimes spent time watching the play.

I select here the scenario ‘Faster than Usain Bolt’ as the main basis for analysis in this section because it could be argued that this is the least likely to be described as role play. Instead this might be simply an interesting mathematics challenge engaged in through a context of physical education. If this is described as role play, then what difference might this make to participants’ mathematical learning?

As typified by the Reception extracts of freely chosen play reproduced in Chapter Four (Extracts 6, 7, and 8) enjoyment and involvement levels of participants, as interpreted from facial expressions, utterances and behaviour were high (Laevers 1993, Pascal and Bertram 1997). Often, the length of time participants remained involved in what was called the ‘athlete’s training village’ was substantial and they returned to play repeatedly during the day and over the three days. For example, a recording made on day three (video 16) lasted for a little over 27 minutes and of the 11 children who started this play, five were still involved as the recording ended, with an additional eight children engaged in a long-jump challenge on the other side of the outside area during this time. The children can be seen organising and managing their own play, temporarily assuming the positions of athletes, trainers and spectators and moving freely between these roles. They were independent and autonomous and once the play began, largely oblivious of anything else that was going on, such as other children’s play, adults moving around or myself filming what was happening.

Play was often repetitive and revocable in the sense that the same children could be observed repeating and refining what they were doing, with timings and scores being cancelled, withdrawn, rubbed out and re-done. This comment was commonly made to both peers and to adults: *"Can we do it again? / Can we do it again?"* (Cali, 29/05/2012). At the time of transcribing these observations I wrote in my fieldwork notes:

> *"The racing is organised and starts with no adult interference. Look at the talk used to reach joint understanding of what the race is and how it will work successfully and attention to detail/accuracy! They are not 'just playing' at it – they care it is 'right'."*
>
> **Fieldwork notes on transcript of observation, 29/05/2012**

The complexity of the task did not daunt the children as they struggled with the stopwatches and precise timing issues. All this is indicative of their concentration, persistence, precision and satisfaction (Laevers 1993). This appears to have been a successful role play both in terms of motivation and involvement and in terms of mathematics (analysed in Chapter Four). But whereas it may be playful, is it role play? Firstly, the activity was enjoyed for its own sake, for although the product – children's individual time or score – was commented on and compared, the process of engaging in running, timing and recording appeared as important as the times themselves. However, to be defined as role play, reality must be suspended and a degree of pretence prevail. Miss H repeatedly referred to the children as athletes and the outside area as the 'athlete's training village', a fantasy place where children could step in the shoes of an athlete for a short period of time. In the re-view interview held with Rachel and Sabina (see

Reception Extracts 11 and 12, Chapter Four) Rachel referred to children "*being the crowd*" and "*being Usain Bolt*", recognising that playing in this scenario required the temporary assumption of a separate identity as an athlete, spectator or trainer. The children used their own names as they played at being an athlete and recording their scores, thus rather than thematic-fantasy play involving the building of complex imaginary worlds, perhaps this was socio-dramatic play (Hendy and Toon 2001) where participants (themselves as athletes) pretended to race against other 'atheltes' including an invisible Usain Bolt. Maybe they were themselves in the shoes of an athlete making sense of this occupation or maybe they were just racing each other! The pretend scenario was 'real life' in the sense that the roles of athlete and spectator do exist in the world outside the classroom
in a way that pirates and dinosaurs do not. In terms of Garvey's three categories of roles this play was functional and occupation-related (Garvey 1977).

Although participants mainly referred to each other by name and spoke with their own voice as they played (as they might whilst undertaking any other task) occasionally they adopted the voice of an announcer or trainer, for example Kaiya in Chapter Four, Reception Extract Five and Lucy (video 16):

Lucy (5y 3m): [Shouting, through her hands] *OK! Introducing, introducing! / Everybody, everybody! Introducing for the high jump! / Ricky!*

These voices were more authoritative, as illustrated by Rachel in Extract One.

RECEPTION EXTRACT ONE, 29/05/2012

'Faster than Usain Bolt', Day 3, Video 16

Children involved: Rachel (5y 7m), Hannah (5y 1m) and Ricky (5y 3m)

Rachel: [jumping onto the spot to make an announcement alongside the race track] *You have to sit down when you're ready / Nicely. Very nice* [Hannah sits upright, with her arms folded on a spectator's chair] *Now. Hannah! You've got to try and stay on the black lines. Yeah?* [off camera] *Boys! Boys! Boys, I want another word with you. Boys, I want to have a word with you. Now. You must try and stay on the black bit.*

Ricky: [silly voice] *Yeaahhh!*

Hannah: *And, it's only one at a time going, so it's me first, then Ricky.*

Rachel: *Everybody sit on there.*

Here Rachel and Lucy were both speaking with voices of power, their persona was someone who is organising the event. They spoke 'as if' they were someone other than themselves. This is an example of a child taking on the expert role, or 'mantle of the expert' (Heathcote et al 1984, 1995, 1999) and indicates that they were comfortable and confident in what they were doing. Many have written about how much of young children's play seems to be concerned with power (Walkerdine 1981, Holland 2003, Paley 2004a, Gifford 2005) and this scenario allowed children who had the necessary social skills, and confidence and motivation to choose to adopt identities that controlled the play. Research into young children's play points to its stereotypically gendered nature (Walkerdine 1985, Davies B 1989, Lloyd and Duveen 1992, Francis 1998, 2006) but in none of the three scenarios I observed did I find evidence of stereotypically gendered role-playing. In fact my Reception evidence seems to point towards the more assertive behaviour of the girls I observed, such as Rachel in Extract One above. It has been suggested that creating opportunities to engage children in dialogues about their play might help adults widen children's discourses around gender (Rogers and Evans 2008). Miss H was seen continually engaging in dialogue with children about their play roles, supporting in-role talk, commenting on how someone in a particular role might behave, and modelling role-appropriate behaviour (see Extract Three, below) hence this may have helped develop the children's views of what might be 'typical' or expected.

RECEPTION EXTRACT TWO, 29/05/2012

'Faster than Usain Bolt', Day 2, Video 11

Jack (5y, 8m) approaches the start line to race.

Miss H: *Jack, are you ready? Ready? Everybody else, ready?*

Children: *No. Yes!* /

Miss H: *Big, loud, shouty voices [...] a good crowd, Lucy looks like a fantastic crowd sitting there.*

Miss H on this occasion reinforced the idea of adopting a role by having children make cardboard 'vests' to represent each country. Spectators then shouted for "Finland" or "France" as well as for runners by name. On one occasion, Mark was heard saying:

> "*It's the world cup today. //* [Looking at his flag vest] *We're in Finland, and you're not, Jack* [wearing a French vest]."
>
> ('Faster than Usain Bolt', Day One, Video 3).

Miss H's actions using role to establish her learning community have been analysed in some detail in Chapter Four (4.2.1) here it is sufficient to say that she recognised the adoption of roles as playing an important part in both setting up and supporting the mathematical activity.

Comparing this activity to a 'real' sprint race taking place, for example, at a school sports' day, or during a PE lesson, there are some differences. For a sports event, participants would be likely to walk at an appointed time to a track and be allocated a race slot with runners of similar age and gender. They would race once, all starting together, over the same distance. Winners would then be announced and the race would then be over. They would not have an opportunity to improve 'scores' and neither is it likely in the case of this age group that any stopwatches would be involved. Practise and improvement might form an important part of a PE lesson for this age group but it is more likely that an adult would organise this, and also be in charge of any stopwatch and recording. It would be unlikely that comparisons would be made to who was, or who was not, faster than Usain Bolt. In this 'Faster than Usain Bolt' scenario, runners turned up, often unannounced and ran against themselves or any number of other runners regardless of gender or running ability. It does share elements of a 'free flow' activity where children have been encouraged to improve their score but here they ran repeatedly and from time-to-time referred to their time in relation to that of Usain Bolt. Looking at this scenario in this way, reality does appear to be suspended in this class on these occasions whereby any four- or five-year-old could have as many goes as they wished at beating the fastest runner in the world.

Next, I consider the social and communicative features of role play and that such play is concerned with *membership and belonging*. The Reception children's attention to the social aspects of the play is evidenced in all the recorded observations in each of the three scenarios. As was argued in Chapter Four, the social aspect was the thread that bound the play together and around which was 'stitched' the mathematics. The mathematical comparisons of time took place once the rules of engagement were established and adhered to. This does appear to be social play with rules. Over the three days recorded of the Usain Bolt scenario, there were several examples of Oliver wanting to take part but not abiding by the rules of play. Other participants were outraged by his unacceptable behaviour! The following two extracts are typical (Extracts Three and Four).

RECEPTION EXTRACT THREE, 28/05/2012

'Faster than Usain Bolt', Day 1, Video 5

Children involved: Sara (5y 7m), Mark (5y 1m) and Oliver (4y 9m)

Sara: *OK. On your marks. Oliver?* [Oliver is not in a racing start and Sara has a quick word with him. He changes to a racing start]

Sara: *On your marks [...]*

[They all run. Oliver cuts across the track]

Sara: *Oliver, Oliver, I believe that you just cheated*

Mark: ***I*** *didn't*

Sara: *Oliver! Oliver!* [...] [shouting] *Right, are we ready, are we steady? Yes, I know. On your marks, get set, go*! [they run]

Mark: *You cheated, Oliver!*

RECEPTION EXTRACT FOUR, 28/05/2012

'Faster than Usain Bolt', Day 1, Video 6

Children involved: Rachel (5y 7m), Mark (5y 1m) and Oliver (4y 9m)

Rachel is organising all the runners in a line. Oliver pushes in the front of the line of six children ready to race. Mark reports this to Miss H.

Rachel: *I forgot to put it on zero so we're doing it again. And Oliver just pushed in the front*

Miss H: *OK, you need to go and talk to your race official, and that is Rachel at the moment*

Rachel: *I tell you what, Oliver, you can go and sit over there if you are naughty or, you can*

Oliver runs around track, laughing.

Rachel: *Oliver, you can go to the back of the line now Oliver.* [...] [to someone else] *Do you want to sit there? OK. Do you want to sit there? Sabina, can you move up? For James? Right. OK*

[...]

Oliver asks Rachel to time the girls whilst he times the boys. Rachel doesn't agree, nor does anyone else.

In order to belong and take part, the participants were expected to recognise and abide by the rules of this play. As is clear from the above extracts, exactly what to do and how to behave were of concern to participants. Oliver was a younger member of the class and transgressed the rules of play that the children could be heard continually reiterating, such as; *"try and stay on the black lines", "line up nicely"* and *"take your turn"*. In Extract Five, rather than sorting out a possible infringement of the racing rules herself, Miss H responded by delegating the task to the 'race official'. This example is typical of Miss H using role in this way and handing control to the children.

What the Reception role play rarely seemed to be about was dressing up. Although clothes were sometimes worn, the children did not need these to be in role and appeared to wear them simply for the enjoyment of wearing them. Dragons and princesses can be seen on horseback in the horse jumping scenario, but the clothing did not seem to add to the play or to the roles adopted. On the other hand, *props were important* in this play. Some of these were mathematically significant, for example, the stopwatch (as discussed in Chapter Four) some were pieces of mathematical apparatus called something else by the teacher, for example, Numicon materials used to support mental calculations, and some were 'scenario props' such as plastic food in the café and score boards. On occasions, however, important props were items of clothing, such as bands for runners or riding hats. All props became important as role play symbols or signifiers (see Chapter One, 1.2.3). For example, riding hats and broomstick 'horses' signalled who was waiting to jump, and the vests and bands worn whilst racing Usain Bolt signified runners and teams. Coconuts, beaten to represent horses hooves, distinguished the horse jumping officials in the same way that stop-watches identified race officials and it was holding the two sticks that identified the dinosaur in the café scenario rather than an outfit.

If this is described as role play, then what might be the difference between meeting mathematical ideas in a role play scenario and doing so in another practical context? Perhaps the main difference is that, as role play is mainly social, communication is necessary to maintain the scenario and children worked hard collaboratively, starting and stopping runners and accurately starting, stopping, reading and recording the stopwatch times. Mistakes or confusions were likely to get noticed, discussed and occasionally corrected, as can be observed in all three Reception scenarios. The children *cared* that the times were recorded accurately. Lucy and others attended carefully to the number of taps a visiting dinosaur made and consulted the menu board to find what food item was signalled. Horse jumping officials meticulously observed, argued about and recorded a rider's faults. This is role play where children can be seen interacting with many others to sustain the imaginative play and it is what role play can look like in the mathematical contexts of counting and measure, where communication has to take place and agreement has to be reached regarding accuracy and precision for comparisons to be made.

The play described and analysed here brings something both personal and social to a mathematical task and it is this that makes it differ from much other mathematical activity. It is personal in the sense that the mathematics that the participants engage with is something they are generating rather than something 'outside' being 'done to' them and they recognise it as such (see Chapter Six for an analysis of this). It emerges from them being involved in a kind of social performance which is important in locating the mathematical problem in order that it makes 'human sense' (Donaldson 1978).

The following sub-section considers whether what takes place when the Year Four children are engaged in mathematics could be described as role play.

5.1.2 Is this role play in Year Four?

The two scenarios recorded and transcribed in the Year Four class, 'Hemy's Floating Studio' and 'The French Café' (described in Appendix Two) were developed from the school topic by Mrs R in discussion with the children (see Chapters Three and Four). If this is role play, it is role play that is prescribed by curriculum requirements rather than exclusively the interests of the children (Rogers and Evans 2008). Within this constraint, I examine whether any of the key features of play and role play are in evidence in my Year Four observations. Is the play:

- *engaged in for its own sake* - where process is as important as product;
- *enjoyable* and *freely chosen,* often *repetitive;*
- does it involve *active engagement,* and
- entail a degree of *autonomy and control?*

(Sylva et al 1974, Garvey 1977)

And does the role play:

- involve the assumption of a *separate, temporary, identity;*
- entail *pretence*; a *suspension of reality*, and
- is it *social* with *communication* at its heart; is it about *membership and belonging?*

It is clear that the role play in Year Four was neither freely chosen nor seamless as all the children were timetabled to engage with one common task as a member of an established group for a set time each week. It was however, autonomous, with children exercising control over what they did. Mrs R was not involved in what took place other than setting the task initially with the class and then reviewing it when the play had ended. Mrs R saw this independence as one of the strengths of the role play and spoke of it as "*learning mathematics at a distance"* (Interview, 22/03/2012). She trusted the children to work and play 'productively' in the sense of becoming engaged in the task. Mrs R was not worried about precisely what took place and used class role play review sessions to monitor that her trust was not being abused and to discuss and develop the mathematics undertaken. In a sense, a contract existed between the children and the teacher, with both sides aware that if this contract was broken, the arrangement would stop. The children saw themselves as having control and autonomy during role-play and valued the independence and the opportunity to work without adult interference. This is evidenced the interviews with the sample children (see Chapter Six) and in the wider school community (see examples later in this chapter and Appendix Seven), as well as my observations of pleased reactions when they were told it was their turn to role play mathematics. Palmer (2007) points to the lack of what she terms 'havens' from adult supervision for children and these children seemed to recognise role play as a mathematical haven. In this sense, these Year Four learners were engaging in the task for its own sake but they were also concerned to complete the task to their mutual satisfaction and in this sense it was certainly not goal-less (Garvey 1977). In our re-view interview after the first 'Tide times' observation, Sean expressed his awareness of the work they did collaboratively during role play:

L29 Sean: *So we really had to work as a group, like we were doing. And it's very important that if you do get it wrong, then you're not gonna, then you learn don't you.* **Group Two, re-view interview 1, 07/11/2011**

On the other hand, Mrs R saw the process of the children engaging in the role play as more important than any end result and viewed its main value as providing a context for her mathematics teaching whereby children independently explored and applied mathematical ideas taught in the class (see Chapter Four, 4.1.2).

Opportunities to engage in mathematics for its own sake with process as important as product, and where what happens is to an extent revocable, contrasts with much classroom mathematics. Commonly, particularly as learners become older, the product can be seen by both adults and children as the main point of mathematical activity. The Head Teacher (Mr G) saw the establishment of role play mathematics in every classroom as reproducing children's 'natural playfulness' in a way that is difficult to accomplish in the current climate of the primary classroom (discussed in Chapter Three). In the Year Four classroom, even though an onlooker might have found it difficult to observe a clear difference between role play and 'other' mathematical activity, the role play was seen as different to 'other mathematics' by both children and adults. This was to do with how it was planned and its self-sufficiency from the teacher rather than how children behaved. In all mathematical activities children sat on the floor, moved about, talked, discussed and made choices about how to approach a task and what equipment to use, as well as how to record what they had found. In other words, what might be important to the children was not so much *what* happened but *how* it happened.

As analysed in Chapter Four, children in the Year Four class were observed actively engaging in the role play task in both scenarios, however, on some occasions this seemed less playful, or play-like, than on others. What was noticeable in some Year Four observations was a more obvious division between the set task and the children's play. This is perhaps not surprising since 'work' and 'play' are mostly viewed increasingly as separate for older learners (see Chapter One). The most obvious example of this took place when Group Two tackled the 'Tide Times' task, and one exception to the work/play division was the whole class 'Auction of Paintings', both scenarios examined below. I go on to discuss observations of the 'French Café' as an example of what appears to be role play and where the mathematical learning is less clear.

In both Year Four scenarios there was obviously pretence involved in that participants were aware that they were not bobbing about on the sea nor were they in a café in the French mountains However, the degree of pretence varied between scenarios and between groups, and also from time-to-time within one observation. The first role play 'Tide Times' was interesting in terms of the participants pretending and adopting separate identities. Year Four Extracts One, Two and Four reproduced in Chapter Four (4.1.2) are examined here in terms of what role play took place.

In both groups, the children can be heard temporarily assuming the 'action' or 'stereotypical character' of sailors (Hendy and Toon 2001). Fleur and Sean (Group Two) immediately used 'we' instead of 'he', indicating identification with a character, even though the task had been set by Mrs R as, 'When should *he* (Hemy) put to sea?' (see Appendix Three, ii). By physically being in their 'boat' these children spoke 'as if' they were there, putting to sea themselves, in a way that would not be likely if the task was approached as a more traditional mathematics task, away from the role play area. Sean's attention in particular was on the fantasy and he made a number of (unsuccessful) attempts to persuade Saul and Fleur to engage in the pretend play whilst they instead were focused on agreeing the times to set sail, for example, at L94 and L101:

94 Sean: *Fleur, are we going out, are we going out or are we just sitting here watching* [...]?

101 Fleur: *... if we come in by* *<u>before</u>* *low tide ...*

102 Sean: *Why don't we just leave that / why don't we just leave the sheet and we can just do it* [sits in exasperation].

From: Group Two, Observation 1, 'Tide Times', 01/11/2011

Sean was anxious to begin the fantasy play, on entering the boat he immediately donned a waistcoat to signify his persona. A little later, he spoke in character as he pretended to look out of the 'porthole' of the boat at the seascape of sea and boats:

133 Sean: *Wow! Is that what our boat looks like? That [...] those boats that we can see. / My friends have been doing some lovely paintings, aren't they?*

From: Group Two, Observation 1, 'Tide Times', 01/11/2011

Finally Saul and then Fleur joined in the pretend play (Extract One).

YEAR FOUR, EXTRACT ONE, 01/11/2011

'TIDE TIMES': Group Two, Observation 1

Children involved: Saul (8y 5m), Sean (8y 6m) and Fleur (9y 1m)

Length of recording: 28' 41"

178 Sean: *That's all we need to. OK* [....] *Fleur, shall we go out to sea?*

179 Saul: *I'll lower the anchor*

180 Sean: *No higher, bring the anchor* *up. Lowering the anchor stops us*

181 Saul: *Does it?*

182 Fleur & Sean: *Yes*

183 Saul: *Ok, ok, rulers are anchors* [boys mime together pulling anchor – a ruler – up. Fleur watches]

184 Saul: [hopping on one foot] *Oh! My toe! Ow! Oh my toe!*

185 Sean: *Did you hurt your toe?* [hops too]

[Saul mimes moving anchor, re-drops it and some hopping resumes by both boys]

186 Saul: *Ow! That hurt my toe!*

[All laughing]

187 Sean: *Right! Let's go. Are we ready? Let's go fishing, let's go fishing*

188 Saul: *OK* [casts imaginary rod] *I've caught a pike* [...] *it's a massive one*

[All join in 'fishing']

189 Fleur: *I caught a fish*

190 Saul: *I caught this, I caught a bit of seaweed!*

This extended episode of in-role talk with Group Two occurred nearly 19 minutes into the 28 minutes of recording and after they had completed the set task to their satisfaction. They began to play at being on board a boat quietly, seeming slightly embarrassed, with occasional glances and grins at the camera, particularly from Sean. What was notable on this occasion was that once the children had come to some joint understanding of the task, they then used their knowledge of tides and times in their play, re-visiting the mathematics worked on collaboratively earlier in the observation (see Chapter Four, Year Four Extract Four). This would appear to be an example of role play helping children to integrate some mathematics knowledge as well as providing time for them to play with some mathematics that is new to them. When I re-viewed the excerpt of the 'Tide times' film with Group 2, I commented on the fact I had observed them repeat the task:

42 HW: *... because one thing that struck me when I was watching it is that you did, you did all the task and then you did all the task again, you put, went out to sea and then you did it all over again!*

43 Sean: *That time we went fishing* [laughing].

[....]

49 HW: *I think you were quicker the second time ...*

50 Fleur: *Hmm, because we knew what to do.*

From: Group 2, Re-view interview 1, 07/11/2011

In this response, Sean indicated that he recognised the move into the pretence of 'going fishing' whilst Fleur recognised how they had integrated the mathematics. Extract 1, above, is an example of some Year Four role play as *repetitive, active, enjoyable, social* and involving a *suspension of reality* acknowledged by all players. Moreover, this example demonstrates these children incorporating the mathematics they had previously discussed into their play. They made sense of the relationship between the tide timetable and the clock and related these times to a sense of duration and what this might mean to someone using the information to put to sea. It is a particularly rich example of a role play task being appropriate to the scenario and meaningful to the participants.

In contrast to Group 2, the three children in Group 1 remained virtually stationary, sitting on the floor for whole of the 'Tide Times' role play, very aware of the camera and voice recorder. They used both "he" and "we" when talking about putting to sea but there was a preoccupation with the recording devices and the task outlined on the sheet rather than an involvement in the pretence. There was no evidence of Group 1 being at play: they were simply solving a mathematics task. This may have been because this was my first observation and they were uncomfortable being watched (although this was not the case with Group 2). However, there was also no evidence of this group role playing in any of the 'Hemy's floating studio' observations, apart from one comment from Callum at the very end of the second observation just as the group were told their turn in the role play had ended. At this point Callum shook a sheet of blue material and made the only clear 'in role' statement:

> "*Hey look, we're getting a flood, we're getting a flood*!"
>
> (From: Group 1, Observation 2, 15/11/2011)

Probably relevant is that the two boys in this group were newer members to the school and unused to this way of working. With older children it is likely that it will take time to establish that such play is 'allowed' but also valued and this illustrates that both classroom atmosphere and group dynamics are likely to be factors strongly influencing role play.

The nature of the task is also significant. ‘Fish Patterns’ became a mathematical task set around the role play theme with no evidence of in-role talk or play from either group. On the surface, the task did not appear to be set up very differently by Mrs R to ‘Tide Times’. She used children’s interest in fishing during the first observation as a focus for this task and in contrast to the first task, she spoke to them ‘in role’ on the task sheet, which began:

“*Let’s get painting. As Hemy’s helpers you have been fishing because he wants to make another painting of the creatures under the waves*”. (See Appendix Three, iii).

However, although the children remained on task in terms of the mathematics, ‘Fish Patterns’ cannot be described as role play. In this sense, as a piece of negative evidence, it is interesting. As discussed in Chapter Four, such play requires an understanding that this is ‘allowed’ and valued as well as a willing and interested group of children, an appropriate, collaborative task to play with and some adult input (I return to this in 5.4).

Observations of the ‘French Café’ scenario in the spring term revealed a less obvious division between the task and the play although in my re-view interview with Sean and Saul held a week after the observation, they clearly recognised a distinction between work and play (Extract Five, later in this section). In both groups the set task was dispensed with early on in order for the café play to begin in earnest, as is typically illustrated in Extract Two.

YEAR FOUR EXTRACT TWO, 28/02/2012

GROUP 2, OBSERVATION 4: 'French Café'

Children involved: Sean (8y 9m), Saul (8y 8m), Cara (9y 1m), Fleur (9y 4m) and Katie (8y 9m).

All group members are reading a letter of grievance from a customer (Mrs R) complaining about being over-charged.

1 Cara: *Oooo Fleur, do you know what the complaints are?*

2 Sean: [Laughs] *Oh! / That's really bad.* [Glances at camera]

3 Fleur: *I'm going to have £25 and that's it. Can I have a look?* [at the letter]

4 Sean: *It's up the other way!*

5 Fleur: *OK, wait. Cara, lets be on a table. Me and Cara are the customers*

6 Cara: *All right, I want a drink.*

Neither group discussed this complaint further during their play, perhaps because they were not clearly supported in what they were to do about it. Although a stimulus for comparing and checking amounts of money, this problem would need an adult to set it up by 'acting as' for example, the customer ("Well, what are you going to do about it?") or as a manager insisting staff discussed the complaint and decide on a plan of action. Children need time to develop their ideas of character and story (Hendy and Toon 2001) and perhaps such play would involve a depth of involvement in the various roles that was not structured into this task nor possible in the half-an-hour time slot. Immediately prior to this observation, Mrs R had reminded the groups that they were to practise their waiting roles so that the café could open to their parents the following week. Both groups rehearsed these roles, moving between in-role talk such as: "*This is a clean café*" and out of role talk organising the play: "*We're the customers now*" (Ellen, Group 1 observation 4, 28/02/2012) . The children's attention was on playing 'stereotypical characters' of waiters, waitresses and customers, rather than 'fictional character play' involving customers with names, personality and complaints (Hendy and Toon 2001). In complete contrast to the 'Fish Patterns' observations, the 'French Café' observations of the Spring term are of extended role play but where the mathematics learning is difficult to locate, as discussed in Chapter Four. The children were engaged in social and collaborative play, described earlier in this chapter as typical of the role play in Reception. Also in common with the Reception play, participants displayed obvious irritation and, at times, immense frustration when the rules of play were not followed. Extract 3, below is a good example of this, where Saul, as Chef, was not happy about customers (Katie and Sean) coming into his kitchen, whilst Fleur, as waitress, attempted to total their orders.

YEAR FOUR EXTRACT THREE, 28/02/2012

GROUP 2, OBSERVATION 4: French Café

Children involved: Saul (8y 8m) and Fleur (9y 4m) (chef and waitress - W), Katie (8y 9m) and Sean (8y 9m) (customers - C).

220 Saul: [as chef, to Katie, a customer] *You're not allowed in the kitchen! Get out of here, get OUT!*

Everyone in kitchen, Fleur visibly annoyed.

221 Fleur (W): [To Sean] *Shhhh. Saul's doing you. Go <u>out</u> if you're not...* [She puts her head in her hands, Katie comes over to her] *Oh, my God!*

//

222 Saul (Chef): [...] *Who wants to give me some tips? // Do you want to give me some tips?*

223 Sean (C): *Of course, I'd love to*

224 Saul (Chef): *Some tips please*

225 Sean (C): *Yes*

Boys return to table.

226 Saul (Chef): *Tips please*

Sean hands him 100 Euro note.

227 Sean (C): *And, no, wait, wait* [...] [Sean is looking for something]

228 Saul (Chef): *My tips //*

229 Sean (C): [In kitchen] *Could I borrow that cup a second, please?*

230 Fleur (W): *Sean, I'm trying, I'm still serving you, ohh! Grrrr* [Glances at camera. Hand on head] *I can't do it any more ...*

231 Saul (Chef): *Got 300 Euros*

232 Fleur (W): *... I can't do it any more. You're rushing me*

233 Sean (C): [...]

234 Fleur (W): *I'm doing Katie and Saul 's doing you.*

Here is role play where the rules of play are clearly being transgressed. However, this did not stop them engaging. Sean and Saul reflected on how they saw this in our re-view interview a week later (see Extract Five, below), when they talked of being "bossed about".

'The auction of paintings', the culmination to the Autumn term role play (Extract Nine, Chapter 4, 4.1.2) is an unusual example, as it was a whole class role play in a similar sense to how this happened in the Reception Class ('Faster than Usain Bolt') where all participants recognised the state of play that existed (Garvey 1977) and many (in this case, all at the same time) suspended belief to participate. In this example, the task *was* the role play; the two were interwoven. Children took part as 'myself as a member of this auction' rather than 'myself as a child in this classroom'. Once again, this could be described as the 'action play' of occupations in the categorisation of Hendy and Toon (2001). Players sounded like and talked as they would when doing anything else in the classroom, unless they were in the role of auctioneer or treasurer, where different, authoritative voices could be heard. This is comparable to the 'race organisers' in the Reception scenarios. These roles were understood by everyone and children chose different parts during the role play, Mrs R sporadically stopped the play to ask if anyone "would like a turn" at being the auctioneer or a treasurer. The notable difference to the group role play was that the teacher was present, observing and contributing to what happened. The effect of this was that Mrs R said she was excited by 'the performance' of that afternoon and the obvious enjoyment and involvement of the children. This made her decide to work towards a final 'performance' for the spring term role play, 'The French Café'. For Mrs R, the idea of developing an ongoing story connected to the role play made the role play successful in terms of both maintaining the interest of the children and herself, and as a context on which to hang or centre the mathematics. I am reminded here of the use of stories to frame mathematics (Zazkis and Liljedahl 2009). In a sense, an on-going role play story might be one manifestation of role play taking place for 'sustained uninterrupted periods of time' (Rogers and Evans 2007) in a similar way to children continuing fantasy games from playtime to playtime, or the Reception children continuing their fantasy play over time (despite interruptions) when returning to the role play area. One difference between the ‘Auction of Paintings’ and the ‘French Café’ end of term ‘performances’ in Year Four was that the auction was structured mathematically and supported to develop the children’s mathematics whereas the ‘French Café’ was not.

Another interesting observation related to the issue of pretence was the effect the Year Four players’ interest in my recording equipment had on their awareness of their role play as a performance. They ‘spoke’ to the camera as audience, for example by holding their task sheet or recordings to the camera. In particuar, Sean behaved towards me as a film maker as the following examples illustrate:

From: 01/11/2011, Group 2, Observation 1, ‘Tide Times’

After the role play ends, I pack up my camera. Sean fetches the voice recorder.

Sean: *Any good?*

HW: [surprised] *I don’t know, yeah! I’m sure, it’s brilliant!* [laughs].

From: 15/11/2011, Group 2, Observation 2, ‘Fish Patterns’

Sean: [to HW on entering the role play area, indicating the camera] *Give me the thumbs up when it’s on.*

This has similarities to Griffiths’ findings with children of a similar age who talked to her laptop screen as if narrating a television programme (Griffiths 2011). Griffiths explains the effect of video recording as follows:

> “[The recording] *does seem to provide a catalyst for the child taking ‘reporting’ seriously*.”
>
> (Griffiths, personal email communication, 24/01/2012)

The children in my study had been told about my research and that their play was being filmed for discussion with others, including their peers (See Chapter 2 for a summary of how the children were introduced to my research). Maybe the recording helped Sean to take the role play seriously. Perhaps the camera operated in the role of an interested and involved ‘other’, its presence affecting the quality of the play in a similar way to how the presence of an adult has been found to enhance children’s play (Sylva et al 1980). As it is impossible to say what the play would have been like without the recording equipment, I cannot be sure of its influence but the possible effects of the presence of recording equipment has been examined in Chapter Two.

Similarly to the Reception findings, dressing up for the Year Four children seemed to contribute little to the role play with some children more keen than others to wear in-role clothing. When these were worn, neither the play nor the mathematics appeared to alter significantly. Instead, dressing up often prompted laughter initially and then was ignored. However, as in Reception props were significant, for example, non-mathematical props such as aprons and note pads signified the roles of waiters and waitresses, a gavel the auctioneer. Some props made a significant impact on the quality of the play and the mathematics, the most obvious example being the photocopy of a tide timetable in ‘Tide Times’. This prop was mathematically rich as it required interpretation. On the other hand, in the ‘French Café’ the money and menu props, although stimulating some mathematical discussion and activity, were not as rich, possibly because these were not sufficiently structured, or maybe because they were overly familiar, hence not requiring much interpretation. One prop that detracted from the activity was the stills camera provided to make a record for 'Fish Patterns' (which was also out of keeping with the scenario). To summarise, the provision of props and clothing did not define what happened as role play in either class, however, effective props or resources did influence what happened mathematically and contributed to the development of the role play. Of course, it is possible that a rich resource such as the tide timetable would have stimulated worthwhile mathematical discussions without the role play but what the role play appeared to add was a justification to be playful3 with the mathematics of timetables.

To end this section I examine whether the Year Four role play was concerned with membership and belonging. Unlike Reception, in Year Four, there was both a designated role play timetable and a designated 'role play area'. Thus, children choosing role play as a vehicle to be with friends (Rogers and Evans 2008) did not happen in this class at these times (although this appeared to operate during break times). Despite the role play being timetabled for a designated group, the class did feel a sense of ownership and had a sense of the role play being 'their' area maybe in part because it was decided on, designed, decorated and resourced by adults and children jointly, as discussed in Chapter Four. The curriculum time allotted to the collaboration in setting the area up demonstrated the value it was accorded by adults. The class were proud of their role play area (as were other classes) and I observed them showing it to visitors, pointing out its various artefacts and props that had either been made or provided by members of the class. The designated area appeared important for the success of role play in this class as it signified to the children what was expected when they were there, and this was seen by them as distinctive to 'other' mathematics activity.

Each member of Year Four belonged to a 'role play group' and for the majority of the time enjoyed being part of this and were not happy when this was not working effectively. When I re-viewed the 'French Café' role play with Group Two, they took the opportunity to complain bitterly that their role play group was not working well, as can be seen in the following extract.

YEAR FOUR, EXTRACT FIVE, 06/03/2012

Group 2, Observation 4: 'French Café' Re-view Interview

Children involved: Sean (8y 10m) and Saul (8y 9m)

Length of recording: 29 mins 04 secs, this extract starts about 15' into the interview.

Saul: *'Cos Fleur, what she does, she, say/ if Sean's enjoying being a chef or something, and Fleur thinks he's not doing a very good job when he is, Sean ends up being something he doesn't want to be, and Fleur just does what she wants*

Sean: *Fleur just likes bossing us around and she just like, telling us what to do and she's just doing what she wants*

HW: *So sometimes the group, who's in the group ...*

Sean: *Disagree*

HW: *... affects what happens and makes it not work quite as well?*

Saul: *Yes*

Sean: *Which is why I don't really, which is why, if I am allowed to say this, which is why I <u>hate</u> maths work, Because of the annoying stuff that they all, that the group*

Saul: *Yes, because when we are having fun, because role play is basically letting you want to have fun*

Sean: *Yeah*

Saul: *Fleur...*

Sean: *Yeah*

Saul: *... is saying 'everybody just stop being stupid and do your work'*

Sean: *Yeah, she's just like*

Saul: *She makes us do the work while we're having a lot of fun and she goes off playing stuff*

Sean: *Yeah! She asks us to do the work and she hardly helps!*

In the absence of Fleur, Sean and Saul took the opportunity to express their dissatisfaction with the direction their role play was taking, in this case, the dominance of one member and the lack of sharing of responsibility for tasks. This seems to indicate that the children saw what took place in the 'French Café' as having a strong social element. What is also clear from this extract is the division that the children recognised between work (as being that set by the teacher) and play (what they wanted to do). In this scenario, play is seen as being in the shoes of waiting staff and customers and as having fun.

In summary

> "*All play requires the players to understand that what is done is not what it appears to be*."
>
> (Garvey 1977: 13)

During the second day observing the Usain Bolt scenario, Isobel (5y 3m) told me about her 8 year-old sister Hatty's comment. Hatty had said that Isobel was not beating Usain Bolt as she was not running as far as 100 metres. Interestingly, I did not observe Isobel participating in the role play during day two or day three. Perhaps the magic was stopped for her and reality had pushed its way in. At the time I wrote in my diary:

> "*This feels a bit like saying there is no Santa! Perhaps this is the point – how we get them to engage in some 'Santa' maths! - Being prepared to engage*."
>
> **Fieldwork diary entry, 29/05/2013**

The Reception evidence suggests that *reality was clearly suspended* during the observed scenarios. It was *enjoyed for its own sake*, it *actively engaged participants* and allowed children to exercise *autonomy and control*. Cafés do not serve dinosaurs and no horses existed whilst children 'cantered' around the jumping course. Similarly to the Reception evidence, the Year Four role play, although sometimes not obviously role play, appeared to be *enjoyed for its own sake*, was *actively engaged* in, *exploratory* and in particular, allowed participants to exercise *autonomy and control*. Year Four children ‘owned’ the role play area and wanted it to work successfully.

Analysing the children’s speech or behaviour revealed that, typical of the play in both classes was the adoption of ‘action’ or ‘stereotypical character’ roles rather than ‘fictional character’ roles with fully developed personalities (Hendy and Toon 2001), as well as frequent movement between these roles. Perhaps ‘stereotypical character’ play lends itself more to mathematics where *what you do* rather than *who you are* is relevant. On the other hand, maybe it was simply that the observed scenarios led to this play-type. Reality was suspended in the Reception examples but importantly it borrowed those aspects of reality, such as communicating and agreeing value and amount, counting and measuring accurately, that were necessary for some mathematics to take place. As in Heathcote’s process drama, it examined an aspect of reality through fantasy (Heathcote et al 1984, 1995, 1999).

The Reception class appeared prepared to engage in the fantasies they jointly created with Miss H. Perhaps it made sense as part of their world where fairies replace your redundant teeth with money and a man comes down everyone’s chimney on one night every year to leave presents. The role play in Year Four had a different feel as the adoption of distinct identities was observed only occasionally. By Year Four many children were probably more aware of appearing foolish in front of their peers (evidenced by the laughter over adopting character clothing) and more aware of a play/work division (Desforges 2001). Whilst role play can provide a safe environment for the making of mistakes and the taking of mathematical risks, the classroom environment needs to be safe enough for older learners in particular to take the risk of becoming fully involved in role play.

Probably not surprisingly, role play was more fragmentary in Year Four and more prevalent and sustained in Reception, where play is more seamlessly interwoven with the day-to-day experiences. However, when the role play scenario demanded it, Year Four children were observed engaging in sustained role play (e.g. the ‘French Café’ and the ‘Auction of Paintings’) and it was interesting that they still saw the main point of their role play as having fun.

In the Reception class the contribution of such play to the children’s mathematical development was apparent, in Year Four less so. It appeared to contribute to their developing sense of themselves as mathematicians rather than to an observable increase in mathematical understanding. The following section explores this further by considering what role play in particular might add to the learning of mathematics.

5.2 ROLE PLAY MATHEMATICS

This section considers episodes where the role play *in particular* seemed to be making a contribution to children’s mathematics learning in two main ways, in developing and applying their mathematical knowledge (5.2.1) and to developing their identities as capable mathematicians (5.2.2).

Early years’ theorists argue that play reflects children’s understandings of the world (Garvey 1977, Paley 1981, 2004a, Hendy and Toon 2001) and it has also been argued that play opens up the possibility of problem solving (Sylva et al 1974). It has been recognised that what the DfEE (2000a) refer to as ‘well planned’ role play can give children the opportunity to not only make sense of their world, but to learn without the fear of failure. In Chapter Four of this study I identified children's mathematical understandings from observations of their role play in both classes. If children's play can be said to be primarily concerned with membership and belonging, power and identity (Walkerdine 1981, Holland 2003, Paley 2004a, Gifford 2005) role play might be used to good effect in learning mathematics where participants are in control of the mathematics and the problem solving process.

5.2.1 Knowledge and understanding

If children participate in role play in order to make sense of their world, how is participating in role play helping them make sense of their mathematical world? Garvey (1977) argues that children at play enact or represent knowledge of their society and the material world that they cannot necessarily verbalise explicitly. Learners using the language of their 'knowledge communities' without necessarily understanding it in the way of more expert members, has been termed 'appropriation' (Hendy and Toon 2001). It is evident from the extracts analysed in Chapter Four that there are occasions when children are 'appropriating' the language of their mathematical /role play community and were experimenting with both mathematical content and process.

The Reception children's increasing attention to mathematical accuracy within all three scenarios (translating the dinosaur's numerical 'code' and counting, recording and comparing scores and times) is evidence of role play appearing to make a contribution to children's mathematical development. When the role play worked well in Year Four there was the same focus on accuracy and detail, for example, in agreeing the times to leave and return to port in Hemy's floating studio and during bidding and paying for paintings in the class auction. Accuracy is defined by context, and concern over accuracy is an indication of caring about the mathematics (Hodgen et al 2012).

At times when the mathematics and the play are interwoven, the play allows the children to amuse themselves with the mathematics, in a way that might not be the case if they were not participating in a pretend scenario. Examples of this were the Reception children's fascination with "zero seconds" when recording their times racing against Usain Bolt (for example, Chapter Four, Reception Extract Seven) and Year Four, Group Two playing with the possible consequences of tide times and leaving and returning to port (this extract is preceded by Year Four Extract Five, Chapter Four).

YEAR FOUR EXTRACT SIX, 01/11/2011

Group 2, Observation 1, 'Tide Times'

Children involved: Saul (8y 5m), Sean (8y 6m) and Fleur (9y 1m)

Length of recording: 28' 41"

221 Fleur: *It's five and twenty past ten*

222 Sean: *Alright everybody, shall we move somewhere else as we only have 14 minutes left*

223 Saul: *14 minutes?*

224 Fleur: *I think we should move back* [....]

225 Sean: *OK let's go. Go, go, go!*

226 Saul: *OK pull the anchor up*

227 Sean: *Go, go, go!*

228 Fleur: *What else do we need to do?*

229 Sean: *Nothing else, just have to wait* [Saul adjusts clock] *now we're back and we can do it all again!* //

230 Saul: [with clock] *OK, look, we've just left. Go!* [clock shows 06:40]

231 Sean: *Oh no! oh no*

232 Saul: *What time is it?*

233 Sean: *Yeah, we've run aground*

234 Fleur: *It's high tide*

235 Sean: *No*

236 Fleur: [refers to clock] *Yeah, because it's 8:36.*

Sometimes as we saw in 5.1.2, in Year Four, the role play became separated from the mathematics and it was difficult to observe the context supporting the mathematics. As discussed in Chapter Four, it is both difficult to generate tasks from scratch and to predict which role play tasks are likely to work well mathematically. On my evidence, it is more difficult to identify a successful mathematical thread to be supported and explored in Year Four, as play becomes separated from other classroom activity as the children become older and adult observations are less likely to take place. Moreover, it would be difficult to sustain a mathematical thread over an extended period of time where there are less opportunities for children to revisit and repeat experiences and in a crowded mathematics curriculum where teachers feel pressure to 'cover' a lot of content. Here is an extract from my fieldwork diary reflecting on this complexity:

> "*It's not about squeezing the maths out of whatever is there – some stories/scenarios are steeped in maths, others not so much. But perhaps*

there are some activities / maths scenarios that are particularly useful/successful for maths with different age groups – e.g. in R/Y1 it is really all about counting, in different ways with different things, in different contexts. Y6 maybe data-handling (although [Year 6 teacher] *and I, having decided to use this year's role play for data handling, couldn't think of anything useful to do in relation to 'The Hobbit' (as yet!). Maybe at Y3/5 it's about measurement and time*."

Fieldwork diary entry, July 2012

During the year following this study (2012-2013) the Reception teacher reported using what she observed as a mathematically effective interest in stopwatches with her new class to good effect. Reception tasks that are likely to develop children's mathematical understanding combine some element of counting, measurement and comparison with some incongruity or a challenge. Year Four tasks more likely to be successful also need to include some incongruity or challenge but maybe through the use of providing data or measurements to handle. It is likely to be the case that an effective dynamic between role play and mathematics always contains some incongruity to puzzle at and discuss and, importantly, to reach some kind of agreement about, even if this is to disagree. Interestingly, Howe and her colleagues (Howe and Tomlie 2003, Howe 2009) found that children who had been asked to reach an agreement when solving a science problem retained the information six months later even if they had not reached an agreement. Play analysts such as Bruner (Bruner et al 1976) have often referred to the repetitive nature of play and when there is time for repetition, it provides an opportunity for children to refine and gain mastery over the mathematics. There is repetition in the Year Four ‘French Café’ and ‘Tide Times’ scenarios and in the Reception class, repetition forms the core of the mathematical role play activity. It could be argued that other than using games, opportunities for children to repeatedly meet, practise and refine mathematics within the school curriculum, by choice and with enjoyment are rare. Perhaps role play is one such opportunity which needs further consideration with older age groups. Year Four’s ‘French Café’ might be developed into opportunities for refining skills in giving the correct change or totalling a bill, however, on this occasion, neither the specified task nor the props were directed enough to lead to observable, focussed mathematical practice. Indeed, the confused discussions about how much to pay were not dissimilar to those that take place when a large group of people attempt to fairly divide up a restaurant bill. Whilst tying role play tasks too tightly to curriculum content may not result in problems that interest the children, my evidence suggests it is both possible and constructive to identify mathematics collaboratively with children which captures their interest.

Distracters from successful mathematical role play seem to be anything that it has to be done to satisfy the adult that some appropriate activity has happened, for example, completing a recording sheet which takes time away from exploring the mathematics. In particular, *individual* recording stops children working collaboratively and reaching an agreed solution (e.g. Year Four’s ‘Fish Patterns’). Individual work and work to check understanding can take place outside the role play time (see below).

Bruner (1986) distinguished between paradigmatic thinking and thinking undertaken in the ‘narrative mode’, arguing that whilst paradigmatic thinking is based firmly in reality, in the narrative mode children are able to work beyond the literal and cope with inconsistency. This is a useful analysis when examining mathematics within role play, in that role play encourages thinking in a narrative mode where other mathematical activity might not. Bruner's argument is that these are two very different modes of thought, one leading to universal truths and the other to more particular connections. Perhaps we can observe children dealing with narrative 'truths' in the role play scenarios which may lead to the making of particular, narrative connections. This may link to giving the mathematics an emotional association and placing it in one's episodic memory (Goswami and Bryant 2007) which subsequently can be associated with further mathematics.

Integral to role play making a contribution to children's mathematical development is the commitment and involvement of the teacher; structuring and supporting the play, observing and analysing what is going on, providing stimulating props, and modelling and giving verbal guidance and suggestions, and this is explored later in this chapter (5.4).

5.2.2 Changing one's identity

Section 4.3 (Chapter Four) overlaps with this subsection. It examines how participating as a member of a mathematical community might affect a learner's view of mathematics and themselves as mathematicians. As discussed in Chapter Four, if being successful at mathematics is considered to be as much about actively participating as about competency, this is dependent upon learners forming a productive disposition and a positive "I can do" identity. This subsection considers in what ways adopting a role other than one's own might make a contribution to the development of children's mathematical identities.

> “*By ‘playing out’ situations that are beyond our real-life experience, we find out more about ourselves*.”
>
> (Hendy and Toon 2001: 20)

Hendy and Toon, above, imply that by playing beyond our immediate experience we expand our view of who we are and what we might do. A temporary change of role, or the assumption of another identity, might influence a child’s self-identity as a successful mathematician. Providing the opportunity to play at being a mathematician in a safe environment could contribute towards children feeling ownership of, and control over, mathematics.

In both Year Four and Reception, participants can be seen exploring some mathematics whilst playing at various role play scenarios. They do so more often without asking for help from an adult. They are in control and in a position of author*ity* – the state of being an author (Klein 2007). Adopting a role different to your own is empowering (Hendy and Toon 2001) as a child who might not be finding mathematics straightforward day-to-day can voice suggestions and become knowledgeable in this secure environment, often away from adult eyes. This is particularly noticeable in my Year Four examples, e.g. Saul explaining tidal movement (Chapter Four, Year Four Extract Four) and Sean explaining multiplication (Chapter Four, Year Four Extract Seven). For these children, role play might be an opportunity for them to see and tackle mathematics which is accessible and relevant. This contrasts with a popular view of mathematics as a ‘club’ for which you do not know the rules and you do not belong and where someone else is in control. This analysis is developed further in Chapter Six, where data from re-view interviews with children explores their views of themselves doing mathematics. Here is an extract from my research diary reflecting on this:

> *Note: At (*a recent national*) conference I was seated at a table with six others, five from the same secondary school. Two were men. One of the men, sat opposite me, I found extremely annoying as he talked loudly over everyone else and when asked to do some maths, he quickly took control and did it before anyone else had time to digest, let alone discuss, what and how to answer the question. He closed down all discussion. It struck me that this was precisely the reason I was doing my research – to counter this type of elitist club mentality in mathematics learning and teaching. To open up participation to all.*
>
> **Research diary entry, 30/09/2012**

In both year groups, children were observed intermittently taking some risks by tackling some tricky mathematics and seeking further mathematical 'arousal' (Lewis 2013) by continuing to re-visit difficult tasks, socially and mathematically, that were often self-set. The only adult help that was requested was practical, such as which button starts or stops the stop watch in Reception, or within Year Four, when participants were not in-role but trying to make sense of the task:

YEAR FOUR EXTRACT SEVEN, 01/11/2011

Group 2, Observation 1, 'Tide Times'

Children involved: Saul (8y 5m), Sean (8y 6m) and Fleur (9y 1m)

Length of recording: 28' 41"

155 Fleur: [reading from task sheet] '*Add notes to the tide information to explain each part'*

156 Saul: *We have to explain* [...]

157 Sean: *That'll take like an hour!*

158 Saul: *We've got like an hour. / Or twenty minutes or so*

159 Sean: *Shall I say 'what does it mean?'* [stands] [...]

160 Saul: *Just say you don't understand?*

161 Fleur: <u>*You*</u> *don't understand, not us*

162 Saul: *Me!*

163 Fleur: *All of us*.

Sean leaves to seek teacher advice. Fleur and Saul wait in silence for him to return from speaking to Mrs R, Fleur reading sheet.

Mrs R's invitation to 'add notes to the tidal graph' (L155 above) could have been a follow-up task to the role play, perhaps to check understanding after the play had taken place and which would lead to more time for the children to become involved in the play itself. The occasions when children asked for help were rare and no help was requested whilst they were fully engaged in the play, even when things became difficult, as typified in Year Four Extract Three (5.1.1). Frequently in both classes, the play continued without adult help being sought or the activity being abandoned.

It was the independence and autonomy of the role play that was valued by children in all age groups when they were interviewed over three years in an annual questionnaire and interview (Appendix Seven and see examples of quotations later in this chapter). It is this independence that may positively affect children's view of themselves as capable and resilient and in a context they recognised as mathematical. The deliberate autonomy from adult supervision in Year Four, the support for independence from the teacher in Reception, plus the social nature of the play might change how mathematics is viewed. Mathematics became a site for some struggle, which appeared to be relished by participants, as Sean here explained in two of our re-view interviews:

YEAR FOUR EXTRACT EIGHT

Group 2, Observation 1; Re-view 'Tide Times', 07/11/2011

59 Sean: *Well it is if it's, if you haven't done it too quick then you have to spend more time doing your own thing which is more / boring than doing the activity, because the activity is fun because it takes a while to do ...*

60 HW: *Hmmm*

61 Sean: *... and you really have to think about it.*

Group 2, Observation 2; Re-view 'Fish Patterns', 22/11/2011

171 HW: [...] *Yeah, I wanted to say, how does role play help you learn in your maths?* /

172 Saul: '*Cos, umm, Mrs R sets you a task and it's all about maths*

[All three begin to talk over each other]

173 Fleur: *And it's helping you stop, so when you come to* [...] *Mrs R always* [...]

174 Sean: *Sometimes what she, sometimes what Mrs R doesn't understand with / Circles, with all the groups, is that we find things harder than what she's given us ...*

175 HW: *Ah, huh*

176 Sean: *... so then when we've done it, we try and double the task up, so we need something else to do*

177 HW: *But you don't really ask for any help when you're in here, do you?*

178 Sean: *But we do some, if it is, in here it's like that sometimes and we got to double it up*

179 HW: *How do you mean, double it up?*

180 Sean: *We got to do it again*.

Sean recognised that tasks might be challenging and seemed to be saying that rather than give up or ask for help, they repeated it, or stuck at it until they could successfully complete it. Saul recognised the role play as being "*all about maths*" (L172) and it might be that even if the role play does not appear to generate much mathematical activity, simply viewing the role play as mathematical will help support children's positive identification with the mathematics. In both classes groups can be observed assuming a collective responsibility for successfully engaging in the task and reaching a successful conclusion, and overcoming difficulties was seen as part of this (See Chapter Four, Year Four Extract 13, 4.2.2). This is social mathematics, where knowledge is generated within the group.

In summary

In Klein's analysis (2007) teachers 'feed' students information and 'steal' the learning process from learners, disabling and disengaging them. These children seemed engaged and enabled by their role play mathematics and learning to be mathematicians; even if not what they consider to be 'the best' (see Chapter Four, 4.3, on identity) then very willing to tackle tricky, or unclear mathematics. As one research project with secondary students found, this way of working, dialogically and collaboratively, is empowering for students and changes their attitudes to mathematics (Hodgen et al 2012). For this to happen, the environment needs to be safe for them to make mistakes and for them to negotiate the complex emotional issues of what it feels like when they get something wrong. Role play seems to provide such an environment in these two classrooms and particularly in Year Four, away from, possibly censoring, adult eyes (even though on these occasions, not from the eye of the camera or researcher). The mathematical role play operated in these two classrooms as somewhere participants can 'pretend to be' mathematicians putting to sea, bidding at an auction for paintings, serving in the 'Pirate Poundland' (Reception Class, January 2012) or calculating the points in a horse jumping competition. It may be additionally safe because it is 'a pretend self' (Hendy and Toon 2001) that is doing the mathematics and making the mistakes.

5.3 PROBLEM SOLVING AND ROLE PLAY

The approach described and analysed in this study has parallels and contrasts with other approaches that prioritise a problem solving approach towards learning mathematics over the learning of mathematical content by itself.

It is a style of teaching and learning where teachers provide contexts for learners to investigate (Ollerton 2010, Taplin no date) and through working together on these, learners' mathematical development is supported in terms of not only increasing their understanding of content but also how this content is applied in different situations. (See the Literature Review, 1.1.2 (iii), for a more thorough discussion of problem solving approaches to mathematics learning.) The difference between other problem solving approaches and that described in this study is twofold. Firstly, unlike many problem solving approaches, the mathematical context does not begin from a recognisable piece of discrete mathematics but instead, a possibility for some mathematics learning is identified from a wider context, be it children's interests or an overall area of study. Secondly, the mathematical possibilities either emerge as the children become involved in the activity over several sessions (hence might vary according to the group of children and the particular time) or are identified within a familiar context, such as paying for goods. In contrast, the mathematics in approaches such as the 'Maths in the City' initiative (Twomey Fosnot and Dolk 2001a, 2001b, 2002) is based around selected and established mathematical models that are presented to children within familiar 'everyday' contexts in a structured way. The strength of such an approach is its replicability. My observations in this study indicated that whilst there are elements that can be reproduced (such as Miss H repeating successful elements with a subsequent Reception class) the route the task takes alters according to the particular children involved. In a similar way in Year Four, the tasks will vary as it is the children who structure and direct the course of the task. For periods of time the mathematics at Maritime School is investigated largely independently of the involvement of either teacher and it is this very autonomy which is seen as valuable by children, as these comments from annual reviews of the role play (Appendix Seven) indicate:

(Year Four3 child, 2009): "*I answer better in role play because it is a place where I can make up my own mind."*

(Year Five girl, 2010): "*Yes* [role play] *is better because you are a bit more independent. Because your teacher sort of tells us how to work it out if they are with us, even if they don't mean to."*

(Year Four boy, 2010): "*You don't need the teachers to help you, your friends help you in role play."*

(Year Five boy, 2012): "*You don't have to have the teacher right in your face commenting on everything you do*."

In contrast to 'Maths in the City' (Twomey Fosnot and Dolk 2001a, 2001b, 2002) in role play in this school it is the children who have the authority, instead of being led to a foreseen mathematical end point by an adult. Moreover, social interaction is viewed as playing a role in the mathematics learning of these children, maybe it is this that keeps them glued to the mathematics.

Role play does have the potential to place children as problem solvers and decision makers (Hendy and Toon 2001). Interest and excitement are triggered by dilemmas, curiosity, intrigue or novelty (Lewis 2013) and it is these elements that might need to be built into a mathematical task. Heathcote's emphasis on a situation to resolve rather than on an accurate portrayal of characters or plot (Heathcote et al 1995, 1999), and of process drama thus opening up the possibility of problem solving and thought, has similarities to the approach observed in this study. Mathematical dilemmas might include those we could categorise as:

- the ‘socio-dramatic’ (Hendy and Toon 2001): which would include reconciling stock-taking, taking measurements and fittings and making bookings or,
- ‘thematic fantasy’ (Hendy and Toon 2001): where such play might lead to the mapping or arranging of journeys or assembling belongings for story characters.

Each dramatic episode would vary according to the participants and their reaction to the materials hence this study could be interpreted as *mathematical process drama* where children are given a mathematical dilemma and encouraged to make decisions (even ‘wrong’ ones) and work through the consequences.

What might be the benefits (or otherwise) of such an approach to mathematics? Firstly, it is engaging. It is a measure of *how* engaging in that children in both age-groups remained involved with the task despite difficulties and inconsistencies. Sylva et al’s (1974) research raised the question of whether play promoted creative thinking and designed a task to see if prior play with objects affected a child’s ability to solve a problem using the same objects. They found that prior experience of free-handling objects was not only as effective as watching an adult demonstrate how to use the tools to solve the problem but also, prior play gave children a more relaxed attitude towards the task. She came to the conclusion that free handling was more effective because only then did children initiate the solution themselves. Perhaps it is the case that play such as that observed in this study allows a chance for children to ‘free handle’ mathematics, to ask “*what if...?”.*

All problem solving approaches have at their heart the belief that pupils can learn by engaging in activities to provoke mathematical thinking and by exploring, noticing and discussing. What differs with the role play approach described in this study is how the mathematics was decided upon and structured, the control the children had over the mathematical directions they took and the nature of adult involvement.

5.4 THE ROLE OF THE ADULT

In Chapter Four (4.1 and 4.2) I discussed the role of the two teachers in my study school as key in building a community of learner mathematicians. There is some overlap between that discussion and that in this section. Here I examine the ways in which the two study teachers structured the role play to include mathematics and analyse the different actions they took that contributed positively to their children's role play mathematics. It has been argued for some years that without some degree of adult involvement, children's play can lack focus, become repetitive and sterile (Hendy and Toon 2001) and even, will not lead to children's cognitive development (Manning and Sharp 1977). My question is, what degree and type of adult involvement appeared to be useful in supporting mathematical role play in these two classrooms?

During the school's preparations for the town's historical celebrations (September 2011) two visitors from a local historical group worked with groups of children in the Key Stage Two classes preparing for a dramatic reconstruction to take place in the town the following month. This is my diary entry reflecting on what I observed:

Yesterday [a man and a woman] *visited and worked with the children related to the* [town's charter] *celebrations. Two things – how the woman used ' in character talk' to get children involved and behaving in a particular way – e.g. "Stand up STRAIGHT", "Chests out, Royalists!", etc.* [whereas the] *man didn't manage to do this and the result with this group was not as impressive!*

Research Diary entry, 07/09/2011

One of the visitors spoke to the children in character and one did not and I used the word 'impressive' in my diary to denote the difference I observed in the children's enjoyment, engagement and involvement (Laevers 1993) as well as in the quality of the resulting dramatic activity. The use of in-role talk by the adult resulted in the children immediately paying attention and for extended periods behaving 'as if' they were in someone else's shoes, in this case, Royalists and Cavaliers. Inviting children to behave 'as if' by speaking to them as existing in a role both whilst playing and, importantly when discussing the play, was common in the Reception class and appeared to have a positive impact on the children's willingness to engage in the mathematical play. I observed this less in Year Four, but the majority of my observations took place when the teacher was not present. However, speaking to the children in role did take place in Year Four, particularly when setting up the role play.

Both teachers in my study school engaged in role play *modelling* and *verbal guidance* (Smilansky 1968); proposed imaginative situations, and made use of evocative toys (Garvey 1977). This was particularly obvious in how Miss H operated in Reception as she played intermittently alongside her pupils (see Chapter Four). Mrs R with her Year Four children 'play tutored' (Smilansky

1968) away from the allocated role play time and in whole class sessions. In episodes where the role play seemed to be operating mathematically, both adults were observed modelling the mathematics the children were engaged in, be it bidding for a painting, reading a stop watch or using a number line. Such interventions might have only lasted a few minutes.

Deciding when, as an adult, to adopt a role or to intervene to further the mathematics is subtle and complex. Observing the play in Reception, listening to the children talking about their play in Year Four were the first steps in each teacher making a decision when to act (in or out of role) to introduce a further question, or dilemma. Although the older children worked independently of adult supervision during role play, Mrs R could adopt an interventionist role during class review sessions where she recognised, acknowledged and developed the mathematics. Importantly, children were then given the opportunity to return to the mathematical play after these interventions.

As explored in Chapter Four, the pretend play informed the teachers in the two study classrooms about their children's mathematics. Both considered it valuable for both themselves and their children and, as explored earlier, it was not only the adults who controlled the mathematical knowledge but the children in both age groups and in different ways actively contributed to the direction of their learning.

In neither class was the mathematical role play seen as an add-on but was integrated into other classroom activity, sometimes to a high degree. Crucially, as described in Chapter Four, both teachers created the role play from the outset – practically and in terms of ideas –with the involvement of their children. If a role play area is created for, rather than with, children, the children will not understand

how the adults expect them to play there (Hendy and Toon 2001) but these children, particularly in Year Four, expected to engage in some mathematical play. This had a much more subtle effect than the play tutoring (Smilansky 1968). Creating and developing the role play alongside the children meant that the children's ideas as well as the adult's guided what took place. Once created, these teachers, usually in whole-class sessions in Year Four, spent some time listening to the children, guiding their thinking and generating possible 'what if...?' situations. Sometimes adults spoke as devil's advocate, sometimes as a character who might be involved in the play and sometimes they simply asked open questions or invited clarification, operating as a 'guide on the side' (King 1993). In the following example (Extract Five) Miss H discussed with her class what to do about a lost (toy) rabbit. This is typical of how she worked with the children to jointly develop ideas for the play. She started by asking what "we" could do, as
we see in Extract Five.

RECEPTION EXTRACT FIVE 20/03/2012

'Ramon is lost': Class on carpet with Miss H.

Miss H: *What could we do?*

Child 1: *Give it back*

Child 2: *Phone the police*

Miss H: *Phone the police, we could phone the police, couldn't we? Who could take him to the / where would he go?*

Child 3: *Could take him back to school*

Miss H: *Take him back to school?* [...]

[...]

Miss H: *You could think about it when you are playing couldn't you?*

Child 4: *I'm going to see if the Year One's* [...]

Miss H: *Oo, maybe the Year O3nes have got Ramon, they might need to be investigated. You might need to ask them some* /

Child 5: *Clues*

Miss H: *Ask them for some clues or ask them some questions, OK? You've got 10 seconds to think about how you are going to help find Ramon, OK. 10 seconds.*

Here Miss H integrated the children's words and suggestions into her own and as a result the children were buzzing with ideas when they left the carpet to play. In our interview in April, she explained how she saw this:

"*I think that's the other thing, like, when they come up with something, just, just go with it unquestioningly, just like, 'Oh yeah, that makes perfect sense'. Like, yeah, and don't even make anything of it, like in the way of going "Oh yeah! That's a brilliant idea",* (but) *just saying "Yup, OK, right so, you need to go to the office to fill that out then come and show me", just like really normally, and then no one even questions that it is going to be anything different. Does that make sense?*

Miss H to HW, semi-structured interview, 17/04/2012

This comment really struck me during our interview, as I had not thought about tone of voice before, but what is critical here is that Miss H answered the children's ideas out of her role as teacher and in role as joint participant in their play. She ‘speaks as if’, in other words responding *as if* she is part of the play, instead of *commenting on* the play. She engages with their play ideas not by pretending to ‘be’ a particular character but by helping them think through what would happen if they followed up a particular idea. This would seem to be significant in giving her children authority over what happens. Later in the same interview Miss H referred to how the other adults began to copy this tone, and everyone being:

> *“... in a complete imaginary world talking as equals...”*
>
> **Miss H to HW, semi-structured interview, 17/04/2012**

Importantly, in terms of the mathematics learning this meant that:

> “*When you introduce something mathematically, then they don’t question that either.”*
>
> **Miss H to HW, semi-structured interview, 17/04/2012**

This is a fascinating point. The children (and teacher) adopted roles (without question) in a jointly constructed scenario. This approach led to opportunities for the teacher to introduce some mathematical problems to tackle which in turn were entered into without question by the children. Thus, the adoption of a role in this way may encourage children to enter into some mathematics that they might otherwise not consider tackling.

The Year Four children understood the nature of activity that took place during their time set aside for role play. When the role play resulted in useful mathematical activity Mrs R was focussed on the possible mathematical opportunities and directed her children's attention towards them and encouraged and made suggestions for their development, for example, in the 'Tide Times' task.

> "*Pretend play has much to inform us about the children we care for and teach.*"
>
> (Hendy and Toon 2001:5)

Hendy and Toon (2001) argue that in their pretend play, children reveal much about themselves and my observations revealed much about the children's mathematical understandings as well as misunderstandings. Opportunities for the Year Four teacher to be informed by her children's' pretend play had to be carved out from her teaching time. Mrs R had used a camera in the past to 'observe' the children's play and during this study occasionally eavesdropped on their play. Significantly, setting aside time periodically as class 'reflection' sessions for children to talk about (review) what happened in the role play was used effectively to monitor what was happening by Mrs R. In these sessions the pupils' role was to focus on the mathematics whilst the teacher focused on the learners and what they were demonstrating. Both observation and review discussions were important in keeping in tune with what was going on as well as what might be done mathematically (in and outside the role play) as a consequence.

The role played by reflection on mathematics learning is discussed in Chapter Six. Children are likely to remain interested when continuing attention bestows value to what they are doing and, in the case of my study, also added value to their mathematical solutions. Reflective class sessions appeared to reify the role play, establishing the importance of the mathematics the children engaged in independently hence it might be this that contributed to the positive development of their mathematical identities. Studies have found that the unobtrusive presence of an adult enhances young children's play and learning (Sylva et al 1980, Hendy and Toon 2001), maybe reflective sessions such as these fulfil a similar function.

Both teachers provided role play props, Garvey's 'evocative toys' (Garvey 1977), some that evoked the scenario and some to evoke some mathematics. In order for role play to lead to mathematics, props need to call to mind, some particular mathematics. As discussed in Chapter Four, props that seemed effective mathematically presented some sort of mathematical challenge for 'sense-making', for example, the tide timetable in Year Four and the stopwatch in Reception. These appeared to prompt a 'resolution of conflict', which was identified as constructive for learning by the Cambridge Primary Review (Alexander 2010). Having watched shop play from Reception to Year Four over several years, I share Griffiths' (2001) objections to the unreality of much classroom shop play. For example, limitless supplies of assorted coins, versus a more authentic dilemma in which each child (or pair) has differing, fixed amounts to spend placed in their wallets in advance, and which could lead to discussions involving comparisons, fairness, estimation and decision making.

IN CONCLUSION

In this chapter I have examined the opportunities that role play in particular brings to enhancing learners' understandings and knowledge as well as contributing towards their developing sense of themselves as mathematicians.

Whilst a sceptical reader may not recognise what is described in this study as role play, I define it as such, indicating when such play occurs. On the occasions that it did occur, the play was social, with communication at its heart and all scenarios put reality on hold, giving participants opportunities to 'walk in another's shoes'. Whilst engaging in the activities the children moved in and out of role, or what Hendy and Toon (2001) prefer to call 'the pretend self'. Participants recognised a playful situation existed, operating with shared rules and, in Heathcote's sense, collectively worked together to explore solutions to problems (Heathcote 1984, 1995, 1999) which had a mathematical core. This could be called *mathematical process drama,* where mathematical knowledge and understanding (and misunderstandings) are played with and the social and the mathematical are interwoven.

The ability to suspend belief is an extraordinary facility occurring across cultures. Children seem motivated to engage in pretend play and motivation is important because the emotional system affects what we are processing cognitively (Vygotsky 1933). Role play under this analysis has the potential to engage children's emotions in mathematical content and understanding. Assuming a 'role' is important for mathematics learning because, as an activity that is process driven, dependable and risk-free, it is atypical of much mathematics in school. Perhaps role play encourages identification with the content of the mathematics, making the mathematics 'personal' to both pretend persona and to the children themselves. These children cared about taking part and engaging in role play and if the mathematics was woven into this, they enjoyed playing with this as well. The situation and the problem (the mathematics) made sense to them (Donaldson 1978). In the language of Heathcote, they were given a (in this case, mathematical) muddle to resolve and they persisted in doing this collaboratively (Heathcote and Bolton 1995, 1999).

Goldin et al (2011) have pinpointed that whilst engaging in mathematics social interaction can evoke strong emotional feelings which are changeable minute-to-minute, situated and transitory. These feelings do not always have to be positive as negative emotions can lead to profound feelings of achievement. Perhaps role playing mathematics, in engaging emotion, helps create 'mathematical memories' on which learners can hang later learning (Hodgen et al 2012). If the children in my study were building and retaining memories of having been successful at sometimes tricky, mathematical problems, helped by re- viewing what took place, their memory is likely to be "I can" and this could be used again. There appears to be very little research into how teachers can be pivotal in creating situations that support mathematical learning in this way.

It has been argued that pretend play and imagination help young children think logically in the abstract and that observations of pretend play reveal how children sort out their understandings of the world and gain control of events (Garvey 1977, Hendy and Toon 2001). This study contains some observations of some pretend play that reveal the children's understandings of, and control over, some mathematics. As such, observations of role play of this sort are valuable for teachers. The following appear to be some key features in role play contributing to children's mathematical learning in both classrooms:

- Adults value the play and give it priority by observing it and discussing it with the children.
- Adults were mathematically observant and opportunistic, looking and listening out for likely mathematical threads of development that might interest the children and willing to try out tasks with the children.
- Children were involved in both creating and developing the role play and the mathematical directions the role play might take.
- Children were given some autonomy and authority over what happened.
- Tasks involving the practice or application of some discrete mathematical knowledge need careful structuring and constraints.
- Tasks were collaborative, involving a problem to solve or something to interpret – social communication remaining at the core of the task.
- There was an expectation of some sort of agreed 'resolution', with one, joint recording.

My findings indicate that the contribution role play can make to children's mathematical learning is in the development of collaborative, shared knowledge (see Chapter Four) as well as to the child's positive identity as a mathematician. Role play can afford children opportunities to free-handle some mathematics and this aids not only their confidence but their sense of what mathematics is. In other words, it comes from the learner rather than from someone else. Opportunities to tackle mathematics, where adults stand back and allow children some direction over what, as well as how they learn, with no pre-decided end result, are important in provoking identification with the mathematics and in children's developing sense of themselves as competent mathematicians, where mathematics is often messy and involves a struggle. Pendlington's (2005) research helped 10-11 year-old learners realise that 'struggle' is a necessary part of learning. There are similarities here to a study with secondary learners in which suites of lessons were developed that did not shy away from the complexity of tasks set in various contexts. The authors found that this experience changed their students' views of mathematics and whether they saw it as do-able by them (Hodgen et al 2012).

Goffman (1990) uses the term 'performance' to refer to how we behave differently in different contexts, rather than performing as, or pretending to be, someone else. He argues that these different roles are not masking the 'true person' but are what makes us persons – these parts add up to the whole of who we are (Lawler 2008). Thus role play could be seen to be operating to help make the participants the mathematicians they are (becoming).

In addition, whilst working on a pretend scenario as a group, discussing and agreeing terms of reference and overcoming problems, although often messy and inconvenient for us as teachers attempting to recognise and assess learning, groups could be seen converging on ideas that might go beyond what each is capable of individually. These children exhibited resilience in tackling some complex mathematics in some complex social situations. The mathematics is complex precisely because its collaborative and social nature created a real dilemma. A joint understanding of exactly what was being worked on had to be agreed before seeking a solution. The role play tasks observed in this study were complex, in contrast to more usually fragmented and narrowly focussed mathematical tasks. This makes these tasks difficult to unpick mathematically and to plan and to predict. What is presented to learners is a genuine problem that does not already have ‘an answer’ and thus legitimately requires some collaborative effort.

Whereas early years’ educators (Broadhead et al 2010) and others (Freudenthal 2002) might talk of ‘what children do naturally’, another view is that what children do depends upon what they are given and what this then allows them to do. At the heart of effective role play mathematics is the adult role, intermittently talking ‘as if’ and occasionally eavesdropping as well as periodically re-viewing the play with the children. Children need time to work on a dilemma independently and to return to it. The provision of time and opportunities for learners to try out ideas without ever-present external correction is particularly constructive in learning mathematics where there is often an undue emphasis on ‘getting it right’, often first time. Although I have identified some key features or conditions that might lead to some mathematical role play, these are all dependent on the wider context of the classroom and the school. Mixing role play and mathematics is an unpredictable cocktail. Moreover, such activity can be seen as lacking in clear, measureable objectives and thus risky in a current educational climate, where cognitive learning is prioritised at the expense of affective learning. I am arguing for what I am calling role play mathematics because my findings indicate that whatever we call this, children both value and gain from being provided with opportunities to work with mathematics presented to them to tackle wholesale and not sliced up into bite-sized pieces by other, ‘knowledgeable’, people.

The following chapter examines the children’s views of what they learnt about mathematics whilst role playing. This invitation to re-view and to reflect on their play became in itself a powerful learning tool and is explored in the following chapter, ‘Re-view and reflection’.

CHAPTER SIX RE-VIEW AND REFLECTION

INTRODUCTION

This chapter is the third of my data analysis chapters and analyses what happened when children re-viewed the videos of themselves role playing. It examines the connections between the children reviewing the videos and their reflections on their learning. It relates directly to both the data and the arguments presented in the earlier chapters on mathematics learning (Chapter Four) and role play (Chapter Five).

The data analysed in this chapter is drawn from the same data pool listed in the introduction to Chapter Four. In particular, I draw on transcripts of three audio recordings of 're-view' interviews with Reception children and six audio recordings of 're-view' interviews with Year Four children. These were diagnostic or clinical interviews (Ginsburg 1997) aimed at finding out whether these young children could recognise and reflect on what they had learned. The origin, nature, role and purpose of these 're-view' interviews are described in detail in my methodology chapter (Chapter Two). An entry in my fieldwork diary in November 2011 states my intention was: "*to get a picture of what is going on in* [the children's] *heads*" (Fieldwork notes, November 2011). I deliberately called these 're-view' interviews (with hyphen) as their purpose was to engage participants in re-viewing – looking again – at themselves in role in order to establish if they saw themselves as learning mathematics whilst doing so. A major part of these interviews became the sharing of excerpts from the video recordings combined with open-ended questioning to stimulate talk about the mathematics. I use the phrase 'Visual Re-proposal' (VRP) to describe this approach (see Chapter

Three, 3.3.4). Appendix One (iii) consists of examples of the open-ended interview questions and Appendix Four, of transcripts of a re-view interview with both Year Four (i, a) and Reception (i, b).

The two threads in this chapter are as follows: firstly, I analyse the children's responses to viewing the video extracts and secondly, I analyse the teaching processes that underlie this approach, where children are invited to reflect on their learning in this way. The research questions that relate to this chapter are as follows:

- *To what extent might role play affect the development of mathematical resilience and involvement as well as a positive attitude to the subject?*
- *What particular classroom conditions positively affect or inhibit mathematics learning through role play?*
- *What adult intervention helps or hinders?*

This chapter is structured as follows; firstly, I summarise from the literature (see Chapter One) what myself and others understand by 'reflection' and the role it plays in learning mathematics. Secondly, in 6.1 I explain the origins of the term 'Visual Re-proposal' and what I mean by this. Thirdly, in 6.2 I present examples of children reflecting on mathematics in both the Year Four (6.2.1) and the Reception (6.2.2) classes. And finally, in 6.3, I examine the evidence of children making generalised statements about how they learn, which has been referred to as 'meta-learning' by social psychologists. I conclude by summarising the contribution this kind of reflection might play in positively developing children's identities as mathematicians and in learning about themselves as mathematicians, linking this to arguments related to identity made in the previous two chapters.

In keeping with many others I am of the view that mathematical learning requires children to make connections (Gifford 2008) and this would seem to involve an element of reflection over and above activity and experience (Flavell 1979, Mason J H 1982, 2002, 2008a 2008b, Mason and Davis 1987, Gravemeijer 1994, Freudenthal 2002, Goswami and Bryant 2007). Metacognition broadly encompasses an awareness of one's own thinking and learning strategies 'thinking about thinking' and has been categorized into declarative knowledge and observable skills (Flavell 1976). Whitebread et al's (2007) observations found children between the ages of 3-5 exhibiting behaviour that indicate that they were engaging in reflection and self-regulation whilst playing. Later research involving the use of video (Tanner and Jones 2007, Griffiths 2011, Tanner et al 2011) also found evidence of metacognitive statements made by children as they viewed videos of themselves working.

As described in Chapter Two, I planned from the outset to use video clips of role play to check, or 'triangulate', the observations and analyses I was making whilst observing children role-playing. On the first occasion I used such an excerpt with one group of Year Four children, not only did the children comment on the mathematics that they were engaged in, but they also made reflective statements about their learning more generally. This prompted me to consider the role that reflection and metacognition might play in my study and led to the 're-view' interviews playing a more important part in my data collection and analysis than I had initially anticipated.

As previously, data presented here as verbatim extracts from transcriptions of video or audio recordings, fieldwork notes or diaries is clearly indicated, headlined and dated, with extracts from observations numbered consecutively through the chapter separately as Reception and Year Four extracts.

The purpose of this chapter is to establish whether or not the children were able to reflect on the mathematics they had learned and whether they understood the nature of the mathematics involved in their role play. This chapter also explores the roles reflection and metacognition play in learning mathematics and learning about oneself as a mathematician.

6.1 RE-VIEWING VIDEOS OF ROLE PLAY: VISUAL RE-PROPOSAL

In this section I examine the origins of what I began to call 'Visual Re-proposal (VRP) as a prelude to presenting data and analysing what happened when I used this approach with Reception and Year Four children.

I was already aware of the power of children viewing video of themselves working. Whilst involved in a research project during 2009-2010 (Williams 2010) I used videos I had taken of role play with children and school staff in order to demonstrate where there was some mathematics happening and to encourage discussion about mathematics. As did Griffiths (2011) I found that viewing videos of themselves and others was very popular with the children, prompting much talk about what they had been doing as well as discussions amongst both children and adults about what to do next. This had links to the idea of 're-proposal', an approach used in the Reggio Emilia pre-schools of Northern Italy (Malaguzzi 1993) in which an adult notes, verbatim, an interesting comment they have overheard made by a child, simply repeating this back to them on a later occasion without comment or analysis, the intention being to prompt the child to explore further. The video extracts seemed to have the effect of prompting discussion and analysis amongst groups of both children and colleagues without much comment from myself. I recognised that using video in this way might be useful in establishing whether the children in my study saw themselves as learning or engaging in mathematics during their role play.

‘Visual Re-proposal’ was the name I gave to the use of filmed excerpts in the way described. I selected video extracts from my observations of children’s role play where I identified participants engaged in thinking or talking mathematically. I prepared some open-ended questions to use in conjunction with the excerpts to help me delve a little deeper into what the children may have been thinking. The methodological advantages and disadvantages of using video in this way is discussed in Chapter Two. Once the interviews started I became interested in whether the reflective statements the Year Four children made when first interviewed were unusual or were prompted by watching themselves on video. The role of my re-view interviews broadened to encompass the aim of whether the children themselves not only recognised themselves doing mathematics, but whether they were able to reflect on the mathematics they were doing.

In Chapter One (Literature Review) I discuss related approaches to my term, Visual Re-proposal, such as ‘visually stimulated recall’ (Griffiths 2011), ‘video stimulated reflective dialogue’ (Tanner and Jones 2007, Tanner et al 2011) as well as ‘re-proposal’ (Parker 2001) and how the literature views their relevance to learning. Here I analyse my evidence in relation to this research.

As discussed in Chapters Three and Four (4.2) the children in all classes of my study school were accustomed to being encouraged to regularly discuss their learning in all subject areas. Not only were they asked to identify their learning by being asked questions such as, ‘What have we learned here?’ but also to predict the likely mathematical learning when planning their role play. As indicated previously, annual interviews were held with a sample of children from each class reflecting in particular on role play and mathematics (see Appendix Seven for the school questionnaire re-viewing role play). The fact that my re-view interviews took place as part of this broader, reflective context cannot be ignored. As Tanner and Jones (2007) found, reflective abilities are dependent upon the nurturing of these teaching approaches within the classroom thus this chapter must be seen in the context of the wider school ethos and initiatives.

6.2 REFLECTING ON MATHEMATICS

I first used VRP with the Year Four children and so it is their interviews that are analysed initially, followed by the re-view interviews with Reception children.

6.2.1 In Year Four

Immediately following each recording of the role play, I watched and transcribed the two videos recorded, making reflective notes and identifying at least one excerpt from each observation for re-viewing. These excerpts were shown exactly one week later to the relevant role play group. They were also passed to Mrs R for her to use with the class. The process of selecting extracts is discussed in Chapter 3 in summary, I selected extracts where children seemed to be discussing a problem related to the mathematics. I deliberately chose short extracts to replicate something of the spirit of re-proposal (Malaguzzi 1993, Parker 2001) thinking that less to view might encourage deeper discussion and provide less opportunity for distraction. This approach has parallels with ‘freezing the action' during process drama which gives participants the opportunity to reflect (Hendy and Toon 2001, Heathcote and Bolton 1999).

For the first re-view interviews I showed four minutes recorded early on in 'Tide Times', from transcription lines 32 to 73. Most of these four minutes are reproduced as Year Four Extracts One and Two in Chapter Four. (The complete transcript of Observation 1 is reproduced in Appendix Three, i.) I analyse what happened with Group Two on this occasion in some detail here, as it is a typical example of elements of metacognitive talk and is particularly rich in the sense that a large amount of this type of talk and reflection occurred. In analysing the interviews in terms of the children's metacognitive statements, I also make reference to the mathematics the children engaged in whilst playing as well as the mathematics they employed as a result of viewing the video.

After stopping the video, and when prompted by my rather faltering question: "[...] *What did you / what can you remember doing when you were / what do you think was going on in your heads when you were working on that problem?*", the children in Group Two immediately began to comment on what they had been doing. I continued by asking Fleur, seated with her back to the camera holding the clock, "*What were you doing*?"

YEAR FOUR EXTRACT ONE, 07/11/2011

'Tide Times', Group 2, Re-view 1

Total length of recording: 19 minutes, 47 seconds

Children involved: Saul (8y 5m), Sean (8y 6m) and Fleur (9y 1m)

10 HW: *What about your, ummm, were you doing there Fleur, when you had your head in your hands?*

11 Sean: *I think she was...*

12 Saul: *Oh she was holding the clock*

13 Fleur: *Yeah, I was like counting what time it would be 'cos it said 21 and I go like that 'cos it was, 'cos it said 21 something I go / like that with my fingers to know what time*

14 HW: *What were you working out?*

15 Fleur: *'Cos, and like, 'cos Sean said we needed to be back at that time so I was getting the clock ready for that time, so when it ...*

16 HW: *You were trying to find 21 on the clock?*

17 Fleur: *... yeah and I'd go like that*

18 Sean: *Because before we did that we doing our fives round the clock and we were going earlier, and then we realised that it went in fives, so we had to realise that one of those in the middle must have been it, so we had to work out the exact one*

19 HW: *Hmmm. Because 21 / doesn't come when you are counting in fives?*

20 Sean: *No, so we had to really work it out as a group.*

Fleur was setting the analogue clock to read 15:21 and described *how* she was establishing the position of the clock hands at 21 minutes past by counting around the clock face *"... with my fingers*". This has characteristics of a metacognitive statement as Fleur was reflecting not simply on what she is doing, "... *counting what time it would be*", but *how* she was doing this; *"with my fingers",* presumably to keep check on counting in fives to 21. Sean enlarged on Fleur's statement (L18) demonstrating his understanding of analogue time. Watching the task on video and hearing Fleur's comment prompted Sean to describe clearly the mathematics involved in this task hence engaging in some mathematics beyond that in the videoed extract. This is an effective example of re-proposal by visual stimulus as both Fleur (L13) and Sean (L18) were prompted by this video excerpt to analyse the mathematics they were involved in whilst watching themselves play in their floating studio. Sean's unsolicited comment at L20 (analysed in 6.3) was the first where a child made a more general statement about learning.

As I watched this video excerpt with the children I was paying attention to not putting words into their mouths. I focused on keeping my questions open, repeating what the children had said rather than clarifying their statements, in keeping with the re-proposal strategy (Parker 2001) in order that the child, rather than myself, spoke about the mathematics. This was not always successful, as can be seen in lines 16 and 19 in Year Four Extract One, above.

Later in this interview, we watched the same excerpt again. This was a decision taken at the time to see if a second showing would elicit more reflection (Extract Two).

YEAR FOUR EXTRACT TWO, 07/11/2011

'Tide Times', Group 2, Re-view 1

81 HW: [...] *so what's that clock showing there?*

82 Sean: *Fleur was showing me ...*

83 Fleur: *Eight thirty six*

84 Sean: *.... because I was telling Fleur that I am very good at time but on the handed clock it's not as easy as a digital clock for me, I find digital more easy*

85 Fleur: *Yeah*

86 HW: *Do you agree? With that? That's a good point actually, do you agree with?*

87 Saul: *I find the, the ones with the ...*

88 Sean: *So I asked Fleur if she could show me*

89 Saul: *... not like Sean, like on the digital clock it's quite hard to tell, because there's like one number in one space and then another number in the other space, so basically, I only know like the o'clocks, because it's like simple on a digital clock. Because like all of the other times are really hard because they, like, show numbers that, like 15, like I sometimes think like, 15 isn't on a real clock!*

90 Fleur: *Yes ...*

91 Saul: *So it's confusing*

92 Fleur: *... yes, when you get past the 12 on the digital it goes like 13,14,15 so if it's 15 you take away 2 and that makes 3 'cos it's 3 o'clock, that's how I work it out.*

Viewing the video for a second time prompted Sean to reveal what he found difficult about telling the time and to reflect more generally on his knowledge. This appeared to induce others to do the same (L89, L92). Later in the interview (L129) Sean converted 15:21 to "just after 3 o'clock" by counting on from 13 as one o'clock. My fieldnotes at the time stated; "*Sean* [is] *using 24 hour clock - hasn't done this before.*" (Fieldnotes made on transcribing the recording; 8/11/11). Saul (L89) was clear about what he found difficult about digital clocks - it involves numbers that do not appear on an analogue clock. His statement triggered Fleur's clear explanation of her method of converting 24-hour clock to analogue time (L92).

This was my first example of VRP taking the mathematics further than the mathematics evidenced whilst the children were role playing. This became something I noticed on subsequent occasions and I began to consider what were the particular actions or circumstances that might contribute to this happening or not.

As the re-view interview continued, the three children surprised me as they went on to attempt to calculate the time difference between 08:36 and 15:21. A complex mental calculation as it is in base twelve (Extract Three).

YEAR FOUR EXTRACT THREE, 07/11/2011

'Tide Times', Group 2, Re-view 1

140 Sean: *As you were saying, that was the difference between those, I can tell the hour difference* [pause, thinks] *it's a seven hour difference*

141 HW: *Seven hours between, when you are at sea?*

142: Sean: *Or six, I'm not sure which*

143: HW: *Six or seven hours, that's a good estimate! I think that feels about right*

144: Fleur: *Seven hours, seven hours and twelve minutes*

145: HW: *Fleur is agreeing with you*

146: Sean: *I just leave the minutes between, but I know the hours.*

Here Sean made a good estimate of six or seven whole hours between 08:36 and 15:21 (a duration of six hours and 45 minutes which I used pencil and paper to calculate). Fleur (L144) was precise but incorrect; I cannot be sure how she reached her total, perhaps unsurprisingly making an error mentally calculating the difference between 36 minutes past and 21 minutes past.

This is a typical excerpt from this re-view interview with children discussing a particular piece of mathematics in some detail and not only recognising the mathematics involved in the role play but also, they were able to reflect on their understandings of the mathematics. Moreover, viewing the video excerpt of themselves tackling the mathematics stimulated them to engage in yet more mathematics. These three features of the children's responses are observable in every interview with the Year Four children, except my first interview with Group One. The three features are:

- recognition of the mathematics;
- higher order statements indicating they were reflecting on their understandings of the mathematics and,
- engagement in additional mathematics.

The first two of my three features are similar to those identified by Tanner and Jones (2007) when using video to stimulate pupil talk about learning in Key Stages 1, 2 and 3. The authors categorised pupils' responses into: *affective* comments, *recall* of lesson, *description of intended learning* and *metacognitive* comments about their learning (Tanner and Jones 2007). My third feature is additional to these. My finding that discussing video might be a useful way to not only *reflect upon*, but also to *engage in* related mathematics at a higher level, is significant. It has implications for my key argument, that one particular classroom condition positively affecting mathematical learning through role play is providing the opportunity to reflect on such play in this way. Despite the fact there was a lot to comment on when re-viewing the video of their play that was not mathematical (such as how someone was behaving or the social features of the situation) it was nevertheless possible to steer the children's attention onto the mathematics in a way that was over and above what was evident in the original scenario.

The following extract is an example of this third feature (engagement in additional mathematics) and is taken from the second re-view interview with Group One as we viewed an excerpt from my second observation, 'Fish Patterns' (see Chapter Four, Extract Six and 4.1 for an explanation of the task). As we watch the group try and calculate the amount of fish in a pattern the following took place.

YEAR FOUR EXTRACT FOUR, 22/11/2011

'Fish Patterns', Group 1 Re-view 2

Total length of recording: 23 minutes, 34 seconds

Children involved: Ellen (8y 7m), Cam (8y 9m), Callum (8y 3m) and Nancy (8y 3m)

73 Cam: *11 times 15 is /*

Callum making noises.

74 Cam: *Is 26*

75 Callum: *26? No it is not!*

76 Nancy (?): *Oh my God!*

All laugh [...]

77 HW: [to Callum] *Why did you say that? It's way off, is it?*

78 Callum: *It's not. Way off, way off!*

Children giggling.

79 Cam: *OK, is it 12?*

80 Callum: *No! Hardly [...] 11 times 11, right*

81 Cam: *Is 21, no 22, I mean*

82 Callum: *No!*

83 Nancy: *That's 11 add 11 is 21*

84 Cam: *Oh yeah, yeah. Times*.

This observation was not rich in terms of role play (Chapter Five discusses this in more detail) however, watching it stimulated some interesting mathematics. In the extract, Ellen appeared to think that 11 x 15 was a multiplication fact she should know by heart as was heard saying on video: "*Agh, I should have learned this before!*". Cam then attempted to calculate 11 x 15, revealing his confusion over multiplication and addition. He was not put off by the laughter and persisted in trying to calculate 11 x 15 during this interview, suggesting he felt this to be a safe place for discussing mistakes. The calculation was not answered but both Callum (L80) and Nancy (L83) correctly identified Cam's mistake.

These re-view interviews provided some additional evidence of the types of adult intervention that might influence mathematical learning. In Chapter Two I outlined how I chose to structure my re-view interviews in order to encourage children's reflections. When planning my second set of interviews, I analysed the initial interviews and listed what seemed to be the more effective responses for drawing out the reflective replies that I was interested in. The questions listed for my second interviews were:

"What do you notice/ what can we see?

What is happening?

What is going on inside your head?

How is learning taking place?

What maths learning is taking place? How do you know?

In which bits are you being really clever?"

Fieldwork diary entry, 7/11/2011

After the second set of interviews, alongside an instruction to myself to "*Be quiet!*" I added the following questions:

"Can you say a bit more about ...?

I'm not going to say anything now, because I want you to.

Can you identify something you didn't know before?

Think about the maths for a minute ...

What do you like (about it)?"

Fieldwork diary entry, 29/11/2011

I drew from these questions in further re-view interviews. In the moment, however, it never stopped being difficult for me to stay open, to hear what was being said and to remember not to evaluate comments but instead to invite children to "say a little more". Year Four Extract Five is one example, taken from earlier in the same re-view interview as the previous extract.

YEAR FOUR EXTRACT FIVE, 22/11/2011

'Fish Patterns', Group 1 Re-view 2

24: Nancy: *But when we get back to, when we got back to the carpet and Mrs R said, well, we had a look through ours on the big screen and you know / I said it needs to be a repeating pattern / well just there, well then she said it doesn't need to be a repeating pattern, it just like one pattern because* [trails off]

25 HW: *Ah*

26 Nancy: *I kind of made a mistake there*

27 HW: *Oh, did you? Oh, OK / OK*

28 Nancy: [...] *and Mrs R said it didn't need to be actually repeating, just like a pattern*

29 HW: *Like a pattern with the fish?*

30 Nancy: *Yeah.*

At L29 I clarified Nancy's comment. Evidence of more successful discussions indicates that if I had said to Nancy: "*Can you say a little more about that?"* she might have revealed more about what she understood or misunderstood. As well as being an important research issue this is an interesting teaching issue where research illuminates some teaching practice. The ability to spot, and then remember to make use of a good question, is a skill central to both researching and teaching (and many questions are useful for both). Where there is little evidence of reflective statements from children (notably in my initial re-view interview with Group 1) it appeared to be due to me either, not drawing the children's attention back to the mathematics or, as is more often the case, my questions relating directly to what is happening rather than being more reflective and general. If I responded in a way that invited them to say more and said little myself, it was more likely that they would find the space for reflection. My Year Four evidence seems to indicate that these children were capable of reflecting on their mathematical learning when stimulated to do so by watching themselves working at some mathematics *and* if challenged to work at this level. This was dependent upon the nature of my intervention.

Occasionally my invitations to say more resulted in refusal or denial with children saying that they could not hear what is being said, or that they did not remember. For example, Callum (Group 1, Observation 2 Re-view interview, 22/11/2011) who chose to remain silent despite the other members of the group stating that they could remember what he was doing. It might have been Callum's relatively new arrival in the class that influenced his lack of willingness or ability to answer my questions. Children need to develop a language to talk about their learning and the confidence to do so, and this is dependent upon the nurturing of such approaches within the classroom (Tanner and Jones 2007).

Perhaps re-viewing video of themselves engaged in *any* mathematical task would elicit similar types of response (Griffiths 2011). Re-viewing role play in particular requires further research, however I make the tentative assertion from my evidence that children re-viewing role play might be particularly useful for the following reasons. Firstly, as role play is a performance, it is watchable and children are keen to observe themselves and others engaging in it. Secondly, as a performance of some 'pretend' mathematics, participants might be less concerned about seeing themselves making mistakes (see Chapter Five (5.2.2)). It might be the case that it is less embarrassing seeing and discussing a *character* doing and struggling with some mathematics, rather than themselves. Perhaps the feeling that this is not 'real' makes it more possible for them to examine their misunderstandings with comfort. Thirdly, for VRP re-views to be effective, it is important that children feel comfortable talking about their mathematics without fear of ridicule and embarrassment. If participants feel comfortable and in control of their role play mathematics, re-viewing this might be more likely to draw out children's honest explanations of how they were working.

There was some evidence that children were not always initially keen for the video to be more generally viewed. For example, at the end of the first re-view interview with Group Two, I said that Mrs R was likely to show the class the same clip to talk about the mathematics that was going on. Sean said: *"Oh! I'm not going to be so happy."* And*, "I'm going to make sure I'm going to be ill that day!"* and Fleur: "*It's really embarrassing*!" I asked if they would like me to ask Mrs R not to show the clip. Sean replied, and the others agreed, that he did not mind it being viewed as long as everyone knew the group felt a little uncomfortable about the class viewing this. Something similar occurred with Group One, who all exclaimed "No!" to the class viewing the 'Fish Patterns' excerpt (analysed above) but then the following took place (Extract Six).

YEAR FOUR EXTRACT SIX, 22/11/2011

'Fish patterns', Group 1 Re-view 2

186 HW: [Mrs R has] *chosen it because it's good*

187 Children: *Oh, OK. Errr, yes, OK*

188 Ellen: *I think we should, because in some of the other bits we're messing around a bit.*

Although initially embarrassed, once told that the clip was demonstrating 'good' mathematics, the children did not seem to mind and Ellen reasoned it might be the best clip in terms of behaviour. It thus seems critical that videoed episodes are carefully chosen for reflective dialogue where positive discussions can take place.

Not all the Year Four children's comments during the re-view interviews were positive about their mathematics experiences in the role play and, on one occasion, re-viewing the video triggered discussion about what was occupying them socially. For example, when I asked in the final re-view interview with Group One (Re-view interview of the 'French Café', 06/03/2012) what they found hard and what they found easy about mathematics in the role play, Callum said that it was difficult to concentrate sometimes due to the noise and interruptions and he only believed role play was helping his mathematics learning "*a bit*". It is of note that Callum had joined the school within that academic year and had not had previous experience of mathematical role play hence it is likely to take time for Callum to recognise and appreciate its relevance.

The final re-view interview with the two boys in Group Two (Sean and Saul) was unusually negative and consisted almost entirely of a complaint about the group dynamic "*ruining*" both the boys' enjoyment and their ability to tackle tasks "*their way*" - proof that collaboration is difficult. Both boys saw the solution to this problem as themselves talking to Mrs R and persuading her to change the membership of the group, which later happened and the group membership changed.

I was interested to see whether the Reception class children would be able to recognise their role play as mathematical and whether they could be visually stimulated in a similar way to reflect on their mathematics by using Visual Re-proposal.

6.2.2 In Reception

As discussed in Chapter One, research has found evidence of young children exhibiting metacognitive behaviours (Whitebread et al 2007, Tanner and Jones 2007, 2011). Tanner and Jones (2007) distinguish between metacognitive *skills* such as implicit self-regulation of behaviour; and metacognitive, stateable *knowledge* of one's thinking processes, arguing the latter ability does not usually emerge until children are older. They found responses amongst their 5 - 7 year olds were largely affective and involved recall (Tanner and Jones 2007, 2011).

> *"... pupils were often not aware of how or what they had learned and struggled to describe their thinking."*
>
> (Tanner and Jones 2007:4)

This subsection explores whether or not the four and five year-old children in my study displayed any evidence of being able to recognise and reflect upon their mathematical learning by re-viewing video of themselves engaged in role play, and whether they displayed any evidence of either metacognitive skills or abilities of the sort described by Tanner and Jones (2007, 2011).

My investigation into the Reception children's ability to reflect on their mathematics was similar to that undertaken in Year Four in that I analysed and transcribed each videoed role play observation in turn, selecting what I felt were significant mathematical moments to share with the children. On the first occasion

I used a video extract for re-view, I showed the 'Dinosaur Café' video, 'Are you full up now?' on the interactive whiteboard to the whole class on the carpet, one week after it was recorded. The 'Dinosaur Café' extract used is analysed in Chapter 4, section 4.1.1. (It is reproduced in its entirety in Appendix Three, v). This was a trial run at the idea of holding some re-view interviews with pairs or small groups of children. On this occasion I deliberately had not prepared any questions as I wanted to see if the children made any unsolicited comments in the sense of re-proposal (Parker 2001). Miss H and I had agreed that we would show the clip without introduction and leave a silence after watching it. Miss H introduced the video by saying: "*Mrs Williams has got a little video to show you* [...] *let's have a look*." I filmed the class as they watched the clip. Luke (5y 2m) and Lucy (5y 1m) who appeared in the video were seated immediately in front of the whiteboard next to Jon (4y 11m), with Oliver (4y 7m), Jemima (5y 1m) and Mark (4y 11m) just behind them. Ingrid (5y 1m) was near the front, off-camera. This first occasion of VRP lasted 14 minutes and only in the final few minutes did children's attention waver. As soon as the video started, all watched intently, enthusiastically calling out children's names as they recognised them on screen. Luke immediately smiled and started miming eating food greedily, turning to face the class as he re-enacted his dinosaur role. After a little over two minutes, on hearing the sticks being tapped together, Extract One took place.

RECEPTION EXTRACT ONE, 13/03/2012

Class re-view of Dinosaur café video 'Are you full up now?' (1)

Luke: *I'm waiting [...]. / It counts by itself. It went 1,2,3,4,5,6*

Ingrid: *I knew it was six 'cos I was counting in my head.*

On viewing the videoed role play, Luke recognised counting, and Ingrid (not a participant in the original play) described how she worked out that she heard six taps. Ingrid articulated some mathematics as a result of viewing the video and without prompting. Here Luke used both “I” and “it” in the same sentence. It is not clear whether “it” referred to the dinosaur, as someone other than himself, or to the sticks ‘counting’. Luke and Ingrid were not talking to each other but both comments were made as a response to what they saw happening in the video, although Luke’s reflection upon *how* the counting was happening might have provoked Ingrid’s statement. Both children seem to be exhibiting *stateable metacognitive knowledge* rather than simply metacognitive skills (Tanner and Jones 2007). Ingrid, for example, has conscious awareness of *how* she counted an amount – in her head, or silently.

One minute after this, Jon raised his left forefinger and ‘wagged’ this as he mouthed counting “1,2,3” just after hearing the sticks being struck. He then turned to Luke with two thumbs held in the air (speech unheard). Oliver was watching him (Extract Two).

RECEPTION EXTRACT TWO, 13/03/2012

Class re-view of Dinosaur café video ‘Are you full up now?’ (2)

Jemima: *Luke, did you say six*?

Oliver: [to Luke and Jon] *Six is* [holding up right hand, five fingers outstretched as well as finger and thumb on left hand*], six is like that ...*

He corrects left hand to one thumb, now holding up a total of six fingers.

Oliver: *... and then seven is like this* [adds one finger to his left hand to hold up seven fingers].

Mark: *Seven and six, six and seven* [...]

Lucy: [watching the screen and counting the taps] *Five, that was five.*

A few minutes later Oliver leans across Mark and says [to Jacob]: "*Two and Two are four. / What do three and five make*?"

Jemima's use of the word "*say*" is interesting, as Luke the Dinosaur did not *say* anything. What is particularly noteworthy about this extract in terms of reflection and metacognition is that all three features identified from the Year Four re-view interviews also seem to be discernible here: children *recognising* some mathematics, *reflecting* on their understandings of the mathematics and *engaging in additional* mathematics. Although the Reception children did not make direct statements such as, "here I am doing some counting", both their actions and comments demonstrate that they recognised what they were seeing as counting. Moreoever, watching the video encouraged Oliver (who was not present in the role play video) to engage in some mathematics beyond that on the screen: using numbers in the abstract to calculate within ten which is recognised as challenging for an under five-year-old (Secada et al 1983, Hughes 1986, Suggate et al 1997, Thompson 2008, Nunes et al 2009, Sarama and Clements 2009).

It was not until I watched the video of the class re-viewing the 'Dinosaur Café' video that I noticed these children's responses. I had to replay this video several times to unpick what was said and what was happening. It was difficult to see these at the time and neither I, nor the teacher, were sure if anything had happened of note. It can be difficult to notice details in the moment (for adults as well as children) and my re-viewing of the video stimulated my reflection on what I was noticing in a similar way to how this worked with the children.

In the summer term, after trialling another whole class re-view, I had evidence of metacognitive statements made by the Reception children, some of which related to mathematics and some not. The interest of the children and the reflective quality of their responses to watching video excerpts encouraged me to try paired re-view interviews with the Reception children in a similar way to those in Year Four.

After recording the 'Faster than Usain Bolt' scenario, I selected extracts where there seemed to be some observable mathematical discussion taking place, often including some mathematical recording. As van Oers (2010) found, providing opportunities for children to record their mathematics encourages them to communicate mathematically using symbols, hence I surmised that seeing some written recording might help children to recognise and talk about the mathematics. Reflecting on the interviews with the Year Four children, I listed the following questions to draw upon in the Reception pairs re-view interviews:

Can you say a bit more about ...?

I'm still thinking about ...

What maths were you doing?

What are you thinking about?

In which bits are you being really clever?

What can you teach me about...?

Make me learn ...

How do you know ...?

What do you *think (name)?*

‘What can you teach me about...?’ and ‘Make me learn’ came from a discussion with Miss H where we had discussed asking the children to role play ‘being a teacher’.

The day after completing three consecutive mornings filming the ‘Faster than Usain Bolt’ scenario, I selected pairs of children who had been engaged in this task. Before the interview I asked each child if they would like to come out of the classroom with me to watch the video and answer some questions. All assented. The summer half-term holiday began the following day and thus I only interviewed three pairs of children, Elliot (4y 11m) and Mark (5y 1m); Rachel (5y 7m) and Sabina (5y 0m); and, Olivia (4y 10m) and Ed (5y 5m). I video- or audio-recorded each interview (each lasting around 10 minutes) and then transcribed the recordings.

As had happened previously with the whole class re-views, watching the videos and responding to my questions elicited reflective responses from all the pairs of children. In every interview, when asked what they were doing, learning about or thinking, children made statements that recalled their involvement: Elliot was typical (Extract Three).

RECEPTION EXTRACT THREE, 31/05/2012

‘Faster than Usain Bolt’ Re-view interview with Elliot (4y 11m) and Mark (5y 1m)

HW: *Let’s see if you write on* [the scoreboard] *again / yes! There you are again, Elliot / Look, look look! / So what were you thinking about there? / What were you thinking about there, Elliot?*

Elliot: *Writing my score down*

HW: *Can you remember what was happening with your scores?*

Elliot: *Errr, going really fast.*

When asked what he could remember, Elliot answered that he was "*going really fast*" which did not relate directly to the clip we were re-viewing which was of Elliot recording his time on the scoreboard. A few minutes later I repeated the question "What were you thinking about?" and Mark answered (Extract Four).

RECEPTION EXTRACT FOUR, 31/05/2012

'Faster than Usain Bolt' Re-view interview with Elliot (4y 11m) and Mark (5y 1m)

HW: *So, can you remember what you were thinking about with your scores? What were you thinking about? /*

Mark: *Err, we was / if you get faster you'll get a bigger number /*

HW: *If you get faster you'll get a bigger number? Can you tell me a bit more about that?*

Mark: *If you get slower you'll get a bigger number. If you go faster you'll get a <u>smaller</u> number*

HW: *Ahhh*!

Elliot: *And if you go <u>really</u> fast you will get a zero!* (waves arms in circular movement)

Mark: *No you won't Elliot!* (They both smile).

This is a good example of re-proposal (Parker 2001) operating successfully, as I deliberately repeated Mark's (incorrect) statement, word-for-word, without comment, which he then self-corrected. Mark lucidly described the mathematics he had learned whilst timing the racing. This is despite the fact I had not observed him using a stopwatch. This is complex mathematics that five-year-olds would not be expected to understand: that a larger number on the stopwatch indicates a slower time and it is the smaller number that is 'best'. Elliot followed Mark's statement with what appears to be a number joke (Gifford 2005): "*And if you go really fast you will get a zero!".* In the following extract (Extract Five) I asked Elliot to 'teach me about' the idea of zero seconds.

RECEPTION EXTRACT FIVE, 31/05/2012

'Faster than Usain Bolt' Re-view interview with Elliot (4y 11m) and Mark (5y 1m)

HW: *So teach me about that Elliot, teach me about that*

Elliot: *If you went really fast you will get zero!* ('writes' a zero in the air with his finger)

HW: *Help us learn about that, how would that work?*

Elliot: *If you move your arms go really fast, umm ...*

Mark: *No*

Elliot: *... you will get zero* (writes a big zero in the air with his finger)

Mark: *No! How would you get zero, you're not running! / If you get zero* (both boys laugh).

Elliot pursued the relationship between time and speed to its logical conclusion, enjoying the inverse relationship between moving very quickly and achieving something smaller and smaller, generalising from this one particular occasion to the making of his general statement, "*And if you go really fast you will get a zero!"* Mark recognised the 'nonsense' of Elliot's statement and was clear that zero seconds is not an option when racing. His statement: "*If you get slower you'll get a bigger number*. *If you go faster you'll get a smaller number",* is an example of *metacognitive, stateable knowledge* (Tanner and Jones 2007). These boys had not engaged in this level of mathematics until they viewed the video of themselves and were provoked to do so by our re-view of the video. 'Zero seconds' became a number joke (Gifford 2005) within this class, children enjoying the mathematical logicality alongside the practical impossibility. However, maybe in this pretend scenario such an event might be a possibility if you moved your arms fast enough.

In Sabina and Rachel's re-view interview later that day, Rachel was also coherent about the mathematics she had learned. (The extract used for this interview is discussed in Chapter Four, 4.2.3, Reception Extract Eleven):

> Rachel: (immediately) *The time, the time and when it stops you know what the time is how much you did it, so like, if you got the smaller number than Usain Bolt, that means you're faster than Usain Bolt and if you're, and if / there's a bigger number that means / you haven't beat Usain, that means it's a bigger number.*

Rachel's is a clear example of a Reception child being aware of, reflecting upon and explaining explicitly the mathematics she has been involved in: it is *metacognitive, stateable knowledge* (Tanner and Jones 2007). Neither Mark, Elliot nor Rachel struggled to describe their thinking and this would appear to contradict findings that pupils under the age of seven were often unable to describe what they had learned (Tanner and Jones 2007). The key was that the children had a shared 'other' focus (the video) on which to hang their thinking.

In my last re-view interview, Ed and Olivia watched themselves involved in the long jump where 'athletes' jumped as far as possible alongside a large floor number line and recorded the number that they landed on. Reception Extract Six took place at end of the interview.

RECEPTION EXTRACT SIX, 31/05/2012

'Faster than Usain Bolt' Re-View interview with Ed (5y 5m) and Olivia (5y 6m)

Ed: There's me. There's me, that's me. I can tell. I had a lovely time writing and drawing and writing my own down

HW: *You did? What did you like about doing that?*

Ed: *I liked doing that because it is fun*

HW: *What's fun about it?*

Ed: *It's fun 'cos it's fun, I don't know why it's fun*

HW: *Do you realise what you are doing there, you're doing lots of maths there*

Ed: *Yeah*

HW: *Do you know what maths you're doing there?*

Ed: [immediately] *Jumping maths.*

The initial comment from Ed is typical of Tanner and Jones' (2007) findings in that he was able to recall what he had done and his reflective statement was an affective response to jumping and recording his scores. Ed specifically identified "*drawing and writing **my own** down*" as something he enjoyed, indicating that personal control over participating and scoring played a part in that pleasure. In the notes made when transcribing this interview, I wrote:

> "*What is this 'jumping maths'? What does this mean? No-one has said 'today we're going to do jumping maths', so this is Ed's interpretation."*
>
> **Fieldwork diary entry, 31/05/2013**

Unpicking what Ed might mean, he had already said he enjoyed recording his long jump score and here he pinpointed the active part as enjoyable. He also associated this jumping with mathematics. Although Olivia and Ed could recall and describe what they had done the previous few days, neither of them were able to describe what they had *learned*.

In summary

I began by using recorded videos as a basis for my interviews with children as a triangulation strategy. Once I began the re-view interviews it became immediately obvious that visually stimulated reflection using videos of role play, or Visual Re-proposal, could lead to insightful comments from the Year Four children interviewed. Re-view interviews with both Year Four and Reception children stimulated *recognition* of mathematics as well as some *reflection* on mathematics. Some re-views also engaged participants in thinking further about some mathematics at a *higher level of generality and abstraction*. Some of the children's statements demonstrated metacognitive knowledge as defined by Flavell (1976) which is unusual for Reception age children, and some examples seemed to go beyond young children's reflective awareness identified in previous research (Whitebread et al 2007, Tanner and Jones, 2007, Tanner et al 2011).

When I watched the video of the class re-view of 'Are you full up now?' I was released from my real-time involvement so that I was able to reflect upon and analyse what was going on. VRP might work in a similar way when children re-view themselves engaged in role playing some mathematics. By not being able to change what happened, the video provided the space and time for the children to engage with what happened on a different, reflective level. If metacognitive experiences are seen as critical for learning and can be activated by cues (Flavell 1979) then VRP appears to be a useful cue.

Rather than *can* young children engage in metacognition as a result of re-viewing role play video, one further area of research would seem to be which actions and circumstances aid such reflection and, furthermore, which actions and circumstances aid young children's developing awareness of metacognitive knowledge and associated language? The particular *actions* that contributed to children making insightful comments seemed to be the joint viewing of short video clips where children discussed or disagreed about some mathematics along with my use of 'door-opening' questions encouraging children to say more. Similar levels of reflection might occur viewing episodes of mathematics other than role play (Griffiths 2011) but as it is 'pretend', viewing role play might aid such discussions. Moreover, the ethos of these two classroom as well as the wider school culture and the value given to role play (see Chapter Five) is likely to have contributed to the possibility of insightful reflections taking place.

Quite early on when interviewing the Year Four children I was able to distinguish between statements about the mathematics and broader reflective statements about learning in general – what could be termed meta-learning statements. An examination of these responses follows.

6.3 Reflecting on learning

This section examines evidence of a higher level of metacognitive statement about learning in general, or 'meta-learning'. The term meta-learning is used within social psychology to describe the process of being aware and taking control of one's learning. I begin by examining my Reception data and go on to look at the Year Four data. Not surprisingly, and in keeping with other research (Tanner and Jones 2007, Tanner et al 2011) it was the older children who were more able to identify what they thought was effective in helping them learn generally. However, one Reception pupil surprised me with his unsolicited comments on his learning, indicating that such comments although unusual, are not completely out of reach for this age group:

Jon (4y 11m), spontaneous comment to HW, 20/03/2012

Jon: *I just learned 3 add 3 makes 6 in my head*

HW: *How did you do that?*

Jon: *Well, I just went 123, 456. Now I've just got it in my head. / Actually in my head there's something called neurons and they look like tiny little aliens* *in space. A horse is big but its brain is only this size* (indicates small size with hands), *actually a horse's brain is as big as a rat's brain*.

This was recorded in my fieldwork notebook one week after we had re-viewed the 'Dinosaur Café' video as a class. It was spontaneous and unrelated to anything else that was overtly taking place in the classroom at the time, in the way statements often can be in Reception classes. Here Jon was clear that he could recall a mathematical fact without working it out each time (going on to explain the mechanics of a brain!). Two months later, a Teaching Assistant (Mrs J) commented on her surprise that Jon had spent two mornings involved in researching and making flags for the 'Olympic training village', wondering what had attracted him to this. I suggested she asked him what it was he enjoyed so much. She recorded his response:

Jon (5y 1m): *I liked everything about it. I'd like to do another one*

Mrs J: *What part of it do you like the best?*

Jon: *You do know that when you can do something really well, you want to do it more.*

Fieldwork diary entry, 30/05/2012

On this occasion Jon was explicit about his awareness that success and satisfaction are critical parts of his, and others, motivation. This statement from a five year-old, a clear reflection on learning generally, was unusual. Not many children of this age would be able to respond at this level and had Jon not been questioned further, his metacognitive statement would be unlikely to have happened, indicating that children will not work at this level unless probing questions are asked.

Other Reception children, whilst able to indicate they enjoyed doing something (affective statements) were not able to be explicit about how this might affect their learning. This finding is not surprising and reflects Tanner et al's (2007, 2011) 'precursors' to metacognition in Key Stage One pupils, for example, beginning to show an ability to pause and reflect on performance.

Examination of the Year Four data revealed several examples of children reflecting on learning and how they learn mathematics more generally as a result of watching themselves role playing a mathematical task. Transcripts from role play Group Two were particularly rich. In the first re-view interview ('Tide times') Sean volunteered that he saw working as a group as valuable for learning on two occasions: "*... so we had to really work it out as a group*" (see Extract One, 6.2.1). The following extract is particularly potent in statements about learning and is taken from the same interview. It demonstrates that these children, particularly on this occasion, were stimulated to voice their awareness of the usefulness of mistakes, correction, practice, memory and repetition in learning (Extract Seven).

YEAR FOUR EXTRACT SEVEN, 07/11/2011

Group 2, Observation 1 Re-view interview with Sean (8y 6m), Saul (8y 5m) and Fleur (9y 1m)

29 Sean: *So we really had to work as a group like we were doing. And it's very important that if you do get it wrong, then you're not gonna, then you learn don't you ...*

30 HW: *Hmmm*

31 Sean: *... what to do next time*

32 Saul: *Yeah*

33 HW: *Hmmm. Yeah, I think mistakes are quite good sometimes, aren't they?*

34 Sean: *They are but if you make them very often*

HW laughs.

35 Saul: *They are better than knowing the answer, because like, something new you can remember and something old you sometimes forget it*

36 HW: *Hmmm*

37 Sean: *But you need to go over it, like in piano, you have to go over things that you can't remember...*

38 HW: *Hmm*

39 Sean: *... so you don't, so you don't forget it...*

40 HW: *Hmmm*

41 Sean: *... so if you have to do it again, you are stuck aren't you!*

[...]

47 Saul: *It's quite good to do it again, and you can't, and you can like do the stuff you, like, mistaked* (sic)

48 Sean: *Yeah, it's a lot better if you don't make a mistake the second time, so then you learn something from the first time.*

Working as a group and the making of mistakes, as well as repeating tasks in order to improve attainment, were explicitly mentioned here by the children as useful in helping them learn. Tanner et al (2007) found that whilst such statements made by their Key Stage Two children were often derivative, in the sense that they were echoing what they had heard adults say, they were applied appropriately thus indicating internalisation. Mrs R showed the class the excerpt of Fleur, Sean and Saul setting the clock to the times to put to sea (Year Four Extract One, Chapter Four) and asked them to identify "*any good learning*" they saw taking place. The following comments were made by children who had also engaged in the task in their role play groups but who did not appear in the excerpt shown by Mrs R:

Question: What good learning did you see taking place?

Girl 1: *Working like a proper group and listening to each other*

Boy 1: *All had different opinions, talking to each other*

Boy 2: *Asking questions to find out if they were right*

Girl 2: *Figuring out by talking to each other*

Boy 3: *Discussing things*

Girl 3: *All had ideas, working as a team without a boss telling them what to do.*

Fieldwork diary entry, 07/11/2011

The children's statements, recorded in writing at the time by Mrs R who used this video excerpt as a focus for class reflection on mathematics, reveal evidence of the children's developing abilities to identify and articulate effective learnings strategies. At the same time they demonstrate that the children were internalising the school's view of the importance of talk in learning. This is unsurprising as Mrs R was often heard inviting a group to: "Do a lot of talking about this." The children's comments, such as; 'team without a boss', 'all having ideas' along with the use of words such as 'discussing' and 'listening' and ideas such as asking questions rather than speaking are indications that these Year Four children view mathematics learning as co-constructing knowledge, with themselves as members of a community of learners (Wenger 1998, Lave and Wenger 1991), as discussed in Chapter Four, 4.2. Similarly, Tanner et al (2007) found that pupils not only liked learning from their friends but also recognised the value of discussion and disagreement in the learning process. These comments correspond to those made by children across the school when interviewed annually about how they saw role play in relation to their mathematics learning, in that these too, consistently identified teaching and learning approaches such as group work and group questioning, discussion, space and time to think and work independently from an adult, as all important in learning mathematics (Appendix Seven contains the school role play questionnaire).

In the third set of re-view interviews, Ellen, a member of role play Group One, referred several times to role play being "*less boring*" and that it was "*easier*" to do the mathematics whilst role playing. When asked to expand on this, she referred to there being more space, as well as:

"*... because when you go in there you sort of feel like you are actually <u>in</u> a café*." (Ellen, re-view interview 4, 'French Café' 06/03/2012).

Ellen might have been suggesting that the 'reality' of the situation made the mathematics not only more engaging but easier to access. However, it might have been the case that the mathematics engaged in was 'easier' than in other mathematics lessons. Evidence from all re-view interviews would seem to suggest that the children did not find the mathematics too easy and they continued to work on the mathematics during the interviews. Moreover, the tasks were complex in that participants were not given many clues about where and how to start, and also the tasks involved reaching a *collaborative resolution*. This resulted in a level of difficulty unlike the more usual classroom mathematics where children may also receive support.

In what follows, when I asked Saul (Group Two) what the 'Pricing Paintings' task (see Chapter Four, Year Four Extracts Eight and Nine) had to do with mathematics, he did not answer 'in case you were in a real situation'. Instead he demonstrated an awareness of the complexity of learning in that this might not take place immediately but after time, and as a result of working in different contexts, all contributing towards some mathematical understanding (Extract Eight).

YEAR FOUR EXTRACT EIGHT, 09/12/2011

Group 2, Observation 3 'Pricing Paintings' Re-view interview with Sean (8y 7m) Saul (8y 6m) and Fleur (9y 2m)

60 Saul: *Ummm / I think that bit wasn't that much maths, but what, we were like preparing for something*

61 HW: *Ah! Can you say a bit more about that?*

62 Saul: *Umm, 'cos when we did that thing, that's when we got involved with a lot of maths, and umm, so we didn't do much maths when we were doing the paintings, 'cos we needed time to, like, figure out what, what you're gonna bid, and um you, but that bit isn't really maths, the other bit is.*

“*The other bit*” that Saul referred to here was the auction of paintings that took place after they were priced. He went on to say:

69 Saul: *Umm, and teachers, we’re doing what they‘re, they normally do, they get, they get all the classroom sorted out before what we’re doing, say we’re doing some maths, they would have to decide what we’ll be doing in maths, and umm, we were deciding like that, but just with paintings.*

When transcribing this re-view interview I was struck by Saul’s comment. What Saul appeared to be saying was that part of what he enjoyed about role play mathematics is that the children did not simply do mathematics set and organised by teachers but that they planned and decided on the mathematics they used along with well how to tackle the task. Once again, the issue of control over their learning was identified as something these pupils took pleasure in.

These findings indicate that the Year Four children in my study had the ability to make spontaneous metacognitive, ‘learning about learning’ statements after viewing videos of themselves role playing and also when questioned and encouraged to explain further what they thought. To conclude this chapter, after summarising my findings relating to reflection, metacognition and learning mathematics and the role that VRP might play in this relationship, I examine the role reflection might play in learning about oneself as a mathematician. This builds on the discussion of children’s mathematical identities in the previous two chapters.

IN CONCLUSION

> "*Metacognition is a "fuzzy" and elusive term that refers loosely to the knowledge and control which individuals have of their own cognitive systems (Brown, 1987). This dual nature includes both (a) the awareness that individuals have of their own knowledge, their strengths and weaknesses and their capabilities and preferences as learners; and (b) their ability to regulate their own actions in the construction of new knowledge (Flavell, 1976; 1987; Campione, 1987)."*
>
> (Tanner and Jones 2007:2)

The purpose of this chapter has been to establish whether or not the children in my study were able to recognise and reflect upon the mathematics they had been involved in whilst role playing. Moreover, it pinpoints some actions that teachers might take to maximise the potential for learning mathematics through role play.

Firstly, my data indicates that VRP, in the form of selected video excerpts of children engaging in mathematical role play, combined with probing questioning that invites further response, is useful for encouraging children in both Reception and Year Four age-groups to reflect consciously on their mathematical knowledge, their strengths, weaknesses and capabilities as learners.

Children were readily able to recognise what they were doing as mathematics and in many cases to identify the mathematics that they were involved in. If, as Tanner and Jones (2011) have suggested that conscious awareness may be required for learners' metacognitive skills to support learning, VRP might be a useful way of raising children's conscious awareness.

My analysis identified three key features that were observed in both year groups: pupils recognising the mathematics, pupils reflecting on their understandings of the mathematics and, pupils engaging in additional and higher levels of mathematics. Moreover, I identified an additional category of response which I classify as reflection on learning more generally, or meta-learning, where pupils were able to identify and explicitly state practices that helped them learn in a more general sense. Meta-learning was not surprisingly found to be uncommon with Reception learners. My Fieldwork notes on transcribing the re-views with Reception pairs (31/05/2012) mentions an additional idea of inviting the child to provide a *commentary* on what they were doing as they watched themselves. This would have been a useful strategy to try but was not possible withing the limits of this study.

In addition, VRP could have the potential to help to extend mathematical knowledge and tackle misunderstandings by providing a visual focus to discuss and explore misconceptions. My evidence points towards children in both age-groups', "*ability to regulate their own actions in the construction of new knowledge"* (Tanner and Jones 2007:2) in that children were observed engaging in constructing mathematics, often at a new and more abstract level, when re-viewing videos.

"*Real life moves too fast*." (Hendy and Toon 2001: 63)

As argued by Robson (2010) reflective dialogues afford opportunities that are not as readily available during the activity itself. VRP might provide the stimulus, the focus and the space for expressions of declarative knowledge and reflection on knowledge and capabilities. Additionally, re-viewing video clips distances the learner from being involved in the action, affording children space to think further and deeper, perhaps providing a necessary element of detachment that helps them learn from a situation in which they have previously been involved.

This chapter has examined the outcomes from my case study children re-viewing and reflecting upon their role play visually, in relation to the following two research questions:

- What particular classroom conditions positively affect mathematics learning through role play? And,
- What adult intervention helps or hinders such mathematical learning?

I am arguing that one 'particular classroom condition' positively affecting mathematical learning through role play involves providing the opportunity to reflect on such play in the way described in this chapter, and that helpful adult intervention is the viewing and discussion of videoed role-play extracts together with the children in a supportive environment. Robson (2010) suggests that different social contexts may have very different impacts on young children's opportunities to display and potentially develop metacognitive skills, significant in this process being children's interactions with their peers and teachers. The interactions observed within these study classrooms lend support to this argument. Metacognitive skills are dependent upon children's language ability, as well as the culture of classroom (Tanner and Jones 2011) the make-up of the group and whether children are used to being asked to work at this level. Cam moved to

Year Four of the study school at the beginning of 2011 and Callum in September 2011, just before my observations took place. Cam and Callum were part of Group One, the group that I had more difficulty with in maintaining participants' focus in the re-view interviews. It is likely that Cam and Callum's unfamiliarity with this level of reflection and discussion influenced their lack of ability to engage. Reflecting is hard, and we might choose to avoid this if possible. What this would seem to indicate is that in order to obtain similar findings, attention would need to be paid to the wider classroom and school culture of reflection and discussion about learning. Video could provide a focus for collective reflection, with those more disposed to and practised at engaging in this way, providing a role model for others.

Moreover, for VRP to be used effectively in tackling misunderstandings, the adult would have to have viewed and analysed the excerpt in order to identify likely mathematical misunderstandings to follow up. Alternatively, maybe there are 'significant mathematical moments' that as teachers we can identify as commonly causing difficulties, such as the giving of change, or telling time. Scenarios set up for children to explore these significant moments could be used as a basis for later discussion. This issue is returned to in Chapter Seven.

All children enjoyed viewing themselves on video and simply seeing themselves engage in mathematics in this way was often enough to prompt unsolicited recall and recognition of the task and sometimes reflection on the mathematics they were doing. Whist re-viewing video of any rich mathematical activity might produce similar results, what may be significant about using video of role play for reflective discussions, is its very complexity, where children collaborate on a mathematics problem independently of an adult 'correcting' mistakes, thereby challenging common views on what it is to learn mathematics,. As discussed in the previous two chapters, role play can provide a safe, fertile site for exposing children's mathematical misconceptions as well as opportunities for what psychology terms 'cognitive dissonance', or the uneasiness experienced when a person holds conflicting ideas or beliefs.

> "*The introduction of the term 'struggle' into the classroom culture played a large part in* [achieving focus on the task in hand] *as the children learned to persist through difficulty, failure and challenge."*
> (Pendlington 2006: 7).

Re-viewing the role play using VRP puts the 'muddle' on display to be discussed, providing an opportunity to sort out what might not have been sorted out whilst the children played in real time. In doing so, it places value on the struggle to make mathematical sense. Children view themselves as coping with, discussing, and resolving complications and this could contribute to their developing sense of themselves as successful, working mathematicians. It is possible that re-viewing role play in this way might give children a new, more positive, identity by putting a collaborative, occasionally competitive, mathematical community on display. The power within a classroom continues to rest with the adults, but nevertheless, teachers' silence, authentic questioning and requests for children's views, plus allowing space for children to sort things out for themselves can alter the relationship of the learners to the learning. In my study school children have been encultured to take some control of the mathematics themselves and this naturally affects my findings, making both role play and VRP more effective as a learning and teaching practice.

What also might make a positive contribution to children's learning is that role play is unpressurised mathematics whereby children's misconceptions are not on display in the same way that they might be in a video of a class or group lesson with an adult in charge. Whilst it is a performance, it is completely opposite to the sort of public humiliation that is often associated with mathematics lessons (Gifford and Latham 2013). Participants can hide behind the role and the scenario and the focus of the discussion is on the scenario and the mathematics rather than on individuals. I believe that what makes re-viewing video of role play (as opposed to other mathematics tasks) particularly productive is that it depicts children doing mathematics that is often problematic. As Askew and Wiliam (1995) summarised, and is encapsulated in the work of Dweck (1999, 2006):

> "*... pupils who view their ability in mathematics as changeable and incremental tend to have, as their goal, increasing their competence. Whether they are confident about their ability or not, they are 'mastery-oriented'.*" (Askew and Wiliam 1995: 28).

Whilst the role reflection plays in learning mathematics is well established, how a child learns about his or herself as a mathematician requires more research. My data seems to indicate that VRP of role play might be useful in promoting discussions of learners and their relationship to mathematics in the way described by Askew and Wiliam (1995) above. My reasons for saying this are as follows. As discussed in Chapters Four and Five, firstly, to form a view of oneself as a mathematician, in other words as someone who 'does mathematics' rather than 'has it done to them', learners have to see themselves as actively engaging in producing mathematics. The comments from the children in both age groups, interviewed after re-viewing themselves role playing, indicate that they saw themselves as actively engaged in producing mathematics, for example, Year Four, Extract One, and Reception Extract Four. It is my argument that not only is a positive self-image important, but seeing yourself as able to engage in mathematics actively is also critical to promoting a positive view of mathematics and oneself as a mathematician. It is when the mathematics is divorced from the learner that problems arise and this fact is well documented in the research (Twomey Fosnot and Dolk 2001a, 2001b, 2002, Nardi and Steward 2003, Askew 2008, Boaler 2000, 2009).

Through the re-view interviews the children communicated strong positive images of their mathematical capabilities. Whilst they might not see themselves as 'clever' or 'the best' at mathematics, they were all observed tackling mathematical tasks with 'gusto' and with little adult support, viewing mathematics as something they can struggle with and yet still gain some success. Mathematics, rather than being an elitist subject 'not for them', was something at which they could all 'have a go', make mistakes and improve. It is worth remembering that the Year Four sample was of a group of children whose mathematical attainment was identified as 'just below average' (see Chapter Two).

CHAPTER SEVEN

SYNTHESIS OF FINDINGS AND CONCLUSIONS TO THE STUDY

Year 2 girl to Year 2 teacher, outside the role play space craft, 20/01/2013:

Erin: *I don’t want to go*

Mrs P: *You don’t want to go where, Erin?*

Erin: *My Mummy won’t want me to go up into space.*

In this chapter, I present the findings and conclusions in order to address my five research questions (7.1). I consider the implications of this study for teaching and for future study and research (7.2). Section 7.3 outlines the limitations of the study before my final concluding statement of the implications of role play for children’s mathematics learning in relation to the current educational climate.

This study set out to examine one problem evident in the research literature that, despite research evidence that all children have the capacity to act mathematically (Hughes 1981, 1986, Munn 1997, 2008, Sfard 2011) school mathematical play provision does not result in mathematical exploration (Munn and Schaffer 1993, Young-Loveridge 1993, Gifford 2005). Amongst the wealth of research concerned with play and learning, only some has directly influenced mathematics teaching (Tucker 2008). Despite the focus of successive governments on mathematics teaching (if not on learning) (Thompson 2010) when we look at what happens in classrooms, many learners of all ages exhibit a negative attitude to the subject (Winter 1992, Nardi and Steward 2003, Allen

2004, Klein 2007, Boaler 2009, Askew et al 2010) and fail to appreciate its purpose, other than to learn how to do mathematics (Walls 2009).

7.1 Main findings and conclusions

The key findings of this study are to do with participation and involvement in mathematics as well as what might constitute mathematical activity. Teaching and the quality of relationships within the classroom, as well as time to listen to children and take into account what they say about their mathematics are strong in both my findings and my methodology. The following questions were posed and addressed in this study:

- *What mathematics can be learned through role play?*
- *What does mathematics learning look like in different role play contexts?*
- *To what extent might role play affect the development of mathematical resilience, involvement and a positive attitude to the subject?*
- *What particular classroom conditions positively affect mathematics learning through role play?*
- *What adult intervention helps or hinders such mathematical learning?*

These are grouped into three subsections for further comment.

(i) What mathematics can be learned through role play?, and
What does mathematics learning look like in different role play contexts?

The challenge for the teachers in this study was to remain flexible and creative about the mathematics their children might encounter in the role play scenarios. This was more of a dilemma in the Year Four class due to curriculum constraints. Scenarios that involved the interpretation of numbers, measuring instruments, charts and graphs were successful in terms of mathematics learning'. In particular, interpreting numbers of 'taps' as a menu 'code' in Reception's 'Dinosaur café', reading stopwatches when Reception 'athletes' compared their times with Usain Bolt's (4.1.1) and interpreting the tidal charts and graphs in terms of putting to sea in Year Four (4.1.2). These presented opportunities for children to become involved in an authentic, understandable situation where the solution was either unknown or involved a degree of approximation. Who knew in advance who could run the small track as fast as Usain Bolt? How close to low tide can we risk coming back into port? The emphasis was on peer interpretation, collaboration and exploration, and a final resolution or reaching some joint agreement (even if this was to agree they had not solved the problem). One generic idea that would appear to transfer well between role play scenarios is that children should be required as part of the role play to check something - for example, a measurement, calculation or some counting, thereby providing some degree of vagueness or conflicting opinions that have to be resolved.

The role play situations involved collaborative mathematics where peers shared meanings and understandings through exploratory talk and discussion, identified in the literature as being central to learning (Wegerif and Mercer 1997, Mercer 2000, Mercer and Sams 2006, Wheeldon 2006, Howe and Mercer 2007, Barnes D 2008, Monaghan 2010).

By including the requirement of *joint*, purposeful recording, the mathematics involved representation and communication both in the moment and with others later. The Reception teacher was observed using these joint recordings effectively in class sessions as a focus for children to reflect on the mathematics that took place and developed them into further mathematical teaching and learning (4.2, 5.4).

In tackling mathematical content, children in both age groups were observed thinking mathematically, engaged in explorative mathematizing (Sfard 2011) and in gathering and ordering information, analysing information and making conjectures (Ollerton 2010).

The use of a recognisable piece of structured number apparatus (in this case, Numicon number lines) introduced as ‘time checkers’ and ‘jump checkers’ in Reception, provided a successful mathematical prop to support children’s mathematics whilst playing (4.1.1). The teacher previously modelled their use in the role play context to support a particular mathematical operation she wished children to carry out independently. The previously prepared ‘ready reckoners’ used in Year Four’s ‘Auction of Paintings’ (4.1.2) operated in a similar way. The use of structured mathematical equipment in this way needs further exploration, particularly with older children.

For mathematics to emerge and develop from and within role play, this cannot be ‘free play’. Role play contexts present complex social situations in which the mathematics is not always obvious nor easy to access and children’s attention needs to be drawn towards the mathematics, prior to and after the play. I discuss this below (ii) but despite the complexity, children in both age groups in this study were keen to engage and exhibited resilience when tackling the tasks. This study provides evidence of children in both age groups building on prior mathematical knowledge and experience in different mathematical areas and making sense of the mathematical ideas that they were being taught. These involved measure, number and data. Sometimes, the context appeared to hinder the building of mathematical knowledge, for example, observations in Year Four's 'French Café' where the introduction of spending constraints might have led to more constructive mathematical discussion.

Observed differences between the mathematics observed in the role play in the Reception class and the Year Four class in the study school were due to the curricula constraints shaping each age-group. It was more difficult to observe mathematical learning taking place in the Year Four class role play but I am not suggesting that the two age groups learn differently. The demands of a knowledge-based curriculum in the statutory years of schooling make it difficult for teachers to nurture role play in the way the Reception classroom and the Early Years Foundation Stage (DfE 2012) allow. With more flexibility, older children's mathematical learning could be catered for similarly successfully using the Reception approach of play-based learning based on observing children's interests and skills and structuring their learning. Despite this, when the Year Four tasks were structured to include specific, identifiable mathematics ('Tide times' and "Auction of Paintings'), mathematical learning was evident. I return to this in (iii).

This study observed three different kinds of approaches to role play that fostered mathematics:

- developing a storyline, which over time was used to introduce relevant mathematical problems to solve and conflicts to resolve. In this situation the mathematics forms part of a wider story or topic;
- based on adults' observations of children's general role play and their attention and interests, mathematical activities related to the role play were set up separately which might eventually be introduced into the role play and,

- based on the general role play theme, adults modelled some contextual mathematics, such as paying for a ticket or using a stopwatch. The associated resources were introduced into the role play for children to explore independently.

Learning mathematics through role play is also to do with *purpose* and *relevance*. Children in both classes 'saw the point' of what they were being asked to do mathematically because the adults invested time steeping the children in the scenarios. Consequently, the children relished the opportunity to independently take control of what played out. Adult strategies such as: being explicit that the purpose of the role play was mathematical (Year Four); setting something up and believing (behaving as it) useful mathematics would emerge, and regularly discussing the role play and the mathematics with the children (see iii), were all key to its success.

(ii) To what extent might role play affect the development of mathematical resilience, involvement and a positive attitude to the subject?

This study provides clear evidence of children in both age groups participating enthusiastically in a mathematical learning community as active, involved members (4.2). The findings of this study have a contribution to make to narratives of 'communities of practice' (Lave and Wenger 1991, Wenger 1998) by examining how role play might contribute to the nurturing of such a community in a mathematical classroom, and how this can inform and develop present understandings of mathematics teaching and learning.

In both classrooms, children were involved in creating and developing both the role play and the mathematics by being given some authority over the directions it took (as reported in 4.2 data analysis in relation to Hufferd-Ackles et al's (2004) mathematical discourse community). This process required the adult to be mathematically aware, observant and opportunistic. Such participation led to children being clear about the mathematics that they were going to meet as well as its purpose. Ownership is an overused term but the children in this study demonstrated this clearly and were placed in a position of power in relation to the mathematics.

Mathematical identities are variable as a result of the interplay between the culture of the classroom and the relationships within it (Askew 2008). Role play appeared to alter the relationship the children within these two classrooms had with mathematics. As described in Chapter Six, during the re-view interviews the children spoke confidently and clearly about the mathematics in the role play scenarios they had participated and about what they had learned.

Pretend play of the sort described in this study provided a risk-free context, some thinking space in which children could try out some mathematics, and also to experience and apply some mathematics in a 'life' context. As a risk- free activity it is thus atypical of much school mathematics and this is likely to be its value. Role play, in that it involves interaction, engages players' emotions and thus might aid the creation of 'mathematical memories' on which to hang future learning. The children in this study could recollect themselves engaging actively in some mathematics, tackling some difficult problems independently and sometimes being successful. Whether this would have happened without the re-view opportunities where they were encouraged to reflect on their play is an unknown factor (see (iii) below). It was clear that the children of both age groups could identify what mathematics they were engaging in and its relevance, and that they relished tackling some mathematics independently: mathematics that was not separated into easily digestible learning objectives. This may have contributed positively to children's developing sense of themselves as mathematicians with a broader view of what mathematics is and can be.

What also made a difference to the effect the role play had on children's mathematics, was the provision of sustained play time, uninterrupted by adults correcting or steering the direction of the activity. Time also for children to return to a task after a break to develop the original idea. The provision of extended, uninterrupted role play time has been recommended by Rogers and Evans (2007, 2008) as necessary for young children to demonstrate their abilities to sustain complex narratives. Sustained, uninterrupted time is necessary for children to develop the resilience to explore mathematics confidently in some depth, and also to develop a sense of being a learner of mathematics (Watson et al 2003). Time to work at some mathematics away from an adult was highly valued by the Year Four children (as demonstrated when they were interviewed) and although the resulting mathematics could be unclear, such time appeared to nurture their mathematical independence and confidence.

Time was also necessary for the adult to eavesdrop on the play to assess where participants' attention lay and to decide where to focus future discussions. Such time was difficult to find in the Year Four class due to the external constraints of the statutory curriculum.

(iii) ***What particular classroom conditions positively affect mathematics learning through role play?, and***

What adult intervention helps or hinders such mathematical learning?

The principal classroom conditions that positively affect mathematics learning through role play in both age-groups are:

- the role play scenario forms a central part of what takes place in the classroom;
- the quality of the mathematical challenge offered to learners, and
- what develops in terms of mathematical possibilities and opportunities is discussed and developed in whole-class reflection sessions.

The value placed on role play in the study classrooms affected the quality of the mathematics that took place. Adults valued the play and gave it priority by observing it and discussing it with the children. The pretend scenario, jointly agreed with the children, led to work in many curriculum areas. Children understood the scenario and accepted the mathematical challenges that were introduced.

When investigating my research questions, I was not anticipating that re-viewing videoed role play episodes with the children would provide valuable opportunities to further their mathematical learning. This study found that viewing video of themselves role-playing can provide rich opportunities for participants to both reflect on the mathematics they learnt and to engage in further mathematics. For example, Reception children re-viewing themselves racing Usain Bolt (6.2.2) and Year Four children re-viewing themselves in Hemy's floating studio (6.2.1). In re-viewing their play, children of both age groups were able to state what mathematics they had learned and how they learned it. In common with findings related to using *re-proposal* with younger children (Malaguzzi 1993, Parker 2001) children of both ages also frequently engaged in further, higher level mathematics when re-viewing their role play. The finding that discussing video of role play might be a useful way to engage in and learn about related mathematics, is a significant finding.

The value of using video of role play in this way rather than of any other group-based mathematical activity, might be that the focus of the discussion can be on the scenario and the mathematics, rather than on the individual and what they may and may not be able do. This may allow a move away from direct questions that appear to query individual children's methods, putting them 'on the spot', such as, 'How did you do that?' '... reach that answer?' and towards questions that invite children to explain and interpret what they see and do, such as, 'What is going on here?', 'Can you talk us through the mathematics that was going on?' This might allow the safeguard of self-esteem whilst reflecting on some mathematics.

To summarise, role play scenarios jointly constructed and created with the children can provide a rich site for mathematical cognitive dissonance where children can begin, with the subtle, occasional and sensitive involvement of an adult, to work together to jointly construct new mathematical understandings at the same time as building learners' resilience and enjoyment. Occasionally, insufficient or unclear structuring in terms of how the role play scenarios are set up, led to the mathematics becoming lost or overridden by social concerns. Over-structuring role play however, leads to no play taking place at all and tasks then resemble other classroom tasks.

In both classes role play was most successful in terms of mathematical learning where children's interests were at the heart of what was planned, either as a result of discussion as in Year Four, or observation in Reception. Where interactive group challenges were set that were fairly loosely structured to begin with, this provided the opportunity (for the Reception teacher in particular with fewer curriculum constraints) for more structuring of the task as the days went by and the integration of increasingly complex mathematics. Mathematical role play needs to be loosely structured to begin with to allow children to 'wallow' in the scenario and to begin to take ownership of this. They then appear to be more receptive to tackling some mathematics that might be introduced. It may be the case that one of the important aspects of role play is that it creates a thinking space for children to begin to make some sense of some mathematics and to get personally in touch with this. Perhaps there is more chance for a learner who has experienced that space (and been left to undo a mathematical muddle) to persevere when faced with some incomprehensible mathematics at a later stage; to say "Hang on, give me some time, I can get to the bottom of this" instead of "I can't do this and I don't care" or "Just tell me how to do this". In other words to take responsibility for their own mathematical learning.

7.2 Identification of implications for teaching, future study and research

This study is one small step in understanding the learning of mathematics through examining children participating in some mathematics integrated into role play. Here I consider the implications of the thesis for teaching and learning mathematics through role play and possible lines of future study and research. The implications are varied and I discuss them under two separate headings: 'implications for teaching', where I outline the professional implications of this study that I would be interested in as a classroom teacher, and 'implications for further research'.

(i) Implications for teaching

The mathematics described in this study is participatory, explorative and recognises learners as authoritative and capable (Klein 2007). It is about children participating in an inclusive community and speaking the same language where each member has something to offer. It is as much about learning to behave mathematically as learning mathematical content. One implication of the study is that role play of the sort described may be one way of providing an alternative view of mathematics and mathematics learning to that common in most mathematical classrooms.

Children left to role play some mathematics will not always engage in mathematics. Boaler (2009) pointed out in her investigation of 'project' mathematics in a secondary school that children will time-waste but, nevertheless, the experience is still empowering as it transcends the boundaries generally existing between classrooms and the outside world. Adults valuing the play and remaining in touch with what goes on through observation and class reviews, leads to relevant mathematics being tackled within other teaching episodes. It also draws children's attention to the mathematics. Time to revisit and repeat tasks with the benefit of discussion and hindsight (on behalf of teachers and children) is critical, not every day for older learners but at least regularly.

Rich role play scenarios are valuable for problem-raising in that they provide a meaningful context in which to place some mathematics however, mathematical tasks can be difficult to generate from scratch. These do not have to be ‘real’ but they do have to be relevant to the children. Time spent immersing learners in the scenario and discussing together likely problems is likely to lead to children’s willing involvement in the mathematics.

With the growth of the iPad and similar tablet devices, it is becoming increasingly straightforward to use film for children to reflect on their learning. The potential for using technology as a means of *visual re-proposal* to stimulate reflective dialogue has dramatically increased since the beginning of this study and will continue to do so. The challenge is likely to be not to over-egg the omelette but instead to assess when and in what ways the use of video for re-view and reflection is of most benefit and whether film of role play makes role play particularly effective for mathematical learning. This study did not explore children filming themselves. The study school has recently begun to investigate this approach and this would be an interesting area for further exploration.

Finally, I have referred elsewhere in this study to the influence of the whole school ethos on my findings, in particular, the ability and the willingness of the study children to listen to others and to talk about their learning. One implication for teaching mathematics is how dialogical relationships established in a classroom and in the wider school influence the learning of mathematics, as well as children’s attitudes towards learning mathematics. Establishing a community of mathematical learners requires teacher and child becoming co-learners and co-questioners, and the responsibility for learning as well as control over the source of mathematical ideas shifting towards the child (Hufferd-Ackles et al 2004). Role play can provide an arena where such features of a ‘math-talk learning community’ can flourish.

(ii) Implications for future study and research

For some years, research has been pointing to collaborative tasks and talk as important in learning mathematics (Mercer 2000, Barnes 2008, Monaghan 2010) and role play seems to have the potential to support both collaborative activity and mathematical conversations. Identities are important and contagious (Sfard 2011) and the children in this study saw themselves as children who can ‘have a go’ at some mathematics. More research is needed into how by structuring mathematics differently, for example, by integrating learning intentions into rich tasks, and how *role play in particular*, might affect learners’ attitudes to mathematics.

Furthermore, research into whether it is possible to identify specific areas of mathematics that are particularly apt for role play scenarios with particular ages of learner would be valuable. Moreover, although work has been done developing story-based problems for Key Stage One (5-7 year old) pupils (Lee and Tompsett 2004) research into problems that are likely to work well in role play scenarios would be advantageous. Once some likely mathematical problems have been identified, then isolating ‘significant mathematical moments’ that commonly cause difficulty (such as the giving of change) based on our professional knowledge of both subject matter and the development of children’s mathematical understandings would also be valuable. Role play and re-viewing role play could be used to build understanding and unpick misunderstandings.

This study investigated role play with one small group of Year Four children identified at that point in time as being lower attaining in mathematics.

Engaging in role play did appear to help their mathematics (4.1, 6.2.1, 6.3). Further research would be useful into how best to help children of all abilities to benefit from role play opportunities for mathematics. It is my impression from working in the study school that those children identified as higher attaining, although a diverse group, were more difficult to engage in role play scenarios. But this may be due to the level of challenge rather than the role play per se. How might role play help all children demonstrate what they are capable of mathematically?

Setting up successful mathematical role play in different age-groups within the constraints of a statutory curriculum is another area requiring further study. My findings in a Reception and Year Four class indicate that how role play was structured and supported by the teachers differed, mainly due to the difference in the curriculum requirements and pedagogical approach between non-statutory and statutory school-age children.

More research is needed into whether, in presenting a mathematical 'muddle', role play is effective in promoting responsibility and resilience with older learners. It remains unclear exactly what might be different if children are simply told a story that requires some mathematical resolution. Further study is needed into whether role play is uniquely placed to create 'mathematical memories' on which to hang future learning, or whether the use of *any* context, for example, soda machines (Dolk and Twomey Fosnot 2005) or a story about a merchant (Lee and Tompsett 2004)) is equally effective.

And finally, a comparative study of Year Four children from different schools talking about their learning might help us to understand how the specific school ethos and climate might affect children's mathematical learning.

With the benefit of hindsight, I would have made more use of the re-view interviews with the younger children, integrating them into the observations of the play with more children in order to establish if they always made positive contributions to children's learning.

7.3 Limitations of the study

I started by asking what it was that I would want to read as a practising teacher. As a young teacher some 30 years ago, I have strong memories of articles that intrigued me by describing children's responses to a mathematical activity, elements of which I could replicate in my classroom. It was chiefly for this reason that I chose to illustrate this study with role play examples from two classrooms, Reception and Year Four, where there appeared to be something different taking place: to excite interest. It draws on my strengths as a teacher. I was interested in the detail, hence it is situated, developmental, partial and modest. The limitations of this study are its scope and its applicability. This interpretive, qualitative study is research in one case where data was collected from a very small sample in a single instance of a bounded system, two classrooms in one primary school during the academic year of 2011-2012. The findings of this study cannot be isolated from the circumstances and the context in which it took place, personally, historically and geographically. It is very unlikely that exactly what has been observed happening here would be observed happening anywhere else. However, close description of the activities that I observed makes elements of these replicable. Although results will differ, my analyses and interpretations of these observations will stand as useful for comparison and discussion in relation to observations in other situations.

An interpretative study is open to interpretation and, as with any small-scale interpretative study, the interpretations of others are as pertinent as my own. These are to be encouraged as well as interpretations of readers' own experiences of such play.

It is hoped that this study can help draw attention to some key issues in mathematics education in terms of participation and attitude and that it makes a modest contribution to the debate on what mathematics education is about. This study is original in that it attempts to connect what has not been connected previously by suggesting an approach to planning mathematics whereby children and their interests and concerns are central and where their motivation and engagement in mathematics is considered critical. This approach takes for granted that children can and will be interested in mathematics.

Whether or not the observations that comprise this study will be defined as role play by readers remains an issue. In places, what is described might not be what others might think of as 'role play'. In terms of how the adult structures the action to include mathematics the role play in this study has more in common with Heathcote's 'mantle of the expert' (Bolton 1979, Heathcote and Bolton 1995) than with much early years' role play.

Finally

Role play mathematics is not about dressing up and providing complex structure and props but is about allowing playful participation in some social situations with a mathematical edge. It is an unpredictable cocktail. It is not easy to combine everything that is required to maximise the potential for learning, particularly in the later years, however, role play appears worthwhile in affording children the opportunity to be in control of some mathematics and to play at being mathematicians. If, as some claim, our current education system is educating children out of creativity and if creativity is essential to a rich society (Robinson 2006, Hennessey and Amabile 2010) then role play is an opportunity to be mathematically creative.

This study is unusual as well as pertinent in the current political climate, where the emphasis from both government and policy-makers' is on children mastering increasingly complex mathematical skills at an increasingly younger age. This has intensified since the study began. Curriculum requirements for mathematics have increased in difficulty in the newest incarnation of the statutory curriculum for both early years (DfE 2010) and the primary years (DfE 2013). This leaves little space for children to explore mathematics or for the provision of time for sense-making activities such as those described in this study. Hence, it will be difficult to approach mathematics in the way described in the Year Four class in this study with the additional constraints of the new statutory mathematics curriculum from September 2014. Paradoxically, my findings lead me to conclude that the requirement to escalate difficulty in terms of mathematics content *emphasises* the necessity for such an approach. This is backed by well-documented research into the gap between children's understanding of taught mathematics and their ability to apply this knowledge, or 'situated cognition' (Carraher et al 1985, Lave 1988, Askew and Wiliam 1995, Watson and Winbourne 2008).

Insisting on covering more curriculum content at an earlier age will do nothing to tackle the problem identified at the outset of this study, that many learners of all ages and stages neither appreciate the purpose of the mathematics they are taught nor feel positive about themselves in terms of mathematics. To require more content is also a misinterpretation of our ‘mathematical problem’ in relation to the most recent PISA results (OECD 2013) in that the PISA test consists of non-routine mathematical problems that require resilience and flexible use of deep understanding and hence learners need to regularly engage in non-routine problem solving.

After Houssart (2004) I challenge the notion of the ‘mastery’ of mathematics. Instead, this study points tentatively towards explorative mathematizing (Sfard 2011) as constructive in learning and in positively affecting learners’ view of both themselves and mathematics.

> *“There is no other activity for which young children are better prepared than fantasy play. Nothing is more dependable and risk-free and the dangers are only pretend.”* (Paley 2004a:8)

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APPENDIX ONE DATA COLLECTION

(i) FRAMEWORK FOR DATA COLLECTION: YEAR FOUR

Autumn term 2011, over 6 – 8 weeks, repeated in summer term 2012.

Observations

Weeks beginning: 31 October, 14 and 28 November, 12 December.

- 3-4 observations of up to 60 minutes (2 groups of 4 or 5 tackling open-ended task in role play area. Fieldwork notes and video-taped.
- I watch tape back, take reflective notes and identify snippets for use 1/ with children and relevant teachers, 2/ in write-up 3/ for papers /conferences.
- Transcription.

Questions to consider when observing:

- *What roles are the different children adopting? In terms of their classroom membership? The hierarchy of the classroom (groupings)? In terms of the role play theme?*
- *How does what is happening relate to what else is going on in the classroom at this time? In terms of the role play theme? In terms of their mathematics learning?*
- *What level of involvement are the participants demonstrating (Laevers 1993)?*
- *What are the children attending to?*
- *What are some of the broader educational themes that are raised by this observation?*

Thematic Analysis (1)

Questions to consider when watching the video back/transcribing:

- *Participation – what evidence do I have for children establishing themselves as competent and confident mathematicians?*
- *How far did the children do what was expected of them? In terms of their role? In terms of the mathematics work expected of them?*
- *What is the degree of involvement of each participant? Prompts: curiosity, exploratory drive, imagination and creativity, self-organisation. Laevers' 'child involvement signals'.*
- *What evidence is there of understanding and the use of mathematics? Prompts: expression and communication skills, use made of mathematical language and knowledge, 'habits of mind' (Cuoco et al 1996).*

Thematic Analysis (2)

Weeks beginning: 7 and 21 November, 5 December.

- 3 meetings ('focussed conversations' deVries et al, 2010) with Y4 teacher to watch selected snippets of video and discuss questions, above.
- Meeting recorded and fieldwork notes taken. Selective transcription.

Questions to address after discussion of observation:

What are the main themes that are emerging for you as the class teacher? How does this relate to what you are seeing elsewhere/at other times? What decisions are you taking on next steps and why? Surprises?

- Choose video snippet to use with the children.
- Choose statement to use for 're-proposal' (Malaguzzi 1993) with children.

- Selected excerpts of meeting transcribed and teacher to read through, check authenticity, add notes.

Thematic Analysis (3)

Weeks beginning: 7 and 21 November, 5 December.

- 3 're-view' meetings with Y4 children to watch selected snippets of video. Meeting recorded and fieldwork notes taken. Transcription.

Questions to address when watching video snippet(s) with children:

- *What do you notice? What can we see?*
- *What mathematical learning do you think/see is taking place? How do you know?*
- *How does being 'in role' help in learning mathematics? What evidence have we for this?*
- Use statement for 're-proposal'.
- Meeting transcribed with reflective notes.

Questions to consider after transcription:

- *What are the main themes that are emerging? How does this relate to what I am seeing at other times? What are my next steps and why?*

Thematic Analysis (4)

30 min input into two or three staff meetings to feedback main findings and themes to all staff and obtain their views.

(ii) FRAMEWORK FOR DATA COLLECTION: RECEPTION

Spring term 2012, over 6 – 8 weeks, repeated in summer term 2012.

Observations

- Observations of up to 20 minutes in duration in indoor or outdoor role play areas. The group of children may change as activities are self-chosen. Fieldwork notes and video-taped.
- I watch tape back, take reflective notes and identify snippets for use 1/ with children and teachers, 2/ in write-up 3/ for papers/conferences
- Transcription.

Questions to consider when observing:

- *What roles are the different children adopting? In terms of their classroom membership? In terms of the role play theme? Other themes?*
- *What level of involvement are the participants demonstrating (Laevers 1993)?*
- *What are the children attending to?*
- *What are some of the broader educational themes that are raised by this observation?*

Thematic Analysis (1)

Questions to consider when watching the video back/transcribing:

- *Participation – what evidence do I have for children establishing themselves as competent and confident mathematicians?*
- *How does what is happening relate to what else is going on in the classroom at this time? In terms of the role play theme? In terms of their*

mathematics learning? In terms of their other learning? In terms of their interests?

- *How far did the children do what is expected of them? In terms of their role? In terms of the mathematics expected of them?*
- *What is the degree of involvement of each participant? Prompts: curiosity, exploratory drive, imagination and creativity, self-organisation. Laevers' 'child* involvement *signals'.*
- *What evidence is there of understanding and the use of mathematics? Prompts: expression and communication skills, use made of mathematical language and knowledge, 'habits of mind' (Cuoco et al 1996).*

Thematic Analysis (2)

- 3 meetings ('focussed conversations' deVries et al, 2010) with R teacher to watch selected snippets of video and discuss questions, above.
- Meeting recorded and fieldwork notes taken.

Questions to address after discussion of observation:

What are the main themes that are emerging for you as the class teacher? How does this relate to what you are seeing elsewhere/at other times? What decisions are you taking on next steps and why? Surprises?

- Choose video snippet to use with the children.
- Choose statement to use for 're-proposal' (Malaguzzi 1993).
- Meeting transcribed and teacher to read through, check authenticity, add notes.

Thematic Analysis (3)

- Re-view meetings with children/class to watch selected snippets of video. Meeting recorded and fieldwork notes taken.

Questions to address when watching video snippet(s) with children:

- *What do you notice? What can we see?*
- *What maths learning do you think/see is taking place? How do you know?*
- Use statement for 're-proposal'.
- Meeting transcribed with reflective notes.

Questions to consider after transcription:

- *What are the main themes that are emerging? How does this relate to what I am seeing at other times? What are my next steps and why?*

Thematic Analysis (4)

30 min input into two or three staff meetings to feedback main findings and themes to all staff and obtain their views.

(iii) SEMI-STRUCTURED INTERVIEW QUESTIONS

Objectives:

- To probe respondents' understandings of what is taking place
- To check my observations and analyses
- To check my understandings of what has been observed against respondents'.

a/ Children - Re-view Interview questions

"What do you notice/ what can we see?

What is happening?

What is going on inside your head?

How is learning taking place?

What maths learning is taking place? How do you know?

Which bits are you being really clever?"

Fieldwork diary entry, notebook 1, 07/11/2011

"Can you say a bit more about ...?

I'm not going to say anything now, because I want you to.

Can you identify something you didn't know before?

Think about the maths for a minute ...

What do you like (about it)?"

Fieldwork diary entry, notebook 1, 29/11/2011

b/ Adults - Participant interview questions

What are your opinions about your experience of ... so far? Positive? Negative? Interesting?

<u>Guided questions to structure a practitioner interview:</u>

It seemed to me that... How was it for you? What are you feeling/thinking about this?

What in your opinion is the best thing about ...?

Where do you think there is room for improvement?

Some people might argue/say that... What do you think about that?

How did you begin to..?

So what did you do when...?

Can you add a bit more about...?

Where would you go from there?

How are you going to...?

How might that help their understanding of...?

How would you help children who...?

What do you think the reasons might be for...?

What do you think would happen if...?

So where might you take it from here?

Probes:

Can you say a bit more about ...?

Let's talk about... how's that going?

"I wasn't quite sure what you were thinking then... can you help me...?"

Year Four Teacher

Question 1: What is significant for you about what has gone on so far? Question 1a: What has been successful/unsuccessful? Why, do you think? Question 2: How have things changed? How has what you do changed? Question 2a: How has role play/this approach changed the way you see yourself

as a teacher and the part you play in children's mathematical learning?

Question 3: The culture of the classroom, classroom conditions, group dynamics

and ground rules – how do these influence what happens?

Question 3a: What 'preparation' do you do? How do you see the adult role?

Question 3b: What is it that you think might be replicable (to other classrooms/age-groups)?

Question group 4: What do the children learn mathematically?

What evidence have you that role play 'works'?

What do you mean by 'works'?

What stops it from 'working'?

What influence do you think role play has on the teaching and learning of mathematics? (understanding/confidence/content/processes)

What inhibits this learning?

Question 5: One approach we have developed is the children 're-viewing' the role play. What do you see as the role of this?

Question 6: Something we have talked about is role play as a rehearsal for a final event. Can you say something about this?

Question 6a: You said (24/01/12) "The auction reminded me they could play." Can you say a bit more about this?

Question 7: Thinking about learners' identities and 'being a Triangle', what do you think are the effects of having similar attainment mathematics groups throughout the school?

Question 7a: Do you think these children think that 'mathematics is for me'?

Reception Teacher

Question 1: What is significant for you about what has gone on so far?

Question 2: What is the impact of what is happening? On the children? On you? On how you see mathematics?

Question 3: What has been successful/unsuccessful? Why, do you think?

Question 4: How have things changed (changing)? How has what you do changed (changing)?

Question group 5: What do the children learn mathematically?

What evidence have you that role play 'works'?

What do you mean by 'works'?

What stops it from 'working'?

What influence do you think role play has on the teaching and learning of mathematics? (understanding/confidence/content/processes)

What inhibits this learning?

Question 6: What do you think are the features of the activities that make learning more likely to take place? ... and of the environment?

Question 7: Can you say something about what it is that you do? (affirming)

Question 7a: You said (01/03/12) "It's easier somehow to teach through imaginary scenarios" – can you say a bit more about this?

Question 8: What is it that you think might be replicable (to other classrooms/age-groups)?

Question 9: One approach we have tried is the children 're-viewing' the role play. How do you see the role of this?

Head Teacher

1: Could you say a bit more about ....

How you see the function of the mathematics in the role play?

The social aspects of learning mathematics?

'This school is the safest place to make mistakes'

2: How do you think the attitudes of the children / the staff have changed towards role play mathematics?

3: 'A village school in the town' – why do you think this school feels different to other town schools?

Can you explain how the school grew?

(Background to HT arriving, check context information/chapter)

4: How do you see the school's values being played out?

5: What do you mean by a school-based curriculum?

6: What do you mean by 'lead-learners'?

7: Can you say a bit about how these children are developing a language for talking about learning?

8: Is there anything you want to ask / say to me?

(iv) OBSERVATION SCHEDULE BASED ON LEUVEN CHILD INVOLVEMENT SCALE (Leuven 1993, Bertram and Pascal, 1994) [included in Ethics Application Appendix b(i)]

Observer: Date:

Name, sex, age of child: Number of children present:

Signals of involvement:

Concentration, Energy, Complexity and creativity, Facial expression and posture, Persistence, Precision, Reaction time, Verbal utterances, Satisfaction

Description of 2’ period	Involvement level 1-5	Mathematics learning
Time:		
Time:		

Child Involvement Scale:

Level 1 = low activity

Level 2 = Frequently interrupted activity

Level 3 = mainly continuous activity

Level 4 = continuous activity with intense moments

Level 5 = sustained intense activity

APPENDIX TWO: DESCRIPTION OF ROLE PLAY SCENARIOS

(i) YEAR FOUR

<u>Scenario One, 'Hemy's Floating Studio'</u>

Figure 2

As part of a local history project in the Autumn term of 2011, the Year Four class visited localities linked to their topic, two of which were the graveyard and the art gallery. The term begun with a graveyard walk with a curator from the art gallery where the children searched for artist's graves and were told a little about each one. Charles Napier Hemy (1841-1917) was a local artist considered to be one of the finest marine artists of his generation. They were told he had a boat (The Vandermeer) fitted out as his studio, where he could observe and make studies of the sea at first hand. The class then saw Hemy's work in the art gallery.

A floating artist's studio was suggested and agreed for their role play by the children.

A small area of the classroom was sectioned off and made into a boat using sheets of thick card and furniture. A backdrop was painted as a scene from the boat. It was set up with an easel, paints and artist's materials, tide timetables and dressing up clothes.

Scenario Two: The French Café

Figure 3

The overarching school topic in the spring term of 2012 was a geographical theme of understanding and forging global links. Year Four's focus was a mountain village school in France, with whom they had internet contact. The back section of the classroom designated the 'wet area' containing sinks, cupboards and an outside door was set up as the café, which allowed the children to wash up and pour water as part of their play. The sinks were divided from the table area by a screen and the café contained menus made by the children, crockery and cutlery, play food made by the children, aprons, pads and pencils, plastic and paper money and a till.

(ii) RECEPTION

<u>Scenario One; 'The Dinosaur Café'</u>

Figure 4

An indoor role play, set up alongside the inbuilt two-storey structure for imaginative play. Tables were arranged as 'counters' to separate the staff area from the customers. At the back hung a large white board and pens for the menu and a telephone, pad and pens. On the tables, arranged in baskets and boxes was a range of play food, plastic shopping baskets and a tray of structured number apparatus, Numicon operating as ‘money’. Other props included purses and bags. Inside the structure was a table and chairs for café seating. There was an open hatch linking these two areas.

<u>Scenario Two: ‘Horse Jumping’</u>

Figure 5

An outdoor role play set up in the hard-play courtyard. A variety of items were placed as jumps, such as small trays, hurdles and wooden bricks. These were labelled with number cards (1-20) in the order they were to be jumped. Cones designated the route, start and finish points. Props developed with the play and included riding hats, half-coconuts, home-made hobby horses, a whiteboard and pens operating as a scoreboard and scoring booklets for each rider.

Scenario Three; ‘Faster than Usain Bolt’

Figure 6

An outdoor role play set up in the courtyard. There was already a roughly circular black track painted on the ground, cones designated the race end and the beginning. Alongside, a whiteboard and pens were placed as a scoreboard with a spectator’s bench and chairs. Props available included coloured PE bands, stopwatches, homemade athletes’ ‘vests’, a ‘podium’ with 1st, 2nd and 3rd marked, Numicon number lines, large and small. A floor number line to 20+ operated latterly as a long jump with an adjacent flipchart for scoring.

APPENDIX THREE: TRANSCRIPT EXAMPLES

(i) Year Four Scenario: 'Hemy's Floating Studio', 'Tide Times'

01/11/11 GROUP 2, OBSERVATION 1: 'TIDE TIMES', 11:45 – 12:15

Children involved: Saul (8y 5m), Sean (8y 6m) and Fleur (9y 1m) Children have been in boat 2' as I changed batteries in camcorder. They start immediately. Scenario/task sheet [see Appendix 3 (ii)] has already been read by the two boys, whilst Fleur sits and listens and watches and they start talking. [All standing, Fleur with clock and paper, Sean with paper, Saul fiddling with easel]

1 Sean: *Read that through with us and we'll listen to you [....] Who wants to read? OK, Saul here you are, here's the tide...*

[....]

2 Saul: *No, no, no, no, 15:21*

3 Sean: *You just said 15:25*

4 Saul: *No, 15:21*

5 Fleur: *No that's the low tide so we can't go out*

6 Saul: *Yeah, we can't go out on the low tide...*

7 Sean: *That's when we have to go, when we have to leave*

8 Saul: *No, if we go on the low tide, we'll be stuck*

9 Sean: *Alright, alright*

10 Fleur: *So we have to leave at high tide...*

11 Sean: *By 8:36, by 8:36*

12 Fleur: *Yeah, but why would you want to go out at night? Is that p.m.?*

13 Saul: *No*

14 Fleur: *Is that a.m.?*

(Video recording starts here)

15 Sean: *8:37 I think, 8:36*

16 Fleur: *8:36*

17 Sean: *8:30*

18 Fleur: *8:30?*

19 Sean: *Yeah*

20 Saul: [holding bulldog clip] *What's this meant to hold?*

21 Sean: [indicating paper on easel] *That!* /

22 Fleur: [with clock] *8:36, 8:30, half past*

23 Sean: *Everybody dress up* [puts on waistcoat]

24 Saul: *Don't like dressing up... stupid. / Don't want to / Don't want to*

25 Sean: *Alright* /

26 Saul: [to Fleur] *8:36* [...]

27 Fleur: [with clock to Saul] *No, 5, 10, 15, 20, 25, so 36 is there, in the middle*

[Saul nods] /

28 Sean: *Let's get moving shall we* /

29 Fleur: *There, that's right. Joe, Sean that's right* [shows Sean clock showing twenty to 7]

30 Sean: *Yeah that's right*

31 Fleur: '*Cos look, 5, 10, 15, 20, 25, 30, 36*

32 Sean: *Very good Fleur, very good. Well done, well done. Cool.* [Fleur sits and glances at camera]. *So do you know when 15:21 shows up?*

33 Fleur: *At 15:20*

34 Sean: *Yes, we have to leave before 15:21 otherwise we'll get stuck*

35 Fleur: [with tide chart] *No, 15:21*

36 Sean: *Yes, we have to leave before then [points to time on chart] see, 15:21 low tide*

37 Fleur: *We have to leave, we have to get back by* [....]

38 Saul: *For the fishes. When I go out at high tide that's when the fish come in. So if you want to go fishing, so if you have to be back by high tide ...*

39 Fleur: *Wait wait, I need to see when 15 is...* [head in hands, counts on fingers]

40 Sean: *I know, it's high tide now. / Let's get going. Saul, Saul , Saul, you're ready enough to leave yet?*

41 Saul: *No* [...]

42 Sean: *No, I know... we're sailing on the sea*

43 Fleur: *3*!

44 Sean: [pointing to chart] *No! 15*

45 Fleur: *Yes I know, but that's 3:21 in the afternoon*

46 Saul: [Boys refer to chart] *OK, we are leaving at high tide* [....]

47 Sean: *No* [...]

48 Saul: *No we should leave / definitely / then*

49 Sean: *But then we have to change the days* [turns chart over to show next day's tides]

50 Saul: [...] *change the days*

51 Sean: *No, we're leaving at 8:36 and [...] back*

52 Saul: [...] *at night, we'll have less time* [indicates picture] *look, look it's a guy drowning!*

53 Sean: *Oh yes, over there! Anyway I want to go out, look at all those beautiful boats* [indicates back drop]

54 Saul: *Good*

55 Sean: *Good they are, <u>quite</u> good*

[...] [both boys smile/pull face at camera] /

56 Fleur: [shows Sean the clock] *There, that's right. That's 3:21*

57 Sean: *Agh! It means we have to leave <u>before!</u>*

58 Saul: *Sean* [...]

59 Fleur: *So it's supposed to be 5?*

(Does he want her to set an earlier time?)

60 Sean: *Yeah, so we set for 15:21 OK? Set that for 8:20, 8:36 and then when it says that time then we go, before that time we have to...*

61 Saul: *Wait there*

62 Sean: *... we have to get back in to the docks* [glances at camera] *OK? / Then we stop*

63 Fleur: [....]

64 Sean: [waving hand] *Yes. Alright, alright, wherever we, OK, OK wherever*

//

65 Fleur: [still with clock*] 8:36*

66 Sean: *8:36 yeah. I'll just see if that's the correct tide, I don't know whatever that is*

67 Fleur: *So Sean*

68 Sean: *Just wait a second please Fleur*

69 Saul: *So we're leaving at*

70 Sean: *No, that's supposed to be in there* [referring to tide booklet in tray]

71 Saul: *OK. It's meant to be in there anyway*

72 Sean: *Yes, because ... well we have but we have to use this one*

73 Fleur: *Sean look* [shows clock] *its not working*

74 Saul: *Of course it's not working, it's got no batteries in it!* [all smiling]

75 Fleur: *You said, you said when it gets to that time*

76 Sean: *Oh great!*

77 Saul: *It's not working*

78 Sean: [to Saul with tide timetable] *Put it back Saul, we're not using that one*

79 Fleur: *What does it say on the sheet?* [reads sheet aloud]

80 Saul: *What date is it today?*

81 Fleur: *First of the eleventh*

82 Saul: [opening tide booklet] *June. I'm on June. November. No! June, July ...*

83 Sean: *August, September, October, November, December, OK?*

84 Saul: ... *November* [to Sean] *That's now, look. That's now...*

85 Sean: *What?*

86 Saul: *... that's now, that's now, that's now* [passes Sean tide booklet]

87 Fleur: *We need to, put the book back* [takes tide booklet*] that's the wrong one!* [Saul stares into camera]

88 Fleur: [....] *That's the same one. Yes, but Sean, look, this is the, this is the tides thing* [referring to sheet]

89 Sean: *But that's what we're told to use, that was just in there*

90 Saul: [...]

91 Fleur: [Opening tide sheet] *Yeah but he needs the right tide, oh so he's going at 8:36*

92 Sean: *He has to be in* <u>*before*</u> *8:21*

93 Fleur: [...] [scratching head and looking at tide sheet] /

94 Sean: *Fleur, are we going out, are we going out or are we just sitting here watching* [...]?

95 Fleur: *We have to be in by, because look in the height metres, look [...] low tide, we have to be in / I say we be in by, umm/ if we be in by, if we be in by*

96 Sean: *15:21*

97 Saul: *Yeah but if we leave at low tide we will just have to go inside the buoys then we'll be out at sea, then, if we come back at high tide it will be easier*

98 Sean: *Oh, come on* [...]

99 Fleur: *Yes but we have to be, if we go at high tide we can go out, but, but...*

100 Saul: *Low tide*

101 Fleur: *... if we come in by <u>before</u> low tide...*

102 Sean: *Why don't we just leave that / why don't we just leave the sheet and we can just do it* [sits in exasperation]

103 Saul: *Sean you're right in front of the camera* [Sean stands and moves away]

[...]

104 Sean: *Alright, Saul can [...] now what do we do?*

105 Saul: [turning hands of clock] *Twist, twist, twist, twist, twist*

106 Fleur: [takes clock] [...] *we don't need a battery in there now [...] Sean, Saul, whatever your name is, Saul* [hands Saul clock, picks up task sheet]

107 Saul: *Yeah, but I twisted it <u>all</u> the way round*

108 Fleur: [with instruction sheet] *We have to add notes to the tide to explain* [reads sheet] *"Go out to sea, set the clock to read when to return", so we have to add notes to the tide chart, do you get that?*

109 Sean: *Yes I do. Oh, no I actually don't, do you?*

110 Saul: *Yes*

111 Sean: *I don't*

112 Fleur: [...] *to explain each part*

113 Sean: *Oh, that's not easy, notes*

[...]

114 Saul: [with clock] *Shall I put it on a quarter past eight? Shall I put it on my bedtime?*

[...]

115 Fleur: [...] *we have to add notes to the tide information*

116 Saul: *I'm putting it on my bedtime*

[Fleur and Sean discussing times – out of earshot] //

117 Saul: *Sean, I'm showing you my bedtime*

118 Sean: *Alright, you show me your bedtime*

119 Fleur: *Seven minutes to 12. No Saul, we're meant to be working here*

120 Sean: *Fleur, what are we doing? I don't know*

[...]

121 Saul: *There Sean, done*

122 Fleur: *You've done the time there, you don't go to bed at 10 o'clock*

119 Saul: *I do. Sometimes*

120 Sean: *Everybody does sometimes. Look, I'm trying to get the time* [...] [Sean, looking worried, glancing at camera] *Saul , stop it*

121 Fleur: [to Saul, holding clock] *Keep going, keep going. Woah, woah, go back a minute to there, woah woah. That's 5, that's 4*

122 Saul: *Don't you need to go back one more spin, or two*

123 Fleur: *There!* /

124 Saul: *Is this gold?*

125 Sean: *Yeah! Of course it is. Be sensible now. Be sensible and don't mess around*

126 Saul: *Shall I put this folder back?*

127 Sean: *No* [....] [to Fleur, with clock] *We need to leave*

128 Fleur: *Before 3:21*

129 Sean: *No*

130 Fleur: *15:21*

131 Sean: *Yes*

132 Fleur: *15 what? 15?*

133 Sean: *15:21* / [at easel] *Wow! Is that what our boat looks like? That [...] those boats that we can see. / My friends have been doing some lovely paintings, aren't they?*

[Saul inspecting box of artist's equipment, others join him] [...] //

134 Fleur: [returning to clock] *I really don't get it*

135 Sean: *I seriously don't get it*

136 Fleur: *So you have to, basically you have to add notes to the tide chart, the tide information...*

137 Sean: *Here, here*

138 Fleur: *... you have to add notes* [...]

139 Sean: *What does that mean?* [...]

140 Fleur: *But, look, you have to add notes to the tide information to explain each part*

[....]

141 Saul: *That's the tide information*

142 Sean: *That's just an old tide timetable, tide, tide. Right. Set this back up here* [returns clock] *and* [....] *then what do we do? Do we go out? So we set the clock to remind you when to return. Right we've done it. What do we do now, play?*

[...]

143 Saul: *We're done*

144 Sean: *Yes, we're done. Yes!*

[....] [Fleur still mentioning the notes and tide information, looks fed up]

145 Sean: [with tide chart] *Woah! Look at our high tide look, that high!*

146 Fleur: *No, that's, that's the waves. / Sometimes say, this is how far the sea can go up to you, sometimes it's quite low and sometimes its really high. So like this, the sea can be that deep I think, 4 or 5 metres deep*

147 Saul: *That's quite deep tides, that's, when you go to* [beach] *Sean, there's a big orange buoy, sometimes you can't, you can't, you just have to like, go out ...*

148 Fleur: [making swimming motion] *Swim over to it*

149 Saul: *... swim over, and sometimes you can like walk, stand up*

150 Fleur: *So that's right*

151 Saul: *Some of the port's run out of water because it's gone out and that means its gone low. / So does that make sense?*

152 Sean: *Yeah, that makes sense now*

153 Saul: *Good, cool*

[....] [All briefly distracted by teacher's voice talking to another group] //

154 Saul: *Probably like notes*

155 Fleur: [reading from task sheet] *"Add notes to the tide information to explain each part"*

156 Saul: *We have to explain* [...]

157 Sean: *That'll take like an hour*

158 Saul: *We've got like an hour. / Or twenty minutes or so*

159 Sean: *Shall I say 'what does it mean?'*[stands to leave to seek teacher advice] [...]

160 Saul: *Just say you don't understand?*

161 Fleur: *You don't understand, not us*

162 Saul: *Me!*

163 Fleur: *All of us.*

[Fleur and Saul wait in silence for Sean to return, Fleur reading sheet]

164 Sean: *That was as simple as pie*

165 Fleur: *What?*

166 Sean: *Easy peasy lemon squeezy, she said this is how high the tide can be*

167 Fleur: *That's what I said to you*

168 Saul: *It was Sean*

169 Sean: *Yeah, anyway, it doesn't really matter anyway that's our answer*

170 Fleur: *So, what are you writing?*

171 Sean: *'this is how high the tides will go'*

172 Fleur: *OK*

173 Sean: *Right, I need* [...] /

[Saul glancing at camera, Fleur and Sean move and write on sheet]

174 Fleur: *So, this is how high the tide will go*

175 Sean: *Write it above the tide*

176 Fleur: *No you can't write it on the back you have to write it here*

[....] //

177 Fleur: *Is that all you want to write Sean ?*

178 Sean: *That's all we need to. OK [....] Fleur, shall we go out to sea?*

179 Saul: *I'll lower the anchor*

180 Sean: *No higher, bring the anchor <u>up</u>. Lowering the anchor stops us*

181 Saul: *Does it?*

182 Fleur & Sean: *Yes*

183 Saul: *OK, OK, rulers are anchors* [boys mime together pulling anchor – a ruler – up. Fleur watches]

184 Saul: [hopping on one foot] *Ow! My toe! Ow! Oh my toe!*

185 Sean: *Did you hurt your toe*? [hops too]

[Saul mimes moving anchor, re-drops it. Hopping and facial expressions of pain by both boys]

186 Saul: *Ow! That hurt my toe!*

[all laughing]

187 Sean: *Right! Let's go. Are we ready? Let's go fishing, let's go fishing*

188 Saul: OK [Saul casts imaginary rod] *I've caught a pike* [...] *it's a massive one*

[All join in fishing]

189 Fleur: *I caught a fish*

190 Saul: *I caught this, I caught a bit of seaweed*

191 Sean: *Quick! We have to leave* <u>*now*</u>

192 Saul: *Oh yeah, we have to leave*

193 Sean: *We got to leave* [fetches clock and changes hands]

194 Fleur: *Right OK*

195 Sean: *No actually, let's stay out for a bit*

196 Fleur: *Yeah but then we'll be in* [....] *because of the tide*

197 Sean: *I'll look at* this [consults tide chart] *Right* /

[Saul is sitting and 'rowing' with ruler]

198 Fleur: [holding clock]. *Look look look, if we left at 8 o'clock in the morning, now look what time it is, it's half past two, we've got* [....]

199 Sean: *Oh no. / Oh dear!* [takes ruler from Saul] *Anchor please* [puts anchor over side of boat and brings it in again, quickly]

200 Saul: *You just lowered it*

201 Sean: *No we've highered it.* [to Fleur] *No, let's go back in, let's do it all again, let's do that all again*

202 Fleur: [shows clock] *That's 3 o'clock*

203 Sean: *Oh no! 3'o'clock!*

204 Fleur: *What is it quarter to*? [grabs tide sheet] *Oh 20*

205 Sean: *15:21*

206 Saul: *Make it lunch time*

[...]

207 Fleur: *No it's actually 3 o'clock so, yeah we need to get back* [....] *few minutes away and we've got 6 minutes*

[Saul pretends to paint Sean's face] //

208 Fleur: *Do his nose* [takes brush and paints Sean's nose]

209 Saul: *I'll just get the small brush out, get the small brush out...*

210 Fleur: *Yeah, do his nose. Yeah that's good...*

[more painting] [...]

211 Fleur: *Guys, we've only got 5 minutes and we're like*

212 Sean: *Two minutes away*

213 Fleur: *Yeah OK*

[....] [reference to camera and voice recorder by Saul]

214 Sean: *Right everybody, can I tell you something guys? In fact I'll put it back over there and we can go fishing again. Right let's go* [returns clock] / *Hey, let's go fishing shall we everyone?*

215 Saul: [at easel] *No, I'm going painting*

216 Fleur: *Oh yeah, let's do some painting*

217 Sean: *Let's go painting. Let's go painting*

[....] [All 'paint' and painting continues, including careful selecting of brushes. Saul and Fleur at easel, Sean painting 'wall', holding tide sheet]

218 Saul: *Jam-jams, jam-jams. Do you watch that?* [....] [Saul explains a TV programme]

219 Sean: *What are you going to do now?*

220 Saul: *I'm painting my face*

[....] //

221 Fleur: *It's five and twenty past 10*

222 Sean: *Alright everybody, shall we move somewhere else as we only have 14 minutes left*

223 Saul: *14 minutes?*

224 Fleur: *I think we should move back* [....]

225 Sean: *OK let's go. Go, go, go!*

226 Saul: *OK pull the anchor up*

227 Sean: *Go, go, go!*

228 Fleur: *What else do we need to do?*

229 Sean: *Nothing else, just have to wait* [Saul adjusts clock] *now we're back and we can do it all again! //*

230 Saul: [with clock] *OK, look, we've just left. Go!* [clock shows twenty to seven, i.e. hands back-to-front]

231 Sean: *Oh no! oh no!*

232 Saul: *What time is it?*

233 Sean: *Yeah, we've run aground*

234 Fleur: *It's high tide*

235 Sean: *No*

236 Fleur: [refers to clock] *Yeah, because its 8:36*

[....]

237 Saul: [Saul turns clock hands until it says quarter to nine] *Oh no! No!*

238 Sean: *We're still out to sea, we're still out to sea, we've only just left and we're going fishing again now* [uses 'anchor']

239 Saul: *Fishing again!* [Saul turns clock hands] / *Look! Time's going fast! / Time's going fast*

[Teacher calls for session to end. They immediately pack away. Fleur makes final adjustment to clock]

240 Sean: *Oh, that was a great day wasn't it everyone! All that fishing...*

RECORDING ENDS AT 12:15.

(ii) Task sheets for 'Tide Times'

Let's Start Painting

Hemy has decided to go to sea in his floating studio. He knows that the tides are important; he doesn't want his boat to go aground. Can you help him to decipher the tide information?

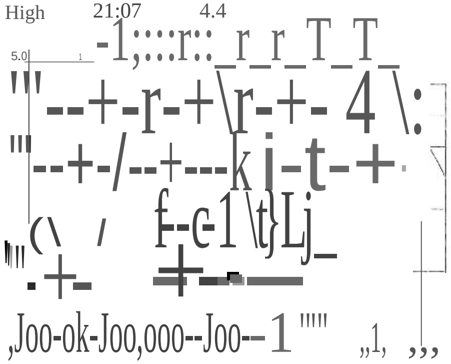
When do you think he should go out to sea each day?

Add notes to the tide information to explain each part.

Go out to sea - set the clock to remind him when to return to harbour.

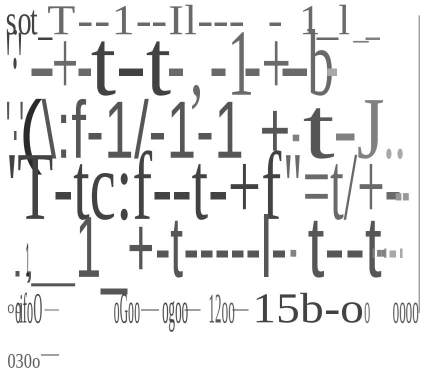
Tuesday 1 Nov

	Time	Height (metres)
Low	02:54	1.1
High	08:36	4.8
Low	15:21	1.2
High	21:07	4.4



Thursday 3 Nov

	Time	Height (metres)
Low	04:39	1.8
High	10:35	4.3
Low	17:21	1.8
High	23:47	3.9



(iii) Task sheet and pupils' recording for 'Fish Patterns'

Let's Get Painting

As Hemy's helpers you have been fishing because he wants to make another painting of the creatures under the waves. Last week he painted

his study of pilchards but he can't make up his mind what to do next.

You have an idea to organise the catch of fish (or some of the fish) in a repeating pattern. Try making several.

Give your fish picture a number title which matches the repeating pattern you have made. E.g. 3 2 1 3 2 1 Take a photo of each of your patterns.

Decide which pattern you like best and work out how many of each fish he will paint if he copies the pattern 5, 10 or 15 times.

Figure 7: Year Four pupil's completed 'Fish Patterns' recording

(iv) Group recording sheet for 'Pricing Paintings' (Figure 8)

The Hemy Art Exhibition

Prices in guineas gns

1	25gns	11	10 gns	21	52 gns
2	60 gns	12	33gns	22	37gns
3	65 gns	13	20 gns	23	12 gns
4	15 gns	14	100 gns	24	24 gns
5	83gns	15	53 gns	25	9 gns
6	27.gns	16	11 gns	26	89 gns
7	61 gns	17	23gns	27	21 gns
8	78 gns	18	28gns	28	16 gns
9	55 gns	19	99gns	29	29 gns
10	51 gns	20	98gns	30	76 gns
				31	54 gns

Opening/Closing times

time opening, AM : ~~10~~ 10:30 o'clock

~~time~~ 9 hours open.

time closing, PM : 6:30 o'clock

(v) Reception transcript: The Dinosaur Café, 'Are you full up now?'

06/03/2012 Reception observation 1: "Are you full up now?"

Children involved: Luke (5y 2m), Lucy (5y 1m), Edie (4y 11m), Sabina (4y 9m), Tilly (4y 6m) and Cathy (4y 3m)

Total length of recording: 6' 35''

On board at back, menu written in children's handwriting can be seen. Legible is: 2 chicken, 3 pear, 4 fish, 5 ice cream.

Luke and Edie are customers. Cathy, Sabina and Lucy serving them.

Luke is 'eating' an ice cream. Edie is standing on the right hand side carefully watching Lucy serving Luke. Cathy and Sabina are in the background.

Lucy: *Are you full up now?*

[Luke (as the dinosaur customer) shakes his head. Lucy roars at him. Luke picks up two sticks, holds the two sticks apart, ready to hit them together]

Sabina: [holding up a coin/disc] *Lucy, our, this is <u>our</u> money*

[Luke strikes the two sticks together firmly eight times. Lucy is listening to Sabina and then glances at Luke]

Sabina: *Only one explorer's, that's one bit of money [...]*

Lucy: [to Luke] *Is that nine?*

[Luke nods and Lucy turns to fetch him something]

Lucy: *[....] ten. It has to be a chicken* [laughs, and hands plastic chicken to Luke]

[Luke 'eats' the chicken. Edie is smiling]

Lucy: *Are you full up?* [laughs]

[Luke shakes his head (no) and holds sticks to signal, strikes them 10 times. Lucy can be seen counting alongside]

Edie: [Smiling to adult out of shot] *He'll eat all the food in a minute!*

Lucy: *10?*

[Luke nods. Cathy shows him a pineapple, Luke doesn't take this and Lucy, after consulting the price board, [laughing] hands him a corn on the cob. Luke 'gobbles' the corn]

Edie: [to Luke] *[...] full up now?*

[Luke shakes his head, Lucy laughs, Cathy offers him something, which is 'eaten'. Luke strikes the sticks together seven times. Lucy can be seen concentrating on counting, eye movements obvious, down to left hand side as I face her]

Lucy: *Six?*

[Luke nods. Lucy consults board, then searches for something. Sabina is on the telephone in the background. Luke is looking in the food boxes]

[...]

Luke: *I want this [...] one*

Lucy: *We haven't got a, we haven't got any [...]. We need to get some [...]*

[Tilly appears from the right, next to Edie. Lucy offers Luke something flat]

Edie: [back to camera] *[...]*

[Luke takes the item out of shot and 'gobbles' it. Edie claps. Luke returns with the sticks. Sabina is saying something unheard to Lucy whilst Luke strikes the sticks together seven times. Cathy is putting a sandwich together and offers it to Luke]

Cathy: *I made this sandwich*

[Luke roars and shakes his head]

Cathy: [to Edie] *Sandwich?*

[Edie takes it and drops it into the box. Luke roars and strikes the sticks twice, then carries on striking them another15? times]

?*: What do you want there? //*

Cathy: [with bread] *I've got all of this*

[Lucy puts her arms around Edie and Luke, talking to them. Luke strikes sticks. Lucy checks number with him, he shakes his head and roars, tapping sticks six times]

Lucy: *Is that five?*

[Luke nods and Lucy goes to board and to fetch food]

Edie?: *Are you full yet?*

Cathy: *Here's a chocolate ice cream for you*

[Luke 'eats' this. They all watch him, smiling]

Lucy: *Are you full up now?*

[Luke shakes his head and taps the sticks five times. Lucy counts silently alongside]

Lucy: *Six?*

[Luke waves his open hand at her, shaking his head]

Lucy: [turning] *Five*

[Lucy gives Luke something, which he 'eats'. She and Edie watch him. Sabina can be seen on the right counting the holes in a Numicon 10-shape]

Lucy: [smiling] *Are you finished?*

[Luke, roars and strikes sticks 6 times. Lucy can be heard counting. Cathy on the left 'eating' an ice cream]

Cathy: [giving Luke an ice cream] *You eat that*

Lucy: *Is that seven?*

[Luke, 'eating' ice cream, holds up open hand of five fingers and then one thumb]

Edie: *Is that six or five? //*

Lucy: [stroking Edie] *You're meant to be a lion*

Luke: *I'm finished now* [leaves]

[Cathy holds a basket of food, Sabina still with tray of Numicon. Edie does a funny walk, some roaring]

(3 minutes)

Lucy: [to Edie] *Are you a dinosaur?*

[Edie taps the sticks five times]

Lucy: *Was that five?*

Edie: *Five!* [Roars. Jumps up and down] *Five! Five! Five! Five!*

[Cathy hands her a double ice cream cone]

Edie: *Oh! Goody!* ['eats' cone, laughter]

Cathy: *Put that there, no*

Lucy: *Are you full up now?*

Edie: *No* [strikes sticks five times]

Lucy: *1,2,3,4,5,6. Was that Six?*

Edie: *Five*

Lucy: *Five! Again?* [glances at board and searches for food] *5 again*

Sabina: [grabs basket] *I give the ice creams out*

Cathy: *Yes, there's money [....]*

[Cathy in background, banging sticks together]

Cathy: [rhythmically] *Who wants to come to our café?*

[Edie 'eats' ice cream given to her by Sabina. Cathy on telephone. Edie bangs sticks 4 times and jumps up and down [...]. She then 'eats' fish given to her by Lucy]

Lucy: [holding microphone, to Tilly] *Say what you want*

[Lucy hands Tilly the sticks and waits. Tilly bangs sticks four times]

Lucy: *Was that five?*

[Tilly's response unheard]

Lucy: *Four. Ok.* [hands Tilly fish] /

Lucy: *Are you full up?*

[Tilly shakes head and bangs sticks 5 times]

Lucy: *1,2,3,4,5,6. Was that six?*

[Tilly's response unheard]

Lucy: *Sabina* [...] [then to Tilly] *She's making the ice creams / [....] ROAR!*

// [Cathy brushing floor, Sabina making up the ice creams, Tilly and Lucy waiting]

Lucy: [moving bulldog clip on menu board] *The shop is not shut down. Whoever [....]*

[Sabina gives Tilly an ice cream]

Sabina : *Do you like chocolate? //*

Cathy: *It's not closed yet*

RECORDING ENDS AT 6' 35"

APPENDIX FOUR: RESEARCH DATA

(i) Samples of Re-view interviews with children

a. Year Four

Re-view of Group 2, Observation 1 'Tide Times': 07/11/2011

Length of recorded interview 19 minutes 47 seconds

Children interviewed: Saul (8y 5m), Sean (8y 6m) and Fleur (9y 1m)

[Children watch video extract 01:33 – 05:00; lines 32-73 of transcript included as Appendix 3 (i)]

1 Sean: [...] *about how we can improve it, make it more interesting for people to listen to*

2 HW: *Well I thought that was very interesting to listen to, because I think there was a lot going on there. What did you, what can you remember doing when you were, what do you think was going on in your heads when you were working on that problem?*

3 Saul: *Time*

4 Fleur: *Yeah, time*

5 Sean: *Time*!

[Pause]

6 Saul: *Lunch*

[Laughter]

7 Sean: *On the last part Saul was talking about lunch, weren't you?*

8 Saul: *Yeah, because I was getting so hungry because we, like, messing with time*

9 Sean: *Yes, because we done our activity so we decided to do it a few more times, and after we did that Saul was, like, when is it going to be lunch*

time? And I had my watch on me and he was like, counting on the watch, how long it would be [laughs]

10 HW: *What about your ummm, were you doing there Fleur, when you had your head in your hands?*

11 Sean: *I think she was...*

12 Saul: *Oh, she was holding the clock*

13 Fleur: *Yeah, I was like counting what time it would be 'cos it said 21 and I go like that 'cos it was, 'cos it said 21 something I go like that with my fingers to know what time*

14 HW: *What were you working out?*

15 Fleur: *'Cos, and like, 'cos Sean said we needed to be back at that time so I was getting the clock ready for that time, so when it...*

16 HW: *You were trying to find 21 on the clock?*

17 Fleur: *Yeah and I'd go like that...*

18 Sean: *Because before we did that we doing our fives round the clock and we were going earlier, then we realised that it went in fives, so we had to realise that one of those in the middle must have been it, so we had to work out the exact one*

19 HW: *Hmm. Because 21 doesn't come when you are counting in fives?*

20 Sean: *No, so we had to really work it out as a group*

21 HW: *Hmmm. What do you think Saul?*

[2'22"]

22 Saul: *Well, if we were saying 21 is the nearest to 21 is either in the lower one or the highest one. So it would be like 21 is near 25*

23 Sean: *And 20*

[HW laughs]

24 Fleur: *Nearest to 20*

25 Saul: *Nearest to 20*

26 Fleur: *And on the sheet on the way back it was saying over 12, midday, so when it's like that I count up to what, what time it would actually be on the clock*

27 HW: *Oh, so that's when you said three?*

28 Fleur: *Yeah*

29 Sean: *So we really had to work as a group like we were doing, and it's very important that if you do get it wrong, then you're not gonna, then you learn don't you ...*

30 HW: *Hmmm ... ?*

31 Sean: *... What to do next time*

32 Saul: *Yeah*

33 HW: *Hmmm. Yeah, I think mistakes are quite good sometimes, aren't they?*

34 Sean: *They are but if you make them very often*

[HW laughs]

35 Saul: *They are better than knowing the answer, because like, something new you can remember and something old you sometimes forget it*

36 HW: *Hmmm ...?*

37 Sean: *But you need to go over it, like in piano, you have to go over things that you can't remember...*

38 HW: *Hmm*

39 Sean: *... so you don't, so you don't forget it...*

40 HW: *Hmm*

41 Sean: *... so if you have to do it again, you are stuck aren't you!*

42 HW: *Yes, so going over it, because one thing that struck me when I was watching it is that you did, you did all the task and then you did all the task again, you put, went out to sea and then you did it all over again!*

43 Sean: *That time we went fishing* [laughing]

44 HW: *Yes*!

[...]

45 HW: [I have heard the word 'bored'] *Because you were bored?!*

46 Fleur: *It didn't have anything to do with* [...]

47 Saul: *It's quite good to do it again, and you can't, and you can like do the stuff you, like, mistaked* [sic]

48 Sean: *Yeah, it's a lot better if you don't make a mistake a second time, so then you learn something from the first time*

49 HW: *I think you were quicker the second time*

50 Fleur: *Hmm, because we knew what to do*

51 HW: *Hmm. Do you think, Fleur, it's interesting you said bored, because I suppose*

52 Fleur: *Like, when you've done it you've got nothing to do and you get bored*

53 Sean: *And you can't do the new activity until the week after...*

54 HW: *No?*

55 Sean: *... so you're pretty stuck if you don't*

56 HW: *So, you've got to come up with something of your own to do in that time?*

57 All: *Yes*

58 HW: *Is that good, is that good?*

59 Sean: *Well it is if it's, if you haven't done it too quick then you have to spend more time doing your own thing which is more... boring than doing the activity because the activity is fun because it takes a while to do ...*

60 HW: *Hmmm*

61 Sean: *... and you really have to think about it*

62 HW: *Shall we have, shall we just watch that bit again, do you mind? ...*

63 All: *No*

64 HW: *... and see if there's anything you didn't notice the first time, because I think that you all did something in this, ummm, sorry I'll just do the full screen, I think, don't you?*

[All watch same video extract together. 5'48"]

65 Saul: [As he watches] *I like these* [....] [referring to bulldog clip on easel]

66 Sean: *I'm saying to Saul, it's supposed to be on there and not to take it off!*

67 Saul: *Yes, but there's still another one*

68 Sean: *Yeees but you're supposed to keep it on there, not move it to...*

69 Saul: *But they're cool!*

70 Sean: *You can buy one of your own then, you can get them in shops!*

[Pause]

71 Fleur: *That's funny!*

[Pause]

72 Fleur: *This bit's really funny, Sean's just sort of wandering*

[....]

73 Sean: *There you go, you're arguing against each other like*

74 HW: *Oh! Let's just pause it.* [I pause video] *What's going on there, Fleur?*

75 Fleur: *[...] the time*

76 Sean: *And I wasn't quite sure how ...*

77 Saul: *Yeah, because he was like wandering around*

78 Sean: *... No, I wasn't, but you two were arguing!*

79 Saul: *We weren't arguing we were [....] sorting it out*

80 Fleur: *I was telling him*

81HW: *Yes, it was good arguing I think, they weren't like, falling out, they were like disagreeing [...] so what's that clock showing there?*

82 Sean: *Fleur was showing me ...*

83 Fleur: *8:36*

84 Sean: *.... because I was telling Fleur that I am very good at time but on the handed clock it's not as easy as a digital clock for me, I find digital more easy*

85 Fleur: *Yeah*

86 HW: *Do you agree? With that? That's a good point actually, do you agree with?*

87 Saul: *I find the, the ones with the ...*

88 Sean: *So I asked Fleur if she could show me*

89 Saul : *... not like Sean, like on the digital clock it's quite hard to tell, because there's like one number in one space and then another number in the other space, so basically, I only know like the o'clocks, because it's like simple on a digital clock. Because like all of the other times are really hard because they, like, show numbers that, like 15, like I sometimes think like, 15 isn't on a real clock!*

90 Fleur: *Yes ...*

91 Saul: *So it's confusing*

92 Fleur: *... yes, when you get past the 12 on the digital it goes like 13,14,15 so if it's 15 you take away two and that makes three 'cos it's 3 o'clock, that's how I work it out ...*

93 HW: *Ooo! Handy hint! Does that always work?*

94 Fleur: *... yes, because if it's 10 [....] 12 and that's midday and then it goes 13, so I take 2 away to remind me*

95 Sean: *I was saying that in there, that I asked Fleur to show me because as I was saying I find digital more easy than ...*

96 HW: *... than analogue it's called when, analogue, have you heard that word before?* [all nod or say yes]

97 Sean: *... analogue, so I needed to check what time that would be*

98 HW: *So was that helpful?*

99 Sean: *Yes it was*

100 HW: *So did you say, did I understand you to say, Saul, that you thought digital is harder?*

101 Saul: *Yes*

102 HW: *Now that's interesting then, that you find that, you are different to each other then?*

103 Fleur: *I don't, I don't really, umm, I think Mrs R mixed us up if Sean knew digital and not the clock thing and Saul knows clock but not the digital, so we can help each other...*

104 HW: *So that's why she, that's why you think she put you together, ahh, yes, yes*

105 Fleur: *... yes, 'cos he knows digital but not clock and me and Saul know clock better, so*

106 Saul: *How many times people go over digital I will just ask them to go over it again, because I have no idea, I don't get it, it's hard*

107 Sean: *When it says on that tide times sheet ...*

108 HW: *Hmm?*

109 Sean: *... I could understand it because it was on digital, but on a clock I wouldn't have been able to make the numbers*

110 HW: *That's this sheet? This sheet here?*

[Indicates tide times task sheet included in Appendix 3(ii)]

111 All: *Yes*

112 Sean: *I wouldn't have been able to make those on a real clock*

113 Fleur: [...] *working out to the 21*

114 Sean: *I wouldn't have been able to do that on that clock*

115 HW: *But Fleur did it and that helped...? Yeah, because finding 15:21 on an analogue clock is hard isn't it?*

116 Sean: *Wait a minute!*

117 Fleur: *Yeah, 'cos the clock goes around twice but like it [...] up to 21*

118 Saul: *8:35, we were doing 8:35, aren't we?*

119 Sean: *No, 8:36 to 15:21* [all join in saying "21"]

120 HW: *So, that was your gap between*

121 Sean: *Yeah, 'cos I thought to myself, that's a long enough gap and that's the only one really one that [....] so we had to take our chance*

122 HW: *Hmm how long a gap is that though?*

[11'09"]

123 Fleur: *Because you <u>might</u> sleep overnight ...*

124 Sean: *You might want to!*

125 Fleur: *.... and you would come back at 2 o'clock ...*

126 Fleur and HW: *... in the morning!*

127 HW: *That's that one there, I see, so this is the, you chose these ones because it was daytime*

128 All: *Yeah*

129 Sean: *And that was afternoon. I'm just going, I'm just going to work that out so I can tell the time* [thinks]

130 Saul: *Time makes me hungry*

131 Sean: *3:21*

132 Saul: *Seriously?*

133 HW: *That was quick!*

134 Sean: *'Cos I know that 13 is one o'clock, 14 is 2 o'clock then I thought 15 must be 3 o'clock!*

135 HW: *Actually, Fleur did it a different way, did you hear the way Fleur did it?*

136 Fleur: *If you go to... you know when you get to 10 it normally goes like that, well because it goes up to 12, you take, whatever the number is, on the 15, you take two away and which ever number you are left with [...] it's 3 o'clock, so if it's 13 it's 3 o'clock*

137 HW: [Pause] *If it's 15?*

138 Fleur: *If it's 15 right that's 3 o'clock, you go, take two and then it makes 13 so that is how I remember it*

//

139 Saul: *I split my finger* [....]

140 Sean: *As you were saying, that was the difference between those I can tell the hour difference [pause, thinks] it's a seven hour difference*

141 HW: *Seven hours between, when you are at sea?*

142 Sean: *Or six, I'm not sure which*

143 HW: *Six or seven hours, that's a good estimate! I think that feels about right*

144 Fleur: *Seven hours, seven hours and 12 minutes*

145 HW: *Fleur is agreeing with you*

146 Sean: *I just leave the minutes between, but I know the hours*

147 Fleur: *It's about, it's about*

148 HW: *You'd need to take sandwiches if you were there for seven hours, wouldn't you?*

149 Fleur: *Basically it's about seven and a half hours*

150 Saul?: *Yeah*

151 HW: [re-starts video] *Hmmm, very good! Do you want to say anything else about what you did that day, is there anything, err that you'd really like to say about what you were doing?*

152 Saul: *Not really*

153 HW: *Are there any bits where you are being really clever, do you think?*

154 Sean: *Hmm – no!*

155 HW: *No?! You don't think so?*

[The others agree with him]

156 Sean: *There might have been after that when we did it the second time, but not in the first time*

157 HW: *You don't think you were being really clever?*

158 Sean: *No! Not the first time!* [laughs]

159 HW: *Really?! Why are you laughing?!*

160 Fleur: *I'm not clever*

161 HW: *You're not clever? That's a funny thing to say*

162 Sean: *We're not clever though!*

163 Saul: *I'm not clever with the time one* [....]

164 HW: *I think you were being very clever there*

[Pause, silence. Watching video]

166 Saul: [....] *there that day*

[Discussion about hairband Saul has picked up in video]

167 HW: *This is interesting Saul, you are talking about something, about fishes here*

168 Sean: *Yes, because we were talking about going fishing*

169 HW: *No, I think it was before that, before that, what were you saying there?*

170 Saul: *Err, sometimes, I have like, Kayaks and I go fishing with my Dad and umm, me and my dad sort of think about the time and he talks about low and high so, umm, when I go fishing he often says to go out like high, so normal like high, 'cos most boats go out*

171 Fleur: *If it's low tide, if it's low tide you can't get out*

172 Sean: *No, and we could have gone out at 21:07 'cos then you can't go out 'cos it's low tide*

173 Saul: *Yeah you have to think sometimes, about the Vandermeer is quite big*

174 HW: *That's a good point, it's bigger than a kayak, too*

175 Saul: *Yes*

176 Fleur: *And sometimes, sometimes in the harbour, in the river going down to* [Port], *there's umm, in the middle when you go to the docks you have to go*

all around instead of just the short cut, because the short cut like, is normally low tide

177 HW: *Ah*

178 Fleur: [....] *because the big ships have to go around, because that's where its [....]*

179 Sean: [referring to the typed transcript] *How did you get all that there?!*

180 HW: *I typed it all up there! It took me ages! So Saul, you said about the fishes, that's when the fish come in, so if you want to go fishing you have to be back in by high tide*

180 Saul: *Yes because Sean was talking about fishing*

181 Sean: *I was saying to Saul that when we finished our task we could go out fishing!*

182 HW: *And you did*

183 Sean: *And there's a seven hour*

184 Fleur: *Seven hour?*

185 Sean: *Seven-and-a-half hour difference, so it would have taken a while to get back to*

186: Saul: *He couldn't* [....]

187: Sean: *Why are you holding me on the shoulder like that?*

188 Saul: *He might, he might not only draw, he might like, who knows what he does? He might like, do different stuff*

189 Sean: *Yes! I do do different things than you do expect*

190 HW: *Yes! You mean Hemy?*

191 Sean: *Yes*

192 Saul: *Yeah, 'cos Sean just looks like a boy who, like, just watches TV...*

193 Sean: *... but I do ...*

194 Saul: *... but you generally do stuff, quite a lot*

195 Sean: *... I do, I do more than you expect I do!*

196 HW: *I'm sure you do!*

197 Fleur: *If you look at the Hemy picture it looks as if he's painting*

//

198 HW: *I'm going to give Mrs R a copy of the video and she's going to use the first bit to show the rest of the class*

199 Sean: *Our bit?*

200 HW: *I think so, I think she is, I've given her both of them but I think she's going to choose that one, because we were talking about it afterwards, and I think she's going to think about, get the class to think about all the different sorts of maths that's going on in there*

201 Sean: *Oh! I'm so not going to be happy ...*

202 HW: *Why?*

203 Sean: *... I'm going to make sure I'm going to be ill that day!*

204 HW: *Are you really not happy or are you just a little bit embarrassed but it's OK really?*

205 Sean: *I'm really not happy!*

206 Fleur: *It's embarrassing!*

207 HW: *Really?*

208 Saul: *If there was a clock in there and you could change it, you could make time go backwards*

209 HW: *Do you want me to ask her not to do it?*

210 Sean: *No. It's OK, but I think other people should know that*

211 HW: *That you feel a little bit unhappy about it. Well, OK I'll tell her about that. Well, thank you very much and I'll be seeing you again on Tuesday, tomorrow, when I think you're back in there again with another task! Do you know what the task is this week, have you already talked about it?*

[Lots of talk and disagreement about whether not they have been given a new task].

Recording ends @ 19'47"

b. Reception Re-view interview

Reception: day four of 'Faster than Usain Bolt', 31/05/2012

Length of recorded interview: 11 minutes 26 seconds

Children interviewed: Elliot (4y 11m) and Mark (5y 1m)

[Children watch extracts from Video14 (day 3) in which they feature]

HW: *I wanted to ask you, I was just thinking about what you were, what you were working on. Let's just watch a little bit at the beginning and then we'll watch another little bit /*

Mark: *Oliver was cheating ...*

Elliot: *O...*

Mark: *... I know*

Elliot: *Yes*

Mark: *He's a cheater*

Elliot: *Yes, Jacob is a cheater he go past me*

Mark: *Yes, every time, Oliver pushed*

Elliot: *I got a ten I got a ten I got a ten!*

[...]

[Not transcribed – very obvious pleasure when spot others and themselves, laughter. Intently watch film.

At 2’38” when I sense their interest waning a little, I fast forward to another section]

Elliot: *It’s doing fast forward* HW:

It is doing fast forward, yes Elliot:

Yes, I can do that on my TV Mark:

TV?!

[Laughter]

Mark*: Oliver said he won, but he didn’t, he’s a cheater. Isn’t he? He’s a cheater*

HW: *So Elliot, what are you doing there?*

Elliot: [peers at laptop screen] *Errrr, I need to see properly and I can’t see properly*

HW: *No we need to see the board. Can you remember what you were doing? Err,*

Elliot: *Err, no. Hah, I got that on*

Mark: *I got a band, I got yellow, you got red, cos I’m in Ricky’s team*

Elliot: *And I’m in Oliver’s team*

//

Elliot: *Ah! There’s you with the red band*

[...] [Boys being a bit silly]

HW: *There you are again, Elliot. What are you doing down there with Oliver?*

Elliot: *Err, writing my score* [smiles at me]

Mark: *Scoreboard*

HW: *What were you learning about, then?*

Elliot*: Err, Racing*

HW: *Racing?*

Elliot: *Yeah*

HW: *Yeah? And what were you learning about racing?*

Mark: *We was running and Ricky, I said if use your hands you'll go faster*

Elliot: [arms raised] *Ricky was using, he was using, he was flying like that*

Mark: *No*

Elliot: *Like that*

Mark: *No, that's* [...] *what Usain Bolt's* [...]

HW: *See, you are doing it again, Elliot, you are going to write something down. What were you thinking about? What were you thinking about?*

Elliot: *Errr* [...]

HW: *Let's see if you write on there again / yes! There you are again, Elliot*

/

HW: *Look, Look, Look!* / *So what were you thinking about there? / What were you thinking about there, Elliot?*

Elliot: *Writing my score down again*

Mark: *Like a monkey*

[Mark is trying to distract Elliot by making silly sounds and poking him. I choose to ignore this as Elliot is laughing]

HW: *Can you remember what was happening with your scores?*

Elliot: *Err, going really / fast*

HW: *You were?*

Elliot: *Yeah. They were going a little bit slowly [...] and then, an little bit* [sic]

[...] [looks around] *Why's that window there?*

HW: *Say again, they were going a little bit*

Elliot: *Faster*

HW: *They were? What, each time?*

Elliot: *Yes. Err, I don't know*

HW: *Can you remember any of them?*

Elliot: *I can't*

[...]

[About 5 mins into interview we look for Mark, and I ask what's happening there]

Mark: *I was writing my score down 'cos Oliver always does big ones and he does scribbles sometimes on the scores* [waves arms]

HW: *Oh, were you trying to get your writing in on that board, then?*

Mark: *Yes*

Elliot: *That's me*

Mark: *Oliver scribbles on my part*

Elliot: [points at screen] *That's my one, my thing, my*

HW: *So, can you remember what you were thinking about with your scores? What were you thinking about? /*

Mark: *Err, we was / if you get faster you'll get a bigger number /*

HW: *If you get faster you'll get a bigger number? Can you tell me a bit more about that?*

Mark: *If you get <u>slower</u> you'll get a bigger number. If you go faster you'll get a <u>smaller</u> number*

HW: *Ahhh*!

Elliot: *And if you go <u>really</u> fast you will get a zero!* [waves arms in circular movement]

Mark: *No you won't Elliot!* [They both smile]

HW: *If you went so fast as /*

Elliot: *Pop*!

HW: *So teach me about that Elliot, teach me about that*

Elliot: *If you went <u>really</u> fast you will get zero!* ['writes' a zero in the air]

HW: *Help us learn about that, how would that work?*

Elliot: *If you move your arms go really fast, umm...*

Mark: *No*

Elliot: *... you will get zero* [writes a big zero in the air with his finger]

Mark: *No! How would you get zero, you're not running! / If you get zero* [both boys laugh]

HW: *What do you think about what he said, Elliot?*

Elliot: *I don't know*

Mark: *I don't know*

HW: *Shall we have a look at a bit more?*

[We continue viewing the clip from 7' 19" - not transcribed. Boys making noises. Distracted]

HW: *You say stop when you think you're being really clever, when you see yourself being really clever*

Mark: *I don't know. I don't know where I am 'cos I can't see myself*

[At 8' 41" we are searching for them - some not transcribed]

Mark: *There's Ricky starting fast* [Ricky is in the position of a racing start]

Mark: *Oliver was arguing with me*

HW: *Oh, that's right* [dispute over the start line]

[The voices on the video can be heard. Mark is racing and others are chanting his name. Someone calls out, "Mark, you got a one and a five"]

Elliot: *A one and a five? That's fifteen* [writes it in the air]

/ [Boys watching video]

Elliot: *I'm nearly going to have a turn*

[Not transcribed - Elliot can be seen looking at the sky. He remembers looking at a jet]

Recorded interview ends at 11minutes 26 seconds.

(ii) Sample of electronic fieldnotes

9th June 2011

Thoughts on two RM seminars yesterday:

<u>Gender in Educational Research</u>

- relevant to METHODOLOGY: Feminist challenge to 'trad' research and view of 'value neutrality', and to what considered to be 'valuable' and acceptable topics for research – ie the personal.

'value neutrality' – by making claim to this you are accepting of a hierarchy – putting yourself 'above' others. Power relations of research. Being close to what/who you are researching.

Semi-structured interviews – asking same q of all, but space to probe answers.

Gender – (Fleurcis) is gendered behaviour innate or socially constructed?

Foucault (1972, 1984) power borne by discourses – individs as positioned in and produced by discourses; as powerful and powerless in diff sits and times.

Gendered behaviour to some extent socially constructed. Gender as s/thg we 'perform', rather than existing 'out there' – Judith Butler.

(How) do I analyse classrm beh without/with ref to girls/boys? Reflect on terms used, beh expressions that mt be gendered, such as 'aggression' or 'manipulation'.

<u>Visual Research Methods</u>

Need to read up on <u>Visual Ethnography</u> and perhaps ask for additional sessions with RM? – spk to GC and SG.

Sarah Pink (YouTube) – Bk 'Visual Doing, Visual Ethnography'(2001) -chap on videoing.

Ref: <u>ROSE 'Visual Methodologies'</u> (2002) – read up on theories of image analysis.

Getting readers into my thkg thro visual methods – photo 'essay' of school/role play with the abstract?

What are the images associated with my research topic? Using photos as part of the data, rather than simply illustrative. What can you tell about this research from this image?

Using images to probe with chn:

"Find one image that sums up what you thk/feel about .... ?"

"why have you chosen...?"

Case study and photo-sampling.

Putting images together to say something.

7th September 2011

In school Mon and Tues, start of new year. Staff meeting explained my position for coming yr – 1 day per wk for sch devpt and one day from mid Oct for gathering data for my RP. e/one seems happy.

Met each teacher individually to see where they were with their RP and what support needed.

3 things said of note.

- (Y2) and (Y6) – really didn't feel the RP was 'hitting the spot' with e/one. I suggest using the devpt of a story in the first weeks, and forgetting the maths acts until the story and/or characs develop. We can then use this to spin some maths problems. V happy with this idea.
- (Y5) – wondering if it matters if chn in character or not? what is the purpose of the RP and maths? Decided that it is imp they experience some opportunities to solve some maths probs collaboratively, not nec in character. He said: "They were solving a problem that Richard Trevithick would have had to have solved" – ie in role in that sense (he was talking of one of the problems he thought was most successful last yr, when they had plans to make a mini steam loco from construction equip, but had to double the size of the plans. Led to an enormous amount of discussion – espec over wheels! Is this a bit like Donaldson's 'human sense' ?
- (Y3) – one of the first things her new class asked her on day one – 'what is our topic?' "What is our RP going to be?'

Yesterday a grp of folk visited and worked with the chn related to the Falmouth 350 celebrations. 2 things – how the woman used ' in character talk' to get chn involved and behaving in a partic way – eg "stand up STRAIGHT" "Chests out, Royalists” etc. man didn’t manage to do this and the result with this grp was not as impressive!

They used a 3D ‘map’ of Falmouth to show chn route of celebration thro’ town. She used voices etc to show chn what they would experience – I could use similar small world idea to model RP behaviour.

5th October 2011

After discussion with supervisor:

Arranging observation and research visits with PR, Y4 teacher for after half-term. Is it better to observe different (ability) groups over the period, or the same grp several times? and if the latter – which group?

SG – what is my hunch? Will, if I observe the higher attainers, folk say, well is that (result) because they are the higher attainers? Lower attainers will produce a powerful result. Where might I be sure of seeing something? If it works with the lower ability – it might work for the rest. Research shows that lower attainers are confused by context – Cooper and Dunn (see Clausen May and Vappula artic on hard drive) in sec schools (S has dyslexia primary ref). Penny Latham says what works with the just below average grp will work with rest of class.

HW – my hunch is observe one grp, because that is how teaching works in this class (recommended A4L) – set task, analyse, adapt, set next/follow-up task. Talks with teacher and chn will cause us to adapt what we do, try something and I can watch that develop; rather than contrast ‘same’ task (it won’t be!) across different children.

Lower attainers because there was some evidence in pilot (NCETM) that lower attainers displayed surprisingly high levels of involvement and resilience. Also –

higher attainers were not so switched on by the RP, didn't show as high levels of enjoyment when polled as others, so that's why started 'maths club' of pure maths acts for them. Can go back and try ideas/themes with other ability grps in summer term if nec- to check stuff out.

So one grp – just above average ability – leads to 5 'Triangles', Tues ams.

20th October 2011 – o/heard on Radio 4, Woman's Hour: interview with Valerie Walkerdine

Quote re. aspirations for those not expected to achieve that much: "*We have to take seriously issues of fantasy and imagination."*

She was talking about working class girls and their identification with 'Chalet School' books, even tho' these are/were far adrift from their lives.

APPENDIX FIVE: ETHICS

(i) Completed ethics form

Roehampton University London

ETHICS

APPLICATION FORM

PLEASE CHECK THE RELEVANT BOX *(NB. double click on the check box and select 'checked')* MEMBER OF STAFF ■ RESEARCH STUDENT ■ (MPhil, PhD, EdD, PsychD) EXTERNAL INVESTIGATOR ■ STUDENT (Other)** ■ *If you are a transfer student or conducting collaborative research you may not need to complete this form, please see Section 2.2. of the Guidelines. **If you are on a taught course you do not need to complete this form unless your project is worth more than 50% of your total credits or you have been asked to do so by your supervisor*	
SECTION 1: PERSONAL DETAILS *Please complete the header with your name and Department*	
Name (lead):	HELEN JANE WILLIAMS
Other investigators:	
Correspondence address:	
Telephone no:	
Email:*(all correspondence will be sent by email unless otherwise requested)*	
FOR STUDENTS ONLY:	
Programme of study:	MPhil (PhD) Education 85RL0009
Mode of study (full-time/part-time)	Full time
Director of Studies:	Dr Sue Gifford

(If you are on a taught course please give the name of your supervisor)	
FOR EXTERNAL INVESTIGATORS ONLY (please see Section 4.5 of the Ethical Guidelines):	
Name of Academic Assessor:	
SECTION 2: PROJECT DETAILS	
Title of project:	**To investigate the teaching and learning of mathematics through role play**
Proposed start date: *(Please note it can take several months to get approval. The Committee will not approve a retrospective start date)*	January 2011
Duration:	18 months for data collection

Purpose of the proposed investigation :
This section should include the material which outlines the rationale for the project, i.e. why this study needs to be done. This should be done in a way that is both accessible and scholarly, i.e. have proper cited sources.

Alongside much anecdotal evidence, there is ongoing research documentation of all ages of learners' disengagement from mathematics, despite their level of educational achievement (Hughes, 1986; Askew & Wiliam, 1995; Nardi and Steward, 2002, Klein, 2007). It is a concern that it remains socially acceptable to state "*I am no good at maths*". As a primary teacher, I am interested in fostering curious and engaged learners. My research will investigate the potential for the learning and teaching of mathematics in the early and primary years, through drama, imaginative and role play, seeking to see if such an approach can influence pupil engagement and involvement in mathematics.
Children are naturally curious and yet mathematics is still approached by many as subject matter 'passed on' to learners. Since Polya's important book (Polya, 1944), mathematics educators have considered how to help student mathematicians become confident as well as proficient and the recent Rose Review (DfES, 2009) states that *how* children learn is as important as what they learn.

There is anecdotal evidence of the power of story in creating vivid and memorable images in the mind (Zazkis & Liljedahl, 2009) and the potentialof drama and role play to both engage participants and to enable participants to reflect on what has been learned, and to consider alternative courses of action (Klein, 2007). As such, drama and role play have long been accepted as useful learning tools in business as well as in school scenarios such as sex education and bullying. Reflectiveness and metacognition are both recognised components of effective mathematics learning (Mason & Davis, 1987; Mason, 2008). I wish to examine how useful drama and story might be in learning mathematics, in;

- engaging children in memorable mathematics; and,
- developing children's reflectiveness and awareness of their own mathematics learning.

Despite the existence of the ubiquitous 'role play area' in nearly every early years setting, there is little research into how this may be used to develop children's mathematical understanding. Indeed, there is evidence that despite adults planning to use this role play to develop mathematics activity, this does not take place in practice (Gifford, 2005). With older learners, projects such as Realistic Mathematics Education (www.fi.uu.nl/en/rme Twomey Fosnot & Dolk, 2001, 2002) and the KS3 'Bowland' materials (www.bowlandmaths.org.uk, Onion et al., 2008) set mathematical learning in a series of 'real life' contexts aimed at developing children's understanding of mathematics. There is anecdotal evidence from both projects demonstrating an increase in pupil engagement. However, there is little other rigorous examination of how role play and drama might facilitate children's mathematical learning and engagement, and none into child-directed learning.

Current guidance on teaching and learning in the early years draws a distinction between 'child initiated' and 'adult initiated' learning (DfES, 2007) but there is no agreement on what these terms might mean in practice. Neither is there any clarity on what 'child initiated mathematical learning' might look like, or what the benefits of this might be. My research would seek to clarify terms in common educational use such as 'child initiated' and 'child directed' and explore what these might look like with different age-groups.

REFERENCES

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DfES (2009) *Independent Review of the Primary Curriculum: Final Report;* HMSO (The Rose Review)

Gifford, S. (2005) *Teaching Mathematics 3-5: Developing Learning in the Foundation Stage*; OUP

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Mason, J. & Davis, J. (1987) *Elements of a Theory of Cognitive and Metacognitive Shifts*; Proceeds of PME XII, ed. J. Barbar

Nardi, E. & Steward, S. (2002) 'I could be the best mathematician in the world... if I actually enjoyed it.' *Mathematics Teaching 179*, June, ATM

Onion, A., Lane, P., Lister, A. & Wintle, K. (2008) 'Bowland Maths: Problem solving in Key Stage 3', *Mathematics Teaching 210*, September, ATM

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Twomey Fosnot, C. and Dolk, M. (2001, 2001, 2002) *Young Mathematicians at Work: Vol 1 Constructing Number Sense, Addition & Subtraction; Vol 2 Constructing Multiplication and Division; Vol 3 Constructing Fractions, Decimals and Percents*; Heinemann

Zaskis, R & Liljedahl, P. (2009) *Teaching Mathematics as Storytelling;* Sense Publishers

Outline of project:
This section should include the details of methodology i.e. what will be done and how.

My aim is to improve our understanding of the relationship between play and mathematics in the primary years, particularly by examining role play, and to investigate how to generate mathematical learning linked to children's interests; as well as identifying and analysing practical actions for teachers to shape the learning of mathematics positively through role play.

I work one day per week at Maritime School and have been appointed to assist in developing the school's reflective practice across the curriculum, particularly with regard to mathematics teaching (see Job Description, Appendix A). Maritime School is a community primary of 210 pupils between 4-11 years of age. The large majority of pupils are of White British heritage. The proportion of pupils with special educational needs and/or disabilities is broadly average, but varies across year groups. There are seven single age-range classes. I will collect my data in the Reception and Y4 classes.

Since September 2010, I have been working alongside staff in all classrooms, planning, setting up and analysing the potential of role play.

The methodology for this research will be qualitative. Its theoretical underpinning rejects the 'objective', value-free, 'scientific' paradigm and aspires for research that empowers all participants, as typified in feminist research (Usher, 1996; and De Laine, 2000; in Cohen et. al., 2007). I intend to develop the following devices to gather evidence of children's responses in order to analyse these, with colleagues, for evidence of mathematical learning and engagement:

- periodically observing and keeping notes on children engaged in role play for short periods, recording speech and activity. A selection of these observations will be analysed and discussed with staff with regard to the incidence and quality of child-to-child and adult-to-child talk (DfES, 2002) and mathematical activity, using approaches such as discourse analysis (Edwards and Mercer, 1987).
- setting up observation schedules in collaboration with staff, based on items such as; time on task without adult interference; the quality and nature of mathematical communication; or how much and what level of involvement is occurring when a child is engaged in a particular mathematical task (see examples, Appendix B(i) and B(ii), the latter based on the Leuven Involvement Scale for Young Children (Bertram & Pascal, 1994);
- recording some child activity as film or audio, for subsequent analysis with both children and staff (peer review). Through building in time for peer-review with both groups, we can begin to engage adults and children in discussions about mathematics learning and how to further develop their learning environment (respondent critique);
- holding face-to-face, in depth, semi-structured interviews with both children and staff. Informal, conversational discussions such as these will be held to check my observations (peer review), for example "It seemed to me that... how was it for you? What are you feeling/thinking about this?" "What in your opinion is the best ...?". I am teaching, and thus my responses will be contingent on children and adults' responses. Improvisatory, flexible interviews such as these have the potential to generate rich and detailed accounts. Examples of guiding questions for interviews are included in Appendix C.

REFERENCES

Bertram, T. & Pascal, C. (1994) *Effective Early Learning Programme Child Involvement Scale*; Centre for Research in Early Childhood, University College Worcester, St. Thomas Centre, Birmingham.

Cohen, L., Manion, L. & Morrison, K. (2007) *Research Methods in Education.* Routledge

De Laine, M. (2000) *Fieldwork, Participation and Practice.* Sage. In Cohen et. al. (2007)

Edwards, D. and Mercer, N. (1987) *Common Knowledge: The Development of Understanding in the Classroom.* Routledge and Kegan Paul

Siraj-Blatchford, I., Sylva, K., Muttock, S., Gilden, R. & Bell, D. (2002) *Researching Effective Pedagogy in the Early Years*, DfES

Usher, P. (1996) Feminist approaches to research. In In Cohen et. al. (2007) *Research Methods in Education.* Routledge

Ethical issues raised by the project:
• As a member of staff at the school I might feel compelled to report only positive findings. However, I have been employed to specifically develop school practice, and will be engaging in peer analysis and review, using my findings to improve school practice. • By involving the school staff in my research I am intervening in colleagues' lives and might increase the bureaucratic burden on them. I will check with staff the cost/benefits of each involvement and respect their right to decline to participate in an activity that, in their opinion, presents an undue burden to them with little benefit. • A close relationship with school staff might mask an exploitative relationship. I could use research friendship to acquire data. As researcher, I develop and interpret the research and are thus in a position of power. By discussing thoughts, interpretations and significance of joint observations with colleagues, I seek to minimize my power privilege. • As a researcher observing children playing with some freedom, I might be inclined to leave them longer than a teacher to see what they do, rather than intervene. This could lead to issues regarding personal safety as well as missed teaching opportunities. In keeping with the Revised Ethical Guidelines for Educational Research (2004) issued by BERA, the best interests of the child will be my primary consideration at all times. I will stop any observation if there is any sign of a negative effect on the children involved. As the supervisory adult I will remain alert to safety issues. Later analysis of observations with staff will reveal rich learning and teaching opportunities, which can be picked up over time. • Ethical issues raised by filming and recording children are covered in Section 3.

SECTION 3: USE OF PARTICIPANTS

- You should download the Participant Consent Form Template and amend it if necessary
- You should also attach any other information to be given to participants
- You should consider carefully what information you provide to participants, e.g. scope of study, number of participants, duration of study, risks/benefits of the project. It is recommended that the participant has two copies of the consent form so they can retain one for information.
- If images or anything else which might allow the identification of participants is to be publicly accessible (e.g. on the web), further written consent must be secured

I am working at the main school for my research, part-time from September 2010 to July 2011 and thus have partial funding from the school in which the study would take place. The condition of this appointment is that my research forms part of the in-service training provision within the school. Problems negotiating access to people and children, and in gaining the informed consent of teachers and carers, and pupils as participants, are minimised as I have an established working relationship with all staff, from Reception to Y6, having worked in the school on a consultancy basis for a number of years.

Regarding recruitment, all members of the teaching staff have given their written consent to participate in my research (see Appendix D, Participant Consent Form). I have met with staff to discuss the nature and purpose of my research, research procedures and any potential inconvenience, benefits, risks and costs for participants and the wider community. Benefits of my involvement in terms of staff development are recognised by staff; they are aware that my research will form part of their in-service provision this academic year (see Appendix E, staff information sheet, Oct 2010). In order to secure their continued goodwill and co-operation, access will be realistic and jointly agreed, and disruption to classes minimised. Consent has been obtained for the following:

- classroom observations,
- classroom teaching
- interviews with children,
- recording observations and interviews, some on film, and
- meetings with staff and children to discuss observations.

I have emphasised that I will be open and honest regarding my research at all times and answer questions pertaining to my research at any time. Whilst retaining the right to report my work, I will seek adult participants' permission to publish. I have made clear that participants retain the right to withdraw their permission at any stage in the project, at which point all their data will be destroyed. A copy of my final report will be given to the school.

Staff comprehend that there is no absolute guarantee of total anonymity in a study such as this and a school of this size. I will however, protect the confidentiality of all human participants and their data at all times. Electronic data will be stored on a password protected personal laptop. Hard copies of data stored at the researchers' home in a lockable filing cabinet. Staff and children's names will be changed and all identifying information removed before storage. Paperwork linking these documents back to the originators will be stored separately. Film and audio recordings will be only kept on a password protected laptop. Pseudonyms will be used for all participants and explicit consent will be obtained if adult participants wish to be identified at the point of publication.

I am following the school's procedures for working with children. In keeping with the Revised Ethical Guidelines for Educational Research (2004) issued by BERA, the best interests of the child will be my primary consideration at all times. Some observations of children will be filmed or recorded. The school has obtained parental/family consent from each child on entry to school for the following:

- photographic images in school literature and on the school website,
- visual recordings for school purposes and future interest,
- press images.

(School Parental Consent form, Appendix F). Children whose parents have refused permission will not be included in observations for the purposes of this research.

I will facilitate children in giving their informed oral consent to my data collection by explaining my research in appropriate terms to each class, encouraging questions. Despite this, I am aware that truly informed consent might not be obtainable due to the children's ages. I will keep in mind that children are not on equal terms with a researcher, acquiring their assent to participate in the recording of observations and interviews.

Educational research seeks to extend knowledge and understanding and parents and carers send their children to school to be educated. This research aims to improve the education of these children. Educational improvements depend upon trying out different approaches and professionally analysing these.

A previous project (Williams, 2010) uncovered some problems with parental consent and child anonymity with regard to video recording. Meeting with parents to explain the research and how data would be gathered, stored and used was 100 per cent effective in gaining consent. I have found that viewing recordings periodically with children and adults increases understanding of, and active involvement in, the project. Visual and voice recordings will be selected at the point of publication to demonstrate findings and in terms of their usefulness for fellow professionals or policymakers. At this point, films will be viewed with relevant staff, carers and children, and consent obtained for their use.

I am employed as a teacher and will deal with negative findings such as children's inappropriate behaviour, or variable professional practice in that role. Our established relationship means that such can be used to develop the practice of the school.

Reference

Williams, H. (2010) *Investigating How Children's Play Can Enrich The Early Mathematical Experience*, National Centre for Excellence in Teaching Mathematics (NCETM) Teacher Education Funded Project no. TEFP0903; www.ncetm.org.uk

Will you be using participants who are aged under 18?

YES ■ NO ■

(If you have answered Yes please refer to section 4.11 of the Ethics Guidelines and highlight the particular issues raised by working with these participants and how these issues have been addressed).

I am following the school's procedures for working with children and Roehampton University's Under 18s Policy. In keeping with the Revised Ethical Guidelines for Educational Research (2004) issued by BERA, the best interests of the child will be my primary consideration at all times. Please refer to the above section for issues of parental consent, gaining the assent of children and school procedures.

For child protection, all films and images made of children will be kept safely on a password protected personal laptop only.

I am a member of the General Teaching Council and have been CRB cleared. My CRB number is 001160914201

SECTION 4: HEALTH AND SAFETY

- **You must download and complete the Risk Assessment Form and attach this to your application.**
- You should be able to demonstrate that appropriate mechanisms are in place for the research to be carried out safely
- If necessary the University's Health, Safety & Environment Manager should be consulted before the application is submitted

Will any of your project take place outside the UK?

YES ■ NO ■

If you have answered yes please list the countries below and refer to Section 4.2 of the Ethics Guidelines:

Is this a clinical trial or a project which may involve abnormal risk to participants?

YES ■ NO ■

Will 'human tissue' samples need to be stored?

YES ■ NO ■

If you have answered Yes please refer to Sections 3.5 and 4.2 of the Ethics Guidelines

SECTION 5: PUBLICATION OF RESULTS

How will you disseminate your findings? (e.g. publication)

Publication of findings will take the form of oral dissemination at conferences, professional seminars and in-service teachers' meetings, as well as written reports included in relevant professional publications and journals.

How will you ensure the anonymity of your participants?

(If your participants do not wish to remain anonymous you must obtain their written consent.)

The school recognises that this research is in the interests of the school and I have obtained the consent of the school to disseminate the findings of this research with fellow professionals. Staff comprehend that there is no absolute guarantee of total anonymity in a study such as this and a school of this size. Confidentiality of data is the norm and I will use pseudonyms for adult and child participants. However, I recognise participants' right or expectation to be identified with this research. Written consent will be obtained from individuals if this is the case.

SECTION 6: STORAGE OF DATA

Section 2.7 of *Roehampton University Code of Good Research Practice* states the following 'research data must normally be retained intact for a period of at least ten years from the date of any publication which is based upon it. Researchers should be aware that specific professional bodies and research councils may require a longer period of data retention.'

Describe how and where the following data will be stored and how they will be kept secure:

In relation to the storage and use of personal data, I will comply with the legal requirements laid down by the Data Protection Act (1998).

Raw and processed data:

Handwritten field notes will be filed, dated, and kept in a locked filing cabinet at the researchers' home. Electronic data will be stored on a password protected personal laptop and in due course will be transferred to disc, dated and locked in a filing cabinet at the researchers' home. Films and audio recordings will be stored on a password protected personal laptop and in due course be transferred to disc, dated and locked in a filing cabinet at the researchers' home.

Documents containing personal details of any participants:

Staff and children's names will be changed and all identifying information removed before storage. Paperwork linking these documents back to the originators will be stored separately.

School, staff and children's details will be stored as described above.

Are there any relevant subject-specific ethics guidelines (e.g. from a professional society)?

SECTION 7: EXTERNAL GUIDELINES, APPROVAL & FUNDING

If so how will these inform your research process?

Are there any relevant subject-specific ethics guidelines (e.g. from a professional society)?

If so how will these inform your research process?

This research will take place in keeping with the Revised Ethical Guidelines for Educational Research (2004) issued by the British Educational Research Association.
These guidelines will inform my research in relation to the underpinning aim (p4) of weighing up all aspects of the process of conducting educational research within this school context and reaching an ethically acceptable position in which my actions are regarded as acceptable and sound by both participants and the community of educational researchers.

With regard to both the collection of data and the writing and publication of research, responsibilities to and respect for both participants and the community of educational researchers will underpin the decisions I make.

Has/will the project be submitted for approval to the ethics committee of any other organisation, e.g. NHS ethics approval? (Please see Section 4.3, Ethics Guidelines)

NO

What is the outcome of this?

Is your project externally funded?

YES ■ NO ■ If you have answered yes you must complete a P1 form and submit this to the Bids & Grants Team, RBDO before you complete your ethics application.

SECTION 8: CHECKLIST

Please read through the checklist and check the box to confirm:
NB. this checklist is part of the Ethics Application and must be completed

Project Details

Have you completed your personal details? (Section 1) Yes ■
Have you outlined the project and ethical issues? (Section 2) Yes ■
Have you described your project in laymen's terms and avoided using too much technical jargon? Yes ■
Have you focussed on the ethical issues and practical steps of carrying out the project rather Yes ■

than methodological arguments which are not relevant to this application

Working with Participants	
Have you completed details of how you intend to recruit participants and whether they will receive any reimbursement? (Section 3)	Yes
If you are working with under 18s have you addressed the particular ethical issues involved in working with these participants? (Section 3)	Yes NA
Have you amended the Participant Consent Form (Template) for your project?	
Have you attached to your form any other information that may be needed for participants, e.g. Debriefing Letter, Information Sheet?	Yes
Have you attached to your form any other participant-facing materials, e.g. recruitment posters, questionnaire, interview questions	Yes
If your project involves clinical trial/s, abnormal level of risk or working with animals have you read University Guidelines carefully?	Yes NA
Health and Safety	
If your project takes place outside the UK have you noted on the form where the project will take place and read section 4.2 of the guidelines?	Yes NA
Have you completed the University risk assessment describing the risks associated with your project and how you will implement control measures to address these?	Yes
If your project involves interviews in a participant's home or lone-working information have you considered the risks and control measures in the risk assessment? (E.g. advising a colleague/supervisor of the timings of visits, ringing before/after interview and developing a contingency plan if contact is not made)	Yes
If your project involves clinical trial/s, abnormal level of risk, working overseas or working with animals, have you consulted with the Health & Safety Manager in drawing up your risk assessment?	Yes NA
If your project involves clinical trial/s, abnormal level of risk, working overseas or working with animals have you marked this clearly on the form (Section 4) and read sections 3.5 and 4.2 of the guidelines?	Yes NA
Publication of Results	
Have you described on the form how you will publish your findings? (Section 5)	Yes
Have you described how you will ensure the anonymity of your participants or asked your participants for explicit consent in your consent form to identify them in your research?	Yes
Storage of Data	
Are you aware that the University's Code of Good Research Practice requires you to retain data intact for a period of at least ten years from the date of any publication? (*Specific professional bodies and research councils may require a longer period of data retention.)*	Yes
Have you described how and where your data will be stored at the University and how this will be kept secure? (Section 6)	Yes
External Guidelines & Funding	
Have you noted any relevant subject-specific ethics guidelines (e.g. from a professional society) and considered how these will inform your research? (Section 7)	Yes
Have you considered whether you have to apply for ethical approval through another organisation (e.g. NHS)? (Section 7)	Yes NA
Have you provided full details of any external funding and the approval stage of your P1 form? (Section 7)	Yes NA

Have you included a contract or any other formal agreement relating to the project? Yes / NA

Applicant's Confirmation

Have you added an electronic signature or typed your name and date in the applicant's signature box? Yes

If you are a student has your supervisor checked your application form before submission? Yes / NA

Will you email the Ethics Administrator and make sure you attach your Ethics Application Form and all documents, e.g. Participant Consent Form, Risk Assessment Form and any additional information for participants or for other purposes? Yes

Presentation

Have you completed the form using size 12 black font, using one font (e.g. Arial) throughout the form and removed any large gaps from the application form? Yes

Have you proof-read your application form and attached documents? Yes

Ethics Approval Process

Do you understand the following?

- the ethics approval process can take several weeks Yes
- that you must not begin your project or enter into any agreement or contract until you have received email confirmation from the Ethics Administrator that you can begin the project Yes
- that the Ethics Application Form will be approved by your Department and the Ethics Committee may be asked to advise on problematic cases Yes
- that you may be asked by the Ethics Administrator to make revisions to your form and you will be given two months to make these revisions from the date of any email sent to you Yes

SECTION 9: APPLICANT'S CONFIRMATION	
I confirm that the information supplied on this form is correct and confirm that the above checklist has been fully completed.	
Applicant's signature:	***HELEN JANE WILLIAMS***
Date:	**14th November 2010**
FOR STUDENTS ONLY: DIRECTOR OF STUDIES SIGNATURE **(Where there is not a Director of Studies this should be completed by the academic supervisor)**	
The Director of Studies is required to: • ***scrutinise the Ethics Application and all participant-facing documentation*** • ***suggest and check any changes which need making before the form is submitted***	

Please tick the box to confirm that you have approved the application and participant-facing documentation ■	
Signature:	**PROFFESSOR GILL CROZIER** ***Please use an electronic signature or type your name***
Print name:	
Date:	

The Application Form does not need to printed out. This should be sent by email with attachments to the Ethics Administrator:

- **Ethics Application Form**
- **Participant Consent Form**
- **Risk Assessment Form**
- **Any other information**
  (e.g. contract, advertising material, questionnaires, debriefing letters)

Jan Harrison, Ethics Administrator
Jan.Harrison@roehampton.ac.uk, 0208 392 5785

PLEASE NOTE: YOU MUST NOT BEGIN YOUR PROJECT UNTIL YOUR ETHICS APPLICATION HAS BEEN APPROVED

(ii) Completed risk assessment

Title: Research proposal for MPhil (PhD) Education 85RL0009 'To investigate the teachi					
Helen Jane Williams	**Event / Activity:** Research Project				**Date Ass**
		Uncontrolled Risk **Severity x Likelihood = Risk Rating**			
Hazard	**To Whom**	**S**	**L**	**R**	**Control**
List the hazards involved in your project Classroom hazards, in particular in the role play area	*Who will be affected by the risk* *E.g. Participant*			0 0	*List how this hazar E.g. Deta groups wi Debriefin participa they can time*
tripping, falling, slipping, something falling on ta participant	child and adult participants	low	low	1	Adult sup with scho regarding and child proceedur
physical injury due to inappropriate behaviour - eg hitting	child participants	low low	medium	2	Discussio regarding behaviour
emotional injury due to inappropriate behaviour -eg name-calling, verbal abuse	child participants	medium	medium	2	restrict n u involved
inappropriate behavoiur due to 'free play' style of play and chidlren being in control	child participants		medium	4	

(iii) Mathematician in Residence – role

a) Job Description [Ethics application Appendix A]

Job Title: Mathematician in Residence

Grade/ hours: by agreement, equivalent 1 day per wk

Responsible to: Curriculum Coordinator / Mathematics Lead Learner and Head Teacher

Direct Supervisory Responsibility for: None

Indirect Supervisory Responsibility for: None

Important Functional Relationships:

Internal: Head Teacher, other teachers, support staff, children
External: Governors, parent volunteers and visitors to the school

Main Duties and Responsibilities:
To assist in developing the school's reflective practice across the curriculum, particularly in mathematics by:

- sharing innovative practice in the teaching and learning of mathematics
- providing expertise to teachers in classrooms
- gathering evidence for school self evaluation purposes
- investigating and improving effectiveness of school structures and time management
- supporting the maths lead learner in monitoring maths learning through
    - observing independent learning activities
    - interviewing and recording pupil talk in and about maths
    - monitoring practical maths organisation systems
- developing school's practice and use of research evidence
- exploring consistency in practice across different age-groups
- working in partnership with the school leadership team to
    - review and improve progress in maths learning through the school
    - embed teaching of maths (and other subject areas) in context and through role play
    - develop reflective practice at all levels (pupil, teacher and whole school)
    - consider implications of Cambridge Review guidance
    - advance school curriculum development with reference to the Rose Review and other current pedagogical thought
- model and exemplify good practice by bringing research into classrooms
- provide a sustainable stimulus for the school to improve teaching and learning of maths at all phases

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Date Prepared: 12 May 2010

Job Description Prepared by: Head Teacher / Helen Williams

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b) Consent for research

November 2010

Dear Helen

Maritime School - teaching and learning of mathematics through role play

I am writing to confirm that in your appointment as *Mathematician in Residence* at Maritime School we have a clear understanding that you are involved in a research project through Roehampton University, London, investigating the teaching and learning of mathematics through role play. As part of your research we appreciate that your methodology will include:

- setting up observation schedules in collaboration with staff
- periodically observing and keeping notes on children engaged in role play for short periods, recording speech and activity
- peer review - recording some child activity as film or audio, for subsequent analysis with both children and staff
- formally planned interviews and informal discussions with both children and staff

I would like to assure you that the school's *Parental Consent Forms*, signed at the beginning of each school year, by every parent or carer, allow you to observe, note, record, film and interview pupils at the school. Your appointment was made in May 2010 to carry out such research in support of the school's reflective practice and self evaluation and to provide part of the in-service training provision for the teaching and support staff. Filming and recording form a regular aspect of the school's daily teaching and learning processes, and parents are aware that professional use is made of film and images of children. When such material is used by a third party or external educational organisation (we have been working with the University of Newcastle for six years and your association with Roehampton is this) it would be normal for parents of children concerned to view the material before confirming consent of its release.

Yours sincerely

Head Teacher

(iv) Adult participants' consent form [Ethics application Appendix D]

Roehampton University London

ETHICS BOARD

PARTICIPANT CONSENT FORM PRO FORMA

Title of Research Project:
<u>How can children learn mathematics through role play?</u>

<u>Brief Description of Research Project:</u>
To investigate the potential for the learning and teaching of mathematics in the early and primary years, through drama, imaginative and role play. This is a case study taking place at Maritime Primary School from January 2011, involving seven classes and teaching staff. Evidence will be gathered by:

- periodically observing and keeping notes on children engaged in role play for short periods, recording speech and activity,
- setting up observation schedules in collaboration with staff,
- recording some child observations on film and/or audio, with the permission of participants,
- Selected observations will be subsequently analysed with children and/or staff,
- holding semi-structured interviews with both children and staff, some of which may be recorded with the permission of participants.

Investigator Contact Details:
Helen Williams

Consent Statement:
I agree to take part in this research, and am aware that I am free to withdraw at any point. I understand that the information I provide will be treated in confidence by the investigator, in keeping with the Revised Ethical Guidelines for Educational Research (2004) and that my identity will be protected in the publication of any findings unless I waive this right in writing

Name ………………………………….

Signature ……………………………… Date ……………………………………

Please note: if you have a concern about any aspect of your participation or any other queries, please raise this with the investigator. However if you would like to contact an independent party please contact the Head of Department or the Director of Studies:

Director of Studies Contact Details:

Dr Sue Gifford
Department of Education, Roehampton University, Froebel College, Roehampton Lane, London SW15 5PJ
s.gifford@roehampton.ac.uk
0208 392 3395

Head of Department Contact Details:
Marilyn Holness OBE
Department of Education, Roehampton University, Froebel College, Roehampton Lane, London SW15 5PJ
M.Holness@roehampton.ac.uk
0208 392 3374

(v) Information for adult participants [Ethics application Appendix E]

Helen Williams, October 2010
Outline of intentions and conditions, research for PhD Education (initially MPhil Education) with Roehampton University, School of Education. Research undertaken at Maritime School.

Proposed Research Focus:
What mathematics can be learned through role play? A school study.
Key aim and questions:
Can children learn mathematics effectively through role play?
What might mathematics learning look like in a role play context?
Does this approach appeal to children / teachers?
To what extent do/ what particular classroom conditions enable children to take control of their own learning?

I have 6 months to work on my proposal and have this confirmed by the University Research Degrees Board. If accepted, I am expected to submit my thesis within 3 years.

During this academic year, I intend to:
- Keep a diary of the role play developments in classrooms
- Make and analyse observations of children engaged in role play
- ‘Interview’ children
- Reflect upon /write up discussions with staff
- Analyse school data collected in relation to role play/ attainment /attitude
- Feedback findings to staff
- ‘Interview’ staff on their views of developments
- Keep everyone informed on how the project develops; answer questions at any time
- Listen to unforeseen and unseen ramifications.

Conditions:
I will be open and honest about my research at all times.
I will fit in with the organization of the school at all times, keeping disruption to a minimum.

If you give your consent as a participant in this research, I retain the right to report my work, however you are free to withdraw consent at any time, without adverse consequences. Any data provided will be destroyed, should this be requested.
Regarding working with children, I will follow any special policies or procedures of the school.
The British Educational Research Association recommends that children should be facilitated to give fully informed consent. I intend to do this.
Confidentiality is my responsibility. I will protect the confidentiality of all human participants and their data at all times. However, there is no absolute guarantee of total anonymity.

(vi) School use of images consent form

Parents' Consent Form [Ethics application Appendix F]
Dear Parent

There are sometimes occasions when we wish to take photographs or make video recordings of pupils at our school. Sometimes this is for strictly educational purposes and on other occasions it may be for other purposes ancillary to the running of the school (eg taking photographs for use in the school's prospectus and on the school web site).

Similarly, there are occasions when the local press visit our school to record particular school events (eg school productions) and they may wish to publish photographs of children in newspapers or use recordings of the children on television when reporting these events.

In order to comply with the Data Protection Act 1998, the school needs your consent before taking photographs or making video recordings of your child for purposes which are not part of its core activities. We should therefore be grateful if you could read the Conditions of Consent below before completing the attached Consent Form by answering the questions, signing, dating and returning it to the School as soon as possible.

Conditions of Consent
1 The information which you provide in this Consent Form is valid from the time when the school receives this form until the time your child leaves the school. If your circumstances change or you change your mind about any issues addressed in this form please let the school know immediately.
2 The school will not use any images of your child once your child has left the school without obtaining specific consent.
3 The school will not itself publish names of pupils with any images of children without prior specific and separate consent from parents.

4	If a pupil is named in any text which the school publishes, a photograph will not be included with the text, unless this is the wish of the pupil and parents.
5	The school will generally avoid publishing close up or individual photographs of pupils. The school's preference is to publish class or group images of pupils.
6	The school will only use images of pupils who are appropriately dressed.
7	The school will not pass to the press the names of any pupils appearing in photographs or recordings which the press wish to publish or broadcast, unless a parent has consented to this.
8	If you agree that the media can take and use images of your child you should note that the media's use of images of children is governed separately by the Data Protection Act, other legislation and industry codes of practice.

Name of Child		
	I have read and understood the Conditions of Consent.	
1	I agree that the school can take photographs of my child which may be used in School literature (eg the school's newsletters; the school's prospectus and other promotional material etc).	YES NO
2	I agree that the school can use images of my child on its website. (Please note the web site can be viewed across the world.)	YES NO
3	I agree that the school can use images of my child in video recordings to promote the school.	YES NO
4	I agree that the school can take photographs and make video recordings of my child for the school's own records, archives and future interest (eg photographs of sports teams).	YES NO
5	I agree that my child can appear in video recordings or in collections of photographs stored on CD-roms which the school may make of school events and which it may sell to parents of children at the school to raise funds for the benefit of the school.	YES NO

<table>
<tr><td>6</td><td colspan="3">I am happy for the press to take and use images of my child.</td><td>YES
NO</td></tr>
<tr><td>7</td><td colspan="4">The school may give the press
THE FIRST NAME ONLY / ***FIRST AND SURNAME***
(delete as appropriate)
of my child for publishing with the child’s photograph in a newspaper or for captioning on television.</td></tr>
<tr><td colspan="2">Signature of parent/guardian</td><td colspan="3"></td></tr>
<tr><td colspan="2">Name (in block capitals)</td><td></td><td>Date</td><td></td></tr>
</table>

APPENDIX SIX

EXTRACTS OF ROLE PLAY OBSERVATIONS INCLUDED IN THESIS

Chapter Three

3.3

Year Four, Extract 1, Observation 4, Re-view of ‘French Café’, Cam and Ellen

Year Four, Extract 2, Observation 4, Re-view of ‘French Café’, Sean and Saul (1)

Year Four, Extract 3, Observation 4, Re-view of ‘French Café’, Sean and Saul (2)

Chapter Four

4.1

Reception Extract 1 ‘Are you full up now?”

Reception Extract 2 ‘Horse Jumping’ video 10 (Rachel)

Reception Extract 3 ‘Horse Jumping’ video 2

Reception Extract 4 ‘Horse Jumping’ video 6 (Kaiya)

Reception Extract 5 ‘Faster than Usain Bolt’ Class introduction

Reception Extract 6 ‘Faster than Usain Bolt’, Day 3, Video 14

Reception Extract 7 ‘Faster than Usain Bolt’, Day 2, Video 12 (zero seconds)

Reception Extract 8 ‘Faster than Usain Bolt’, Day 3, Video 14

Year Four Extract 1, Observation 1, ‘Tide Times’ Group 2 (beginning)

Year Four Extract 2, Observation 1, ‘Tide Times’ Group 2 (L23ff)

Year Four Extract 3, Observation 1, Re-view of ‘Tide Times’, Group 2 (L82-84)

Year Four Extract 4, Observation 1, ‘Tide Times’ Group 2 (L145ff)

Year Four Extract 5, Observation 1, ‘Tide Times’ Group 2 (L191ff)

Year Four Extract 6, Observation 2, ‘Fish Patterns’, Group 1 (L99ff)

Year Four Extract 7, Observation 2, ‘Fish Patterns’, Group 2 (L38ff)

Year Four Extract 8, Observation 3, ‘Pricing paintings’, Group 1 (L63ff)

Year Four Extract 9, ‘Auction of Paintings’ observation

Year Four Extract 10, Re-view of ‘Auction of Paintings’, Group 1 (L185ff)

Year Four Extract 11, Observation 4, ‘French Café’, Group 1

4.2

Reception Extract 9 ‘Faster than Usain Bolt’, End of class introduction

Year Four Extract 12, Observation 1, Re-view of ‘Tide Times’, Group 2

4.3

Reception Extract 10 ‘Faster than Usain Bolt’, Re-view interview, Sabina & Rachel

Reception Extract 11 ‘Faster than Usain Bolt’, Re-view interview, Sabina & Rachel

Reception Extract 12 ‘Faster than Usain Bolt’, Re-view interview, Ed and Olivia

Year Four Extract 13, Observation 1, Re-view of ‘Tide Times’, Group 1

Chapter 5

5.1

Reception Extract 1 ‘Faster than Usain Bolt’, Day 3, Video 16 (Rachel)

Reception Extract 2 ‘Faster than Usain Bolt’, Day 2, Video 11 (Miss H)

Reception Extract 3 ‘Faster than Usain Bolt’, Day 1, Video 5 (Oliver)

Reception Extract 4 ‘Faster than Usain Bolt’, Day 1, Video 6 (Oliver)

Year Four Extract 1 Observation 1, ‘Tide Times’, Group 1 (L178ff)

Year Four Extract 2 Observation 4, ‘French Café’ Group 2 (beginning)

Year Four Extract 3 Observation 4, ‘French Café’ Group 2 (L220ff)

Year Four Extract 4 Sean talking to camera, ‘Tide Times’, ‘Fish Patterns’

Year Four Extract 5 Observation 4, Re-view of ‘French Café’, Saul & Sean

5.2

Year Four Extract 6 Observation 1, ‘Tide Times’, Group 2 (L221ff)

Year Four Extract 7 Observation 1, ‘Tide Times’, Group 2 (L155ff)

Year Four Extract 8 Observation 2, Review of ‘Pricing Paintings’, Sean

5.4

Reception Extract 5 ‘Ramon is lost’

Chapter 6

6.2

Year Four Extract 1 Observation 1, Re-view of ‘Tide Times’, Group 2 (L10-20)

Year Four Extract 2 Observation 1, Re-view of ‘Tide Times’, Group 2 (L81-92)

Year Four Extract 3 Observation 1, Re-view of ‘Tide Times’, Group 2 (L140ff)

Year Four Extract 4 Observation 2, Re-view of ‘Fish Patterns’, Group 1 (L73-84)

Year Four Extract 5 Observation 2, Re-view of ‘Fish Patterns’, Group 1 (L24ff)

Year Four Extract 6 Observation 2, Re-view of ‘Fish Patterns’, Group 1 (L186-189)

Reception Extract 1 Class re-view of ‘Are you full up now?’ (1)

Reception Extract 2 Class re-view of ‘Are you full up now?’ (2)

Reception Extract 3 Re-view interview with Elliot and Mark (1)

Reception Extract 4 Re-view interview with Elliot and Mark (2)

Reception Extract 5 Re-view interview with Elliot and Mark (3)

Reception Extract 6 Re-view interview with Olivia and Ed

6.3

Year Four Extract 7 Observation 1, Re-view of ‘Tide Times’ (L29ff)

Year Four Extract 8 Observation 2, Re-view of ‘Pricing Paintings’ (L60ff)

APPENDIX SEVEN

SCHOOL QUESTIONNAIRE REVIEWING ROLE PLAY

Around 16 children were interviewed annually as groups or pairs from each year group (Reception to Year Six) in the spring terms of 2010, 2011 and 2012.

QUESTIONS	**GIRLS RESPONSES**	**BOYS RESPONSES**
Do you like learning maths in the role play area?		
Do you think learning maths in the role play is a good way to learn maths? Further probes: *So if I was in one of those schools which don't have role play … I might say my children haven't got time to play, they need to get on ….. what would you say?*		
Can you think of some of the activities you have done in any of role play areas in this classroom (or in last year's classroom) which have helped you to see where you might need maths skills when you are a grown up?		
When you are 'playing' maths, how do you think you stick at a problem and want to get to an answer, in comparison with doing maths with an adult or on your own somewhere else in the classroom?		
Do you think playing maths has helped your understanding of maths? How? In what ways?		
Do you think the role play tasks are a useful way of learning for everyone in the class, whether they find maths easy or hard?		
If you are very good at maths, is role play challenging for you?		
Have you or other children in the class suggested what maths activities you could practise in the role play?		

If so – what sort of activities have you suggested? If not – would you like to and if so what do you have in mind?		
Anything else you would like to say about role play areas in your classroom?		
Do you think all your maths should be taught and learned like this?		
What do you think are the advantages and disadvantages of role play?		

APPENDIX EIGHT MARITIME SCHOOL'S VALUES

Taken from the school prospectus (2012-13: 11) and based on the National Forum for Values in Education (NFVE). The NFVE was a group formed from disbanded Government agencies and drawn from various ethnic and religious backgrounds, who produced a statement of 'common' values for inclusion in various National Curriculum documents.

- *We value ourselves as unique human beings capable of spiritual, moral, intellectual and physical growth and development.*
- *We value others for themselves, not only for what they have or what they can do for us.*
- *We value relationships as fundamental to the development and fulfillment of ourselves and others, and to the good of the community.*
- *We value truth, freedom and justice.*
- *We value love and mutual support, a society in which people care for others and work for the common good.*
- *We value the environment as the basis of life and a source of wonder and inspiration.*