Policy- to-practice contexts for early childhood mathematics in England

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This paper considers the relationship between policy and practice in the early years mathematics curriculum for reception-aged children (RC) of five years in England. It explores what the policy requires RC teachers to do in terms of curriculum implementation; what RC teachers' views and understanding of the early years mathematics curriculum are; how RC teachers implement early years mathematics policy; and how RC children respond. A case study design included interviews with élites who influenced the policy-making process, survey of RC teachers and a detailed investigation of three RC classes on three school sites. As élite interviews underlined, international comparison studies had had an important influence on early childhood mathematics policies by creating from late 1990s onwards, top-down pressure for standards. Élites and practitioners drew attention to a tension between a play-based pedagogy and a standards agenda. Tensions in policy text were reflected in mixed and ambivalent views and reported practices by élites and practitioners. RC teachers did not merely receive and implement policy expectations but brought their own values and understandings to practice**.** The study reveals an interplay between local and global influences in a context of changing views of early childhood, early learning and early childhood pedagogy.

Key words: early childhood; policy and practice; mathematics

Introduction

This article was stimulated by a series of investigations of English children's early numeracy in the broader context of concern over low school mathematics achievement in England.

Our European study of numeracy development of five- to six-year-olds revealed that performance differences between countries were negligible. This was surprising given that English children were in formal schooling throughout the three testing cycles, Belgian, German, Greek and Dutch children from the midpoint, and Slovene children not at all (van de Rijt *et al.* 2003). The English sample of 300 boys and girls were then tracked through primary school. Nothing much disturbed performance over children's primary years. Those making almost no progress by seven years, however, were distinguished less by low initial scores than by swift decline during the earliest years of schooling. Applying a discriminant analysis to the original assessment scores at

age seven and eleven years revealed that general number knowledge or problem-solving had the most stable predictive value (Aubrey and Godfrey, 2003; Aubrey, Godfrey and Dahl, 2006).

More recently, a study of similarities and differences in young children's early numeracy age five years in England, Finland and the People's Republic of China (Aunio, Aubrey, Godfrey, Yuajuan and Liu, 2008) revealed that young Chinese children out-performed those from England and Finland and, in turn, Finnish children out-performed English children. Given the overall poor performance of English reception-class (RC) children (at five years) there was a stimulus to explore the policy context to changes in curriculum goals and pedagogical practices over the last ten years that have been associated with English policy-makers' drive to raise attainment, judged in national and international terms. The following questions were thus posed.

Research questions

1. What is the relationship between policy and practice in the early childhood mathematics curriculum for RC children in England?
2. What are RC teachers' views and understandings of the early childhood and how do they interpret policy for early mathematics?
3. How do they implement early childhood policy in the context of classroom practice?
4. How do RC children respond to the early childhood mathematics curriculum presented to them?

Background

In order to analyse the policy-making cycle Ball's trajectory model was adopted. This argues that policies are enacted in specific yet interrelated *contexts of policy influence, policy text* and *practice* (Ball, 1993; Bowe, Ball and Gold, 1992; Mainardes and Marcondes, 2009).

The *context of influence* is where public policy is initiated and policy discourses are constructed (Bowe, Ball and Gold, 1992). Social agencies and interest groups, public

and private, in and around this context struggle to influence the definitions and social purpose of education (Ball, 1993).

The *context of policy text production* is where the texts that embody policies are created. Whilst 'influence' is often related to the articulation of political interests and ideologies, policy texts are typically articulated in the language of general public good. They represent official authority at a particular moment and are framed in generalised and idealised language. Hence, texts must be read and understood in relation to the time and place o production, as well as in relation to other relevant texts.

The *context of practice* is where policy texts are interpreted by those charged with implementation. As Bowe, Ball and Gold (1992) emphasised, policy is never simply received and implemented but it is subject to recreation. Texts may be rejected in part, selectively interpreted, ignored or deliberately misunderstood. The context of practice is not an end of the process because policy returns cyclically to the context of influence and so the cycle is continuous;

Methodology

A case study design was adopted, predominantly interpretive, and seeking to uncover the values, discourses and practices of a wide range of participants. It included 'élite interviews' with key informants who had influenced the policy-making process, a postal survey of RC practitioners and a detailed investigation of three school sites over a school year that involved observation of classroom interactions and teacher interviews. Triangulation provided multiple perspectives to clarify meaning and verified repeatability of an observation or interpretation (Lincoln and Guba, 1985).

Sampling

For élite interviews, a maximum variation principle was used to identify a small group of six national figures in the *context of influence* whose involvement in early mathematics policy and practice was acknowledged and whose views on changing curriculum goals and pedagogic practices were valued. In the event, whilst six agreed to participate, two failed to keep their appointments. Of the four who remained, a

practitioner/advisor, consultant/publisher, a senior academic/teacher trainer and academic/researcher participated, three of whom had previously provided expert advice on RC mathematics. For the *context of policy text* documents relating to statutory requirements for early mathematics for the period 1999-2009 were analysed. For the *context of practice*, RC teacher survey respondents were drawn from schools in the West Midlands of England that had received 'good' to 'excellent' reports from the Office for Standards in Education (OFSTED). RC teachers were enlisted from three schools, one urban with social and ethnic mix, one peri-rural with social mix and one rural, with a more socially advantaged intake. In each school, two target children were chosen, one boy and one girl. For consistency, white British children were chosen as the intake of two of the three schools was exclusively mono-cultural and white though the third was socially and culturally diverse. Six sets of field notes and one video-record were collected from each classroom.

Materials

For the élite semi-structured interview schedule, eleven open questions covered the three contexts of the policy-making process of Bowe *et al.* (1992) and taking account of the research questions. The questionnaire for the RC teacher survey used thirty-six closed questions, multiple-choice and ratings, and four open-ended questions adapted from the Quick *et al.* (2002) study that investigated implementation of the FS and was piloted with four RC teachers in two London primary schools. Teachers' background and experience, available support staff, planning and time-tabling of the learning areas, assessment as well as implementation of the mathematics curriculum in RC were covered. For the RC teacher interview schedule, fifteen open questions were adopted from the teacher survey to obtain more in-depth views.

For lesson observations, a timeline was constructed and field notes kept of activities, resources available and, where possible, interactions. Video recordings amenable to repeated observation generated verbatim transcriptions. A well-structured target child observation schedule of Sylva, Roy and Painter (1980) was also employed with the overall purpose of exploring the way particular children responded to planned curriculum activities over a set period. This comprised an *activity* code, to record what the child was doing; a *language* code, to record interactions that involved the

child; a *task* code, to identify planned curriculum activity; and a *social* code, to specify the social context of the activity. A twenty-minute tracking provided ten samples (at two-minute intervals) through the period of observation. This technique provided a reliable means for investigation of activities in RC classrooms (Adams *et al.*, 2004).

Analysis

Analysis of policy texts took account of subject matter (content and values); goals and purposes; pedagogy; organisation of mathematical activities, as appropriate (categories derived from Holsti, 1969). Closed questionnaire questions were entered into *SPSS 15.0* to generate descriptive statistics in the form of frequencies. Open questionnaire and interview questions and video transcripts were entered in *NVivo 7* qualitative data analysis program to assist coding and data reduction to reach general themes.

Observation field notes identified common and discrepant themes related to classroom layout, and mathematical resources/materials; grouping procedures; lesson structure; use of classroom assistant; objectives/content of mathematics; and patterns of interactions. For target child observation, frequencies were generated from coding of the activity, language, task and social records of the schedule.

Ethics

Responsibilities to élite and RC participants included voluntary and informed consent. Rights to withdrawal from the research for any reason and at any time were stressed. In all actions, children's rights were considered, however, bearing in mind the age of the children and the non-participant nature of observation, parents of all children were informed and consent gained on behalf of their children. Privacy and confidentiality of data was assured during all stages of the research and saved securely for the duration of the analysis. Transcripts for interviews were returned to participants for verification and validation.

Context of influence in policy-making

Globally, it is now widely believed that high-quality early childhood education is associated with later academic and economic outcomes. Several longitudinal studies have been cited as providing evidence for links between early education and later achievement outcomes, for instance, *Early Provision of Preschool Education (EPPE)* Sylva *et al.* (2004) in the UK, the Abercedarian early childhood education project (Campbell and Pungello, 1999) and the High/Scope Perry Preschool Study (Schweinhart, 2004) in the United States of America (USA). A series of papers in *The Lancet* (Engle *et al.,* 2007; Grantham-McGregor *et al.,* 2007; Walker *et al.,* 2007) considered risk factors in early child development for adverse outcomes in developing countries and argued for strategies to avoid loss of developmental potential.

There has been a growing international emphasis on quality outcomes in early childhood education and development provided a strategy to promote economic progress. The Millenium Development Goals, (United Nations, 2000; United Nations Children's Fund, 2006) in turn aimed to reduce poverty, improve the health, safety and well-being of children and their families, support universal completion of basic education and ensure later achievement.

As noted by Dahlberg and Moss (2005), however, the mainstream debate has treated early childhood services in a highly instrumental way as a solution to economic and social problems. Penn (2007) identified risks associated with accelerated global development of such services and policies that rely on technocratic interventions, control and regulation, particularly in developing countries. According to Ball (1999; 2003), the acquisition of skills and dispositions in current policy terms has been stripped of social and psychological meaning. The pressure for performance, he argued, acted back on pedagogy and the curriculum, narrowing educational experience and focusing attention on 'what works'. In response, Dahlberg and Moss (2005) have explored alternative ways of thinking about and practising early childhood education.

Context of policy text for early childhood mathematics

In 2007, Sir Peter Williams was called to carry out a review of available evidence, including international best practice, to make recommendations for teaching mathematics in early childhood settings and primary schools. This aimed to identify 'what was the most effective pedagogy of mathematics teaching in primary schools and early years settings … in helping children to progress in their learning, Department of Children, Schools and Families (DCSF, 2008: 2). Two issues were singled out: 'the need for an increased focus on the use and application of mathematics; and the vitally important question of the classroom discussion of mathematics' (DCSF, 2008:4). It was argued that since the introduction of a National Numeracy Strategy (NNS), Department of Education and Employment (DfEE, 1999a) there had been considerable progress in the attainment of young learners. The percentage later reaching national average and above by the end of primary schooling at age eleven years rose from 59% to over 77%.

Introduction of the NNS

The focus of the NNS was on arithmetic skills: numbers and the number system, calculation and solving word problems. The daily mathematics lesson, lasting between 45 and 60 minutes, comprised three elements:

- oral work and mental calculation, using whole class teaching;
- main lesson, for new topics and consolidating previous work; and
- a plenary session, to draw together what had been learned.

The international external evaluation team (Earl *et al.*, 2003:3) noted that much of performance increase occurred prior to the introduction of the NNS and noted that doubt had been expressed about whether 'increase in test scores actually represented comparable increases in pupil learning'. Evidence of deep changes in teaching practice was 'mixed' and there was still 'considerable disparity across teachers and schools', in terms of subject knowledge, skill and pedagogical understanding. Changes to more interactive practices remained the main challenge to securing effectiveness.

Hardman, Smith and Wall (2003) noted that whilst new top-down initiatives like the NNS bring about change in curriculum design and planning, deeper levels of classroom pedagogy remain untouched. Teacher-pupil interaction was still dominated by closed questions, emphasising recall rather than speculation and problem-solving. This encouraged short answers for which teachers failed to provide diagnostic feedback. The pace of lessons left little time for consolidation and too little opportunity for formative assessment.

In the midst of what Alexander (2004) called 'pedagogical prescription' of the NNS the government published its *Primary National Strategy,* Department of Education and Skills (DfES, para 2.4) that attempted to incorporate the Numeracy and Literacy strategies and in which it was claimed that teachers had the freedom to decide how to teacher.

Meanwhile, Kyriacou and Goulding (2004), reviewing studies of teachers' approach to the daily mathematics lesson for five- to seven-year-olds in English primary schools, noted that the daily lesson was generally well received and there was some evidence of enhanced pupil confidence and competence. Promotion of high-quality discussion and strategic thinking as urged by the NNS had not been achieved. Increase in whole-class teaching that maintained a good pace, as directed by the NNS might, it was thought, create problems for lower-attaining pupils.

Introduction of the NNS in RC classes

In respect of the RC, the NNS recommended that the numeracy hour should be introduced gradually and towards the end of the summer term. The NNS framework set out key objectives for the RC daily mathematics lesson and recommended whole-class interactive direct teaching in which oral and mental work should figure prominently.

At the same time, the Qualifications and Curriculum Authority/DfEE, 2000 (QCA/DfEE, 1999) launched early learning goals (ELGs) to be introduced in a new Curriculum Guidance for the Foundation Stage (CGFS), (QCA/DfEE, 2000) for children of three to five years. One of the six early learning areas identified was

mathematical development. Each area had related ELGs and CGFS identified progress with 'stepping stones', showing the expected development by children at each stage. The non-statutory guidance for CTFS acknowledged that children learned best through 'play' and 'active learning' that promoted a 'child-initiated' and 'child-centred' curriculum approach and pedagogy.

There were thus two documents directed towards mathematics in RC, the CGFS and the NNS. In addition, there was a third document, the *National Curriculum for Mathematics at Key Stage 1 and 2* (DfEE, 1999b) covering children aged five years to eleven years. Gifford (2001) argued that the emphasis in the NNS was on a narrow set of outcomes, giving the document a quite different feel from the CGFS. The Early Childhood Mathematics Group (2001) maintained that there was a lack of clear guidance as to how the CTFS fitted in with the NNS framework for RCs. Furthermore, teachers might look cautiously at the structure of the daily mathematics lesson and expect young children to sit down for too long.

Two mathematics booklets for the Foundation Stage (FS) were later introduced – one for nursery classes and another for RCs (DfES, 2002). They were accompanied by teacher guidance notes, videotaped presentations and hand-outs for parents. The aim was to help practitioners plan mathematics activities. This did not entirely clear the confusion caused by the NNS and CGFS since these mathematical activities were strictly teacher directed (Gifford, 2004).

A national telephone survey of head teachers and RC teachers by Quick *et al.*, 2002) revealed a variety of reported organisational strategies for the RC throughout the year without planning a dedicated daily mathematics lesson. The majority introduced the daily mathematics lesson by the summer term. Around two-thirds of RC teachers in the Quick *et al.* survey indicated that implementing the NNS with a more flexible approach for RC children had not been a problem. Most of the teachers responded positively about implementation of the CGFS.

Case studies of effective practice in twelve *EPPE* preschool settings and two RCs (Siraj-Blatchford *et al.*, 2002, 2003) indicated that teaching and learning was most effective when practice placed emphasis on cognitive pedagogical interactions. These

were characterised by sustained shared and explicit thinking, direct teaching and monitoring, with frequent use of questioning techniques by adults especially in the context of play. These findings were clearly in line with expectations of the NNS.

As Adams *et al.*, (2004) argued, however, many RC teachers felt themselves unable to provide the kind of curriculum they felt was appropriate in the face of perceived pressure for children to perform in line with performance targets set. Although it was acknowledged that the teaching methods used to implement the CGFS were very different from the NNS, it was felt that there was a lack of opportunity for reflection and deep understanding; and too much focus on particular subjects at the expense of a whole and coherent curriculum. Overall, research of the period suggests that many RC teachers were uncertain about RC curriculum approaches and pedagogy and regarded the CGFS and the NNS as contradictory.

Following renewal of the primary framework for literacy and mathematics (DfES, 2006) a new Early Years Foundation Stage (EYFS) statutory curriculum for birth to five years (DfES, 2008) appeared. Mathematics was now incorporated in 'problem solving, reasoning and numeracy' with little change being made to content and with emphasis still being placed on play-based learning. Professional responses, however, have remained mixed. In a poll of 1480 teachers (Ward, 2008), nine out of ten teachers (88%) supported the EYFS whilst *Open Early Years Education* (*Open EYE*, 2007) continued to argue that the EYFS was too prescriptive. More recently, the Tickell Review (2011) has recommended considerable simplification, with reduction of the ELGs and assessment. Concerns about the proposed introduction of a compulsory 'progress check' for two-year-olds, the introduction of three levels (emerging, expected and exceeding) in the EYFS Profile, along with a development chart for birth to five are regarded by *Open EYE* as an indication that assessment and data collection are set to dominate (House, 2012). The suspicion that early years practitioners are still driven by pedagogical prescription has not abated.

From policy to context of practice

Élite interviews

Élite interviews were able to address the relationship between policy and practice in early childhood mathematics and draw on a broad picture of the three main *contexts of influence, text production* and *practice*.

From élite participants' shared point of view the main influence on policy changes in early mathematics was concern about lack of success in mathematics in international terms and the need for raising attainment in later years of schooling. In practice, this was seen to create top-down pressure on early childhood practitioners to introduce formal teaching of mathematics to young children. Research findings such as the EPPE (Sylva *et al.*, 2004) were seen as another catalyst for change in understanding of the characteristics of effective practice. Participants also acknowledged that early childhood practitioner pressure groups had some influence on policy, even though it was likely to be slight.

In terms of the *context of policy* text production, the élite participants highlighted the distinction between the formal NNS and FS emphasis on play-based pedagogy. Whilst early childhood curricula had received considerable international attention, formal teaching of mathematics was generally not regarded as suitable in many other nations before the age of six years. The mathematics ELGs were regarded as artificial and unsuitable and, ultimately, they had to be reinterpreted by practitioners in the *context of practice.*

According to élite participants, RC teachers were caught between two curriculum stages of the primary school, belonging to neither. It was felt that RC teachers welcomed the informality and play-based pedagogy of the FS, yet adequacy of teacher subject knowledge and training was a concern.

Asked to assess the success of the FS curriculum, positive and negative comments were balanced. A practical mathematics curriculum, improved funding and a framework aiming to increase quality of provision had raised practitioners' confidence and contributed to the creation of a positive learning environment. It was also pointed out however, that increase in later mathematics attainment had not been achieved in the way that Government claimed. Élite participants were not optimistic

about the policy-making process, yet acknowledged positive benefits for the *context of practice*.

RC teacher postal survey

Thirty-one teachers completed the questionnaire that was sent out to 161 primary schools, giving a low response rate (just below 20%). Findings suggested that most RC teachers (24 or 77.4%) had less than ten years teaching experience. Teachers held relevant early childhood qualifications, the majority of respondents holding Bachelor of Arts (BA) with qualified teaching status, Bachelor Education (B Ed) or post-graduate certificate of education. Three teachers (9.7%) held a teaching certificate. The majority had received training in the FS and in specific areas such as literacy and numeracy. Almost all RC teachers (29 or 95%) had at least one part-time support teacher. Teachers valued accurate transfer of information on children's transition from pre-school to RC from preschool providers and parents at entry and discussion of children's progress with their future (Year 1) at the end of the year.

The RC teachers reported that initially they delivered the NNS flexibly across the day in term one (23 or 74.2%); by term two this decreased to 21 (or 67.7%). By term three, the daily lesson was planned 14 (or 45.2%), whilst 15 (48.4%), (6.5%) timetabled numeracy throughout the year. Overall, a very mixed picture emerged. In general, RC teachers reported that the school community had a high level of commitment to the FS (21 or 67.7%), yet apart from early childhood teachers and support staff, involvement in RC long- and short-term planning by other staff was low.

Almost all teachers (26 or 83.9%) believed that the FS was a 'good' or 'very good' thing and felt that the curriculum guidance was clear and structured. An open question regarding the benefits of FS mathematics elicited responses related to practical mathematics activities, play-based approaches and informal learning. Having a balance between child-initiated and adult-led activities and creating more cross-curricular links between learning areas were also regarded as positive. An open question on drawbacks of the FS mathematics showed that the main concern of teachers was with NNS objectives and their 'incompatibility with the FS

expectations'. Asked directly about the NNS objectives, RC teachers were not so positive. Two-thirds (19 or 16.3%) were not sure that the NNs and CGFS fitted together, whilst only nine (29%) were certain that they did. NNS guidance was clear enough but implementing it for younger children was problematic.

A majority of 30 respondents (96.8%) felt the FS had 'got it right' in terms of emphasis on 'play', 28 (or 90.3%) for 'verbal skills' and 30 (or 96.8%) for 'taking a developmental approach'. Only seven (or 22.6%) wanted more 'formal learning' and four teachers (12.9%) wished for more emphasis on 'written skills'. RC teachers rated highly skills of 'concentration', 'motivation', 'working with others', 'active independence' and 'enthusiasm' for FS learning, with 'literacy', 'numeracy', 'physical' and 'creative developments' rated slightly lower.

Overall the NNS was seen as the troublesome element of the RC mathematics curriculum. A total of 11 teachers (35.5%) approved implementing the NNS to young children, whilst 15 (48.4%) were not sure, four (12.9%) believed it 'wrong' and one 'absolutely wrong'. RC teachers were generally welcoming of the FS but less so of the NNS. The main drawback of FS mathematics identified by another open question (for 10 teachers) was the incompatibility with those of the CGFS:

> Fitting the demanding mathematical activities (in the NNS) into a play-based curriculum (the CGFS) is sometimes hard.

> NNS objectives do not really match the FS expectations.

Classroom observations

Classroom layout and mathematical resources

The layouts of the three RC classrooms were different. In the Peri-Rural school, the large inside area was well organised to enhance children's active learning with a variety of play activities. In the Urban school, insufficient space for a home corner, sand or water play had a negative impact on practical activity. Although the Rural school had a small classroom too, the teacher organised the outside as well as inside area skilfully. Children thus had the chance to be active, initiate their own learning

and had plenty of play opportunities. Few opportunities for children's use of technology were observed in both the Peri-Rural and Rural schools. In the Urban school, computers were in continuous use and children were encouraged to work on them regularly. Use of the interactive white board for mathematics activities caught children's attention and enthusiasm.

Grouping arrangements for mathematics

Setting children in ability groups for intensive teaching was typical among the three RC teachers. In the Urban school, large teacher-led ability group would have one long daily mathematics session, whilst for the Peri-Rural and Rural schools small-group work activity periods were short, groups rotated and included opportunity for children's free play and child-initiated maths-related activity, on a daily basis.

Lesson structure

Lesson structures in all three schools indicated that mathematical activities were organised as distinct blocks rather than integrated with other areas of learning from the beginning of the year. Duration varied: one 30-40 minutes period in the Urban school; one block of 50-55 minutes period in the Peri-Rural school; and two blocks of 40-45 minutes period in the Rural school, throughout the year. All three classes started their sessions with whole-class counting activities. Thereafter, there was no introduction to the day's topic in the Urban school. In both Rural and Peri-Rural schools, the day's topic was introduced on the carpet before small-group activities commenced. Both schools held a plenary at the end to review and recapitulate key teaching points.

Use of classroom assistants

Ratios of adult to children in all three RC classes were high, especially during the mathematics lessons. In the multicultural Urban school, the role of bilingual support teachers was to ease communication between staff and children. Otherwise, they were not involved in intensive teaching and learning activities. In the Peri-Rural school, support teachers led well-organised small-group activities, inside and outside.

Volunteer adults who were parents, in all schools, were not involved in high-level interactions with children but supervised them for health-and-safety purposes.

Mathematical objectives and content

In the Peri-Rural and Rural schools, teachers addressed a variety of mathematics objectives for the RC including numeracy, shape and space and problem solving. In the Urban school, the main focus was on numeracy objectives.

Patterns of interactions

In the three schools, to enhance children's learning as well as their participation, teachers used regular questioning, mostly the closed type. In the Urban school, for instance, children responded in teacher-led group work to the teacher's questions in both a verbal and non-verbal manner. Responding to closed questions, by 'finding' and 'showing', for the teacher was also common but child-initiations were rare. By contrast, in the Peri-Rural and Rural schools, the frequency of adult-led and child-initiated learning episodes were balanced. Children were actively involved in small-group mathematics work, initiating both talk and activity.

Video-recorded data

Verbatim transcriptions from the video-recorded data were made and a coding scheme created that focused on interactions in one lesson for each teacher in order to reduce data to general themes. Analysis of a small-group activity for each teacher is merely illustrative as type of activity and duration varied.

The Urban schoolteacher's group activity was very intensive as shown in Table 1. The majority of initiations involved introducing the activity or requesting children to show, tell, count of give information.

Table 1. Urban schoolteacher interactions during group activity

Code	Frequency
'Find and show'/ 'Tell me'	14
Asking closed question	11
Introducing/explaining activity	10
Asking to count	10
Leading counting	5
Explaining	4
Praising	4
Asking open questions	3
Disciplining	1

Table 2 shows that the majority of the Rural schoolteacher's interactions were focused on giving instructions but not providing high cognitive challenge. Children's responses were mostly non-verbal and rarely sustained. She rotated two groups: the learning support teachers each covered one group, whilst one group had free play time.

Table 2. Rural schoolteacher interactions during group activity

Code	Frequency
'Throw the dice'	19
'Find the piece'	19
Explaining	3
Asking closed questions	2

The Peri-Rural teacher was also very active during group teaching time. She worked with two groups; a learning support teacher had a third group; and two groups played (one on a maths-related activity, one on a free-play activity).

Table 3 shows that she worked very intensively to coach and support children's efforts to play a board game successfully.

Table 3. Peri-Rural schoolteachers' interactions during group activity

Code	Frequency
Asking closed questions	10
Explaining	5

Target child observations

Target child observations for boys (B) and girls (G) provided qualitative and in-depth data about children's learning experiences. The language record showed interactions between target child (TC), adult/teacher (A) and another child (C) or other children (CHD).

Table 4 shows that in the Rural and Peri-Rural schools, target children spoke to adults nearly twice as many times as those in the Urban school. Target children spoke to other children and adults spoke to target children with higher frequency in the Rural school compared with the Urban and Peri-Rural schools. In the Urban school, the teacher spoke to children frequently, whilst children spoke to her infrequently. Other children spoke to the target child very little in the Urban and Rural schools, yet it was very frequent in the Peri-Rural school. As seen in the previous section, teachers initiated and talked a great deal in the three schools. Target children in all school spoke to others often, especially in the Rural and Peri-Rural schools. In the Peri-Rural school, it seemed that the flow of speech between children and adult was most in balance.

Table 4. Language code and frequency of interactions

	Urban school			Rural School			Per-Rural school		
	TC-1G	TC-2B		TC-1G	TC-2B		TC-1G	TC-2B	
TC►A	7	6	12	14	11	12			
TC►C	6	7	13	15	8	8			
A►TC	9	5	12	12	9	7			
A►TC + CHD	28	25	14	13	20	16			
C►TC	3	4	12	12	6	3			

In terms of mathematics tasks, these were most frequently adult-directed and manipulative activities, particularly in the Urban school. In the Rural and Peri-Rural schools, more time was spent by children on reading, writing and counting activities than on other activities. Relatively little time was spent on activities, such as small-scale construction, informal games and passive adult-led activities.

Records of social codes, for example, working individually, as a pair, in a small or large group, were also used to observe how long target children spent in different groupings during mathematics activities. Table 5 shows that in the Urban school there were no small-group (SG) activities, the majority of time being spent in a large group (LG) and working as a pair (P). In the Rural and Peri-Rural schools, target children spent most of their time in a small-group setting, though pair work, with and without interaction, as well as some individual work (SOL) also took place (see Table 5).

Table 5. Social context of observed children during mathematics

	Urban school		Rural school		Peri-Rural School	
	TC-1B	TC-2G	TC-1B	TC-2G	TC-1B	TC-2G
SG			56	58	30	40
LG	98	78	30	18	56	54
PAIR	12	32	28	30	20	16
SOL				6	10	4
PAIR/ P	10		6	8	4	6

In general, children in the Peri-Rural and Rural schools were offered small-group active and interactive learning experiences, both adult-led and child-initiated. Some free play and child-initiated activities consumed much time though seemed less focused on extending children's learning. In the Urban school, all group work was adult-directed and intensive yet failed to engage children actively or extend understanding. Across the three schools, the match of task to learner might be questioned. In one case, a child in the Urban school was unable to meet the challenge of the task; in other cases across the three schools there were grounds to question whether children were challenged enough.

Teacher interviews

Findings from RC teacher interviews gave direct insight into their views and understanding of the FS mathematics curriculum. The three teachers had extensive experience of RC teaching with appropriate teaching qualifications and additional short training courses related to the FS. They agreed that the FS was child-friendly, flexible and encouraged children's active learning. Asked whether they thought that mathematics work in RC classes had changed since the introduction of the FS, both Peri-Rural and Rural school agreed that this was the case, yet the Urban schoolteacher indicated that RC work had not changed much. In terms of parents understanding of their children's learning, the Urban schoolteacher emphasised that although she and

the school offered courses to parents to involve them more in their children's mathematical learning, they seemed reluctant to attend. Parents from the Peri-Rural and Rural schools were reported to have more understanding of the curriculum and were reported to be involved in children's learning.

Reported involvement of other school staff in the mathematics curriculum planning showed a different pattern. The Urban school teacher reported that there was full involvement of school staff in all stages of her planning, whilst Peri-Rural and Rural school teachers planned alone with little involvement of other colleagues. Thus Peri-Rural and Rural school RC teachers indicated a lack of commitment while the Urban schoolteacher indicated a high commitment. This could account for downward pressure towards formality in the Urban school teaching and the observed emphasis on numeracy that was not supported by practical investigation.

Teachers' attitudes towards planning informal child-initiated activities also varied. The Urban school RC teacher reported that she devoted little time to these activities. Peri-Rural and Rural RC teachers reported that there was much opportunity for such activity, in particular, the Peri-Rural RC teacher emphasised the priority given to child-initiated activity that matched her observed practice.

All three teachers believed that the FS and the strategies matched well and did not regard implementation in the RC class as a problem. The Rural RC teacher added that the FS was child-friendly yet lacked clear guidance. Whilst the strategies provided clear guidance that was not particularly appropriate for young children. This called for professional judgement and creative use by RC teachers, in line with recommendations of the *Primary National Strategy* (DfES, 2003) for teachers to take control of their curriculum and to be innovative. It could be argued that early childhood teachers have taken more control in flexibly implementing their own curriculum.

Discussion

Key findings will now be considered in the light of the research questions posed. The first question was – what is the relationship between policy and practice in early

childhood mathematics curriculum for RC children in England? With respect to the *context of influence*, the period in question, between 1999 and 2009 covered the years in office of the recent New Labour Government. This period was characterised by national and international interest in early childhood education. One reason had been the results of cost-benefit analyses applied to early childhood programmes showing investment in early childhood was cost-saving for the future. Primary school policy in England has also been influenced by international studies of literacy, mathematics and science, for example the Programme for International Student Assessment (PISA), OECD (2009), as noted in élite interviews. England's continuing low, ranking in mathematics internationally had caused concern among English politicians, academics and teachers (Kyriacou and Goulding, 2004). The NNS was introduced after some promising results from the National Numeracy Project which had been running in some inner-city areas, expressly designed to address low standards in numeracy (Straker, 1999). The desire to raise standards in mathematics had a trickle-down effect on mathematics policy in the RC and even the FS. This rested uneasily with non-statutory guidance espousing learning through play, informality and a child-centred pedagogy.

In the *context of policy text*, the FS documents (DCSF, 2008; QCA/DfEE, 2000) and the strategies (DfEE, 1999a; DfES, 2003; and renewed framework, DfES, 2006) had not substantially changed the mathematics content or pedagogy. Élite and RC teacher participants drew attention to the tension between the two sets of documents, two curricula and two opposing pedagogies. As noted by evaluators of the strategies, Fullan and Earl (2002) implementing large-scale reform such as the NNS, could not be done without top-down pressure from political authority. The most important feature about policy and practice, however, centred on the question of interpretation. Tensions in texts were reflected in mixed and ambivalent views of élites and practitioners, and contrasting practices observed among RC teachers.

In the *context of practice*, what RC teachers claimed they did in interview matched what was observed in classrooms, at the same time practice varied considerably in terms of formality, organisation of teacher-led and child-initiated activity and in the nature of interactions between adult and child and between children themselves. RC teachers were not simply receiving and implementing policy guidelines but were

bringing their values, beliefs and understandings into practice. Bowe *et al.* (1992) described this as teachers' 're-contextualising' the policies they received.

The second question was - what are RC teachers' views and understanding of the FS mathematics curriculum and related texts? The survey data from RC teachers indicated that the teachers positively received the FS and approved the changes in the mathematics curriculum in the period of 1999 to 2009. High levels of commitment to implementation of the FS were reported and it was generally believed that the FS mathematics curriculum for RC created a balance between child-initiated and adult-led activities, cross-curricular links and increased involvement in practical activities. Whilst a less formal learning and a more child-centred, play-based curriculum approach were identified as benefits, teachers were mixed in view about the role of formal teaching and written work. There was also a range of views about organisation of RC mathematics lessons and the balance to be achieved between integrating learning areas and delivery of a daily mathematics lesson. Furthermore, the FS and strategy documents themselves were seen as advocating differing pedagogical approaches despite their common objectives. In this respect, the Ball trajectory model assisted in identifying potential mismatches between *contexts of influence* and intentions of policy text on the one hand, and the *context of practice* on the other. The model was particularly useful in highlighting the way policy contexts influenced, interrelated or even conflicted with one another. Furthermore, it offered a means of uncovering and understanding the way tensions and contradictory policy influences became enshrined in policy texts that RC teachers were then faced with translating into practice.

The third question was – how do RC teachers implement the early childhood mathematics policy in the context of classroom practice? Observed practice, differed widely according to context. Factors involved, ranged from teachers' understanding and interpretation of the texts, the availability of resources and organisation of RC classrooms themselves, as well as the influence and involvement of other school staff in RC curriculum planning. The Urban school RC teacher encouraged use of new technologies though outdoor mathematical activities were very rare, as was the organisation of practical activity and child-led and free play. By contrast, the Peri-Rural and Rural schools regularly organised outdoor mathematical activities, an

abundance of topic-oriented free play and encouraged a variety of games and practical activity. Computers did not contribute much to mathematics or to other areas of learning during observation. Classroom organisation and resourcing, however, did not necessarily contribute to appropriate challenge in learning tasks. RC teachers in target schools made use of various groupings for mathematical activities and received a wide variety of responses from children, ranging from active involvement to boredom. As noted earlier by Alexander, Rose and Woodhead (1992), organisational strategies and group work often lead to a mismatch between the collaborative classroom setting and the individual learning tasks carried out. Small group, however, was more intensive than whole-class teaching but gave the teacher the chance to focus on individuals.

It was clear from observation that in all three schools, mathematics ELGs that specified counting, recognising numerals and using mathematical language were addressed. The Urban RC teacher laid great stress on numeracy, whereas teachers in the Peri-Rural and Rural schools included shape and space and practical investigation. From the beginning of the year, all RC teachers organised daily mathematics sessions as distinct activities, without integrating them with other learning areas. Duration of the lesson varied from school to school. All three schools were engaged in implementing the early childhood mathematics policies but each according to their own interpretation and according to priorities of their own and other members of staff.

The fourth question was – how did RC children respond to the FS curriculum presented to them? A striking difference between the Urban school and Peri-Rural and Rural schools emerged in the flow of interactivity. Lessons in the Urban school were adult-initiated and directed. Instruction was largely flowing in one direction – from teacher to children. In the Peri-Rural and Rural schools the flow was varied, questions were more open and could be initiated by child and responded to by an adult, or involve two children. Target child observations showed much more individual choice and independence in Peri-Rural and Rural schools, whereas Urban school children were more constrained by didactic teaching and closed questions. The observations showed clearly the influence of teacher strategy on children's response, interest and talk.

In the Rural and Peri-Rural schools, whole-class activity was balanced with other groupings, from solo, pair, to small and large group, whereas the Urban school activity was confined to large groups of nine to ten children with less opportunity for children to talk, interact and question. As Tharp and Gallimore (1998) noted, teachers supervising large groups may use more of the language of control than they would with smaller groups. Differences in interactivity between the Urban, Peri-Rural and Rural schools may in part be attributable to differences in the homogeneity of the classes themselves. Social and ethnic mix and competence in English language might have contributed to the teaching strategy adopted by the Urban schoolteacher. Whether or not this was the case, children were denied the opportunity to discuss and ask questions about mathematics tasks carried out. Their experience was one of intensive instruction, close observation with no opportunity to apply their learning to real-world problems. Whilst Peri-Rural and Rural schools provided opportunity for play, the underpinning mathematical intention was observed to be subverted by children at times and could lead into conflicts. Children in the Peri-Rural and Rural schools seemed relaxed and enjoyed their activities, even if a smaller proportion of their time was spent on the mathematical tasks they were set. Their more complex classroom organisational structures did not always lead to the careful matching of mathematical tasks to young learners or carry the necessary challenge to extend their learning.

Overall children's responses to mathematical learning varied greatly within the differing contexts. The intensity of adult-led and supervised work in the Urban setting produced a more passive response from children, whilst learning more actively in the Peri-Rural and Rural settings the range of adult-led and child-initiated tasks did not necessarily contribute significantly to their mathematical understanding.

Conclusions

Multiple and contradictory demands that fall on practitioners emerged from analysis of sources of contestation in all three policy contexts. Tensions and dilemmas within broad contexts of policy occur at different levels and highlight the political nature of practice that may be overlooked.

This was a relatively small-scale study with a single researcher and limited resources. The mixed-method approach gave some purchase on a case study of RC mathematics policy and practice within a number of contexts – political, ideological and educational – that were complex, situated and interactive. The Bowe, Ball and Gold (1992) policy trajectory model provided an appropriate framework to explore this fast-changing and unpredictable context. It served to illuminate the degree of interplay between policy and practice and the potential for contestation between the two. The RC occupies a space between the FS and the more formal Key Stage 1 curriculum, between early childhood pedagogy and the requirements of a National Curriculum intended to raise standards of achievement. At the same time, the RC curriculum is located within a context of international discourse, values and early childhood educational practices. RC practice thus carries global, national and local dimensions as well as unchallenged assumptions about connections between play, standards of achievement and learning, enshrined in current English early childhood policy and then enacted through RC practitioners.

This paper illustrates an inter-play between the local and global, and reveals the diverse ways of conceiving and enacting the same FS curriculum. The FS curriculum in RCs, in turn, is adopted selectively and reinterpreted in accordance with local knowledge and beliefs thus exposing a tension between global concerns, national policy and observed practices. This process is both historical and contextual. It has a horizontal dimension in the different interpretations of the FS curriculum across different settings that are portrayed and a vertical dimension in the change over time, as policy evolves. What is less certain is whether policy decision-makers or early childhood practitioners have engaged sufficiently in critical debate about the nature of 'play', 'child-initiated' activity and hence 'child-centred' pedagogies (Burman, 2008; Mac Naughton, 2005) in using and applying mathematics or in classroom discussion of mathematics.

References

Adams, S., Alexander, E., Drummond and M.J., Moyles, J. (2004). *Inside the Foundation Stage: recreating the reception year*. London: Association of Teachers & Lecturers.

Alexander, R. (2004) Still no pedagogy? Principles, pragmatism and compliance in primary education. *Cambridge Journal of Education, 24,* 1, pp. 7-33.

Alexander, R., Rose, J. and Woodhead, C. (1992). *Curriculum Organisation and Classroom Practice in Primary Schools: A Discussion Document* London: HMSO.

Aubrey, C. and Godfrey, R. (2003) The development of children's numeracy through Key stage 1. *British Educational research Journal, 29,* 6, pp. 821-40.

Aubrey, C., Godfrey, R. and Dahl, S. (2006) Early mathematics and later achievement: Further evidence. *Mathematics Education Research Journal, 18,* 1, pp. 27-46.

Aunio, P. C., Aubrey, C., Godfrey, R., Yuajuan, P. and Liu, Y. (2008) Children's early numeracy in England, Finland and People's Republic of China. *International Journal of Early Years Education, 16,* 1, pp. 203-21.

Ball, S. J. (1993) What is policy? Texts, trajectories and toolboxes. *Discourse, 13,* 2, pp. 10-17.

Ball, S. J. (1999) Labour, learning and the economy: A 'policy sociology' perspective. *Cambridge Journal of Education, 29,* 2, pp. 195-206.

Bowe, R. & Ball, S. J. with Gold, A. (1992). *Reforming Education & Changing School: Case Studies in Policy Sociology.* London: Routledge.

Burman, E. (2008) *Deconstructing Developmental Psychology, 2nd Edition.* London: Routledge.

Campbell, A. and Pungello, E. (2000) *High quality child care has long-term benefits for poor children.* Paper presented at the 5th Head Start National Research Conference, June 28- July 1, in Washington, DC.

Dahlberg, G. and Moss, P. (2005) *Ethics and Politics in Early Childhood Education.* Abingdon: Routledge.

Department for Children, Schools & Families (DCSF) (2008a). Independent Review of Mathematics Teaching in the Early Years Settings and Primary Schools. Final Report by Sir Peter Williams. www.teachernet.gov.uk/publications. Accessed 18/10/2009.

Department for Children, Schools & Families (DCSF) (2008b) *Statutory Framework for the Early Years Foundation Stage.* Nottingham: DCSF.

Department for Education and Employment (DfEE) (1999a). *The National Numeracy Strategy*: *Framework for teaching mathematics from Reception to Year 6.* London: DfEE

Department for Education and Employment (DfEE) (1999b) *National Curriculum for Mathematics at Key Stage 1 and 2*. London: DfEE.

Department of Education and Skills (DfES) (2002). *Mathematical Activities for the Foundation Stage.* London: DfES.

Department for Education and Skills (DfES) (2003). *Excellence and Enjoyment: Primary National Strategy*. Nottingham: DfES.

Department for Education and Skills (DfES) (2006). *Primary Framework for Literacy & Numeracy.* Nottingham: DfES.

Department of Education and Skills (DfES) (2008). *Early Years Foundation Stage.* Nottingham: DfES.

Earl, L., Watson, N., Levin, B. Leithwood, K., Fullan, M., Torrance, N., Jantzi, D., Mascall, B. and Volante, L. (2003) *Watching and Learning: Final Report of the External Evaluation of England's National Literacy and Numeracy Strategies.* Toronto: OISE/UT.

Early Childhood Mathematics Group (2001) *Mathematics Teaching, 174,* June, 9.

Engle, P. L., Black, M. M., Behrman, J. R., Cabral de Mello, M. C., Gertler, P. J., Kapiriri, L., Martorell, R. *et al.* (2007) Strategies to avoid the loss of developmental potential in more than200 million children in the developing world. *The Lancet, 369,* pp. 229-42.

Fullan, M. and Earl, L. (2002). United Kingdom National Literacy and Numeracy Strategies – Large Scale Reform**.** *Journal of Educational Change,3* 1, pp. 1-5.

Gifford, S. (2001) Foundation stage mathematics. *Mathematics Teaching, 175,* pp. 20-2.

Gifford, S. (2004) A new mathematics pedagogy for the early years: in search of principles for practice. *International Journal of Early Years education, 12,* 2, pp. 99-115.

Grantham-MacGregor, S., Cheung, Y. B., Cueto, S., Glewwe, P., Richter, L., Strupp, B. *et al.* (2007) Developmental potential in the first 5 years for children in developing countries.*The Lancet, 369,* pp. 60-70.

Hardman, F., Smith, F., and Wall, K. (2003). Interactive whole class teaching in the National Literacy and Numeracy Strategies. *Cambridge Journal of Education, 33,* pp. 197-215.

Holsti, O. R. (1969). *Content Analysis for the Social Sciences and Humanities*. Reading, Mass: Addison-Wesley.

House, R. (2012) Time to act on EYFS concern. Letter published in Nursery World, 12 January, 2012.

Kyriacou C and Goulding, M (2004). *A systematic review of the impact of the Daily Mathematics Lesson in enhancing pupil confidence and compedence in early mathematics.* In Research Evidence in Education Library. London: EPPI-Centre, Social Science Research Unit, Institute of Education.

Lincoln, Y.S. and Guba, E.G. (1985). *Naturalistic Inquiry*. Beverly Hills, CA: Sage.

Mac Naughton, G. (2005) *Doing Foucault in Early Childhood Studies. Applying Post-strutural Ideas.* London: Routledge.

Mainardes, J. and Marcondes, M. I. (2009) Interview with Stephen J. Ball: a dialogue about social justice, research and education policy. *Education and Society, 30*, 106, pp. 303-19.

Open Early Years Education (Open EYE) (2007) Petition against the EYFS gained more than 7,500 signatures, 5 December, 2007. *Open EYE newsletter archive.* *www.openeyecampaign.wordpress.com* (accessed 9 December, 2011)

Organisation for Economic & Collaborative Development (OECD) (2000). *Programme for International Student Assessment (PISA) 2009 Technical Report (Preliminary Version),* Paris: OECD.

Organisation for Economic Cooperation and Development (OECD) (2001). *Starting Strong: Early Childhood Education and Care*. Paris: OECD.

Organisation for Economic Cooperation and Development (OECD) (2006). *Starting Strong II: Early Childhood Education and Care*. Paris: OECD

Penn, H. (2007) Childcare market management: how the United Kingdom government has reshaped its role in developing early childhood education and care. *Contemporary Issues in Early Childhood, 8,* 3, pp. 192-207.

QCA (2003). *Foundation Stage Profile Handbook.* London: QCA.

QCA/DfES (2000). *Curriculum Guidance for the Foundation Stage*. London: QCA/DfES.

Quick, S., Lambley, C., Newcome, E. and Aubrey, C. (2002). *Implementing the Foundation Stage in Reception Classes.* London: DfES

Schweinhart, L. J., Montie, J., Xiang, Z., Barnett, W. S., Belfield, C. R. and Nores, M. (2005). *Lifetime Effects: The HighScope Perry Preschool Study Through Age 40.* www.highscope.org/content.asp?contentis=219
Accessed 10/09/2011.

Siraj-Blatchford I. Sylva, K., Muttock, S., Gilden, R. and Bell, D.l (2002). *Researching Effective Pedagogy in the Early Years, (REPEY).* London: DfES/Institute of Education, University of London.

Straker, A. (1999). The *National Numeracy Project*, Anita Straker with members of the NUT's Numeracy Task Group. London: DfEE.

Sylva, K., Roy, C., and Painter, M. (1980). *Child watching at Playgroup and Nursery School.* London: Grant McIntyre.

Sylva, K. Melhuish, E., Sammons, P., Siraj-Blatchford, I. and Taggart, B. (2004). *The Effective Provision of Pre-School Education (EPPE) Project: Technical Report 12 – The Final Report*. London: DfES/Institute of Education, University of London.

Tharp, R. and Gallimore, R. (1998) A theory of teaching as assistefd performance. In P. Light and D. Faulker (Eds.) *Learning Relationships in the Classroom.* London: Routledge.

Tickell, C. (2011) *The Early Years Foundation Stage (EYFS) Review: Report of the Evidence.* London: Department of Education.

United Nations (UN) (2000) *Millenium Development Goals.* New York: UN.

United Nations Children's Fund (UNICEF) (2006) *Investing in Children: The UNICEF contribution to Poverty Reduction and the Millenium Agenda.* Florence: UNICEF Innocenti Research Centre. www.unicef-irc.org/
Accessed 9/10/11.

Van de Rijt, B., Godfrey, R., Aubrey, C., van Luit, J. E. H., Ghesquière, P., Torbeyns, J., Haseman, H. K. *et al.* (2003) The development of numeracy in Europe. *Journal of Early Childhood Research, 1*, 2, pp. 155-80.

Walker, S. P., Wachs, T. D., Gardner, J. M., Lozoff, B., Wasserman, G., Pollitt, E. *et al.* (2007) Child development: risk factors for adverse outcomes in developing countries. *The Lancet, 369*, pp. 145-57.

Ward, H. (2008) Teachers hail 'nappy plan' *The Times Educational Supplement*, 1 August, p.1.