Primary teachers' perceptions of their mathematical knowledge for teaching and the effects of policy on their mathematics teaching

Corresponding Author: Dr Evelyn Penfold

University of Roehampton, Roehampton Lane, London, SW15 5PJ

Now affiliated with the Centre for Research for Teacher Education and Development, University of Alberta, 116 St and 85 Avenue, Edmonton, Alberta, Canada T6G 2R3

epenfold@ualberta.ca

Co-author: Dr Kate Hoskins

Brunel University, Kingston Lane, London, UB8 3PH

Kate.hoskins@Brunel.ac.uk

Abstract

The mathematics knowledge for primary teachers has been guided by policy since the National Strategies Programme was introduced in 1999. Research regarding the National Strategies focussed on the outcomes of the policy rather than in terms of teachers' mathematical knowledge for teaching (MKT). Teachers respond to policy in a variety of ways according to how they make sense of it within their current practice. This paper focusses on teachers' perceptions of the effect of their policy enactments on their MKT and vice versa. A qualitative methodology included semi-structured interviews in order to explore the perceptions of thirteen primary teachers from five schools in a borough of London. Tension occurred when teachers considered that policy superseded their MKT or they perceived that they needed guidance to teach the new National Curriculum. There are implications for teachers who associate MKT with policy, which is subject to change and therefore temporal in nature.

Key words

Mathematical knowledge for teaching (MKT), policy enactments, primary teachers

Outline of the study

Within this paper we discuss the literature pertaining to MKT, the National Strategies Programme (NS) and the 2013 National Curriculum (NC). We explain our research methodology and methods, which draw upon qualitative research and semi-structured interviews. The theoretical considerations of policy enactment and social constructionism are explained. Three themes relating to MKT represent the policy phases; the time the NNS was in situ (phase one), the period of the PNS (phase two) and following the removal of the NS and the introduction of the 2013 National Curriculum (phase three). Within our discussion

we evaluate our research methodology and methods. We make tentative conclusions from our findings and highlight the potential for future research.

Background context: defining MKT

Put simply, MKT refers to the specialized content knowledge needed to be a mathematics teacher in England. Specialised knowledge includes teachers knowing their pupils' learning and attainment needs in order to teach, using appropriate explanations and activities (Ball et al., 2008). Teaching strategies such as subtraction by taking away or finding the difference should be considered in terms of why one is more appropriate than another (Suzuka et al., 2009). Teachers need to know of and make links between "mathematical symbols and pictorial representations" and be able to use a range of examples within their teaching (Hill & Ball, 2009, p. 70).

A component of MKT can be contained in textbooks, specifically the sequence of learning and the "materials and examples" (Haggarty & Pepin, 2002, p. 572). Ball and Feiman-Nemser (1988) suggest that teachers are able to learn from a textbook and adapt its content to meet the learning and attainment needs of their pupils. Teachers can draw on the textbook as a resource that aids their planning and teaching or they can follow it "to the letter" (Newton & Newton, 2006, p. 70). When teachers are unable to develop their MKT they may focus on the procedural aspects of the textbook that will limit pupil discussion and guide their pupils towards using one particular method and giving the correct answer (Newton & Newton, 2006). Teachers' guides can be useful for planning, yet they are limited in terms of how teachers might explain ideas and what students' thinking and possible responses might be (Matić & Gracin, 2021). Teachers need a broad yet specific 'content-related' knowledge in order to analyse their pupils' learning and take action (Friesen & Kuntze, 2020). This

knowledge involves teachers using multiple representations and selecting the most appropriate one (Friesen & Kuntze, 2020).

The components of MKT detailed in this section are useful in explaining what teachers should know, however there appears to be a gap in the literature in terms of how policy affects teachers' MKT.

Background context: policy

During the 1990s new professionalism emerged as a result of an increase in policy directives and government issued targets to strengthen accountability regimes in state education in England (Hargreaves, 2000). Professional knowledge for the new professional involves 'producers' developing and producing knowledge and 'users' i.e. teachers implementing it (Wideen, Mayer-Smith & Moon, 1996). New professionals are accountable in terms of meeting national attainment targets (indicators of expected progress that are set by the government) and teachers are expected to comply with reform (Webb et al., 2004, Evans, 2008). A connection between policy and teachers' performance resulted from teachers being responsible and accountable for 'developing their knowledge and skills in accordance with the government's definition of what works in schools' (Webb et al., 2004: 90). The accountability culture in which teachers worked meant that some of their professional knowledge, including MKT, came from policy (Evans, 2008).

Policy is 'designed to steer the actions and behaviour of people' in order to produce a desired outcome (Rizvi & Lingard, 2010, p. 4). In England policy is also considered a means to raising standards in education (Ward & Eden, 2009; Askew et al, 2001). Policy changes occur to address what is needed within the nation's economic climate (Rizvi and Lingard, 2010; Bates, Lewis and Pickard, 2011). Alternatively, a new government may change policy,

as was seen in the UK in 2010 when the Coalition government gained power and introduced a new National Curriculum.

The National Strategies Programme was in situ in England between 1997 and 2011 and aimed to increase teachers' confidence in mathematics (and literacy) in order to gain an "accelerated improvement in standards" (Department for Education & Skills [DfES], 2006, p. 3). The NS was a "professional development programme providing training and targeted support to teachers" (Department for Education [DfE], 2011, p. 2). The NNS and the PNS were non-statutory policy initiatives that provided specific guidance through a range of resources that were designed to improve primary teachers' "pedagogy and subject knowledge" (DfE, 2011, p. 2).

Within the NNS Framework there was a structure for teaching mathematics; the numeracy hour that signalled a significant change to teachers' practice (Kyriacou, 2005). "Direct interactive teaching" involved teachers delivering all parts of the lesson to the whole class, including focussed input with a group of pupils (Brown et al., 2000, p. 461). Additional guidance was provided through the following booklets; teaching mental calculations, mathematical vocabulary and exemplification of key learning objectives. The Framework contained specific, detailed ways of teaching concepts and the NNS was perceived as prescriptive as it stated what and how mathematics should be taught (Adams, 2014).

The NNS was perceived as a comprehensive source of professional development, teachers gained a greater understanding of how children learnt maths through detailed and straightforward guidance (Basit, 2003; Webb et al., 2004). The NNS successfully contributed to a rise in pupils' attainment. The target of 75% of pupils attaining the level of progress set by the government was not met, although 73% did attain this level (DfES, 2006). The subsequent policy introduced in 2006, the PNS presented the message that "despite the

distance travelled national test results show progress is not being sustained across the board. We know more can be achieved and the Framework provides a fresh momentum for securing progressive gains" (DfES, 2006, no page number). The PNS Framework disseminated the National Curriculum programmes of study into two or three week sequences of learning, known as blocks of progressive planning (DfES, 2006).

Over the period of the NS many teachers were set targets for their pupils' progress during performance management meetings, experiencing "unrelenting pressure to improve" (Perryman, 2011, p. 182). Being managed by policy meant that teachers did not always perceive that they had a choice in terms of their enactments (Ball et al., 2012). This led to an impasse when teachers had to consider their responses and focus on the "more immediately understandable aspects" of policy (Brown et al., 2003). For example, in the NNS mental methods were designed to facilitate rapid recall of number facts and underpin written calculations (Department for Education and Employment, 1999). However teachers taught the mental/oral starter as a discrete part of the lesson and perceived that pupils would select the method that they liked best (Brown et al., 2003).

The 2013 National Curriculum and mathematics mastery

Prior to the introduction of the 2013 National Curriculum (NC) the English government conducted a review of mathematics. A key finding was that the performance of 10, 14 and 15 year olds in the PISA tests had 'stagnated' and employers claimed that mathematics (and science) needed to be 'promoted in schools' (DfE, 2013b: no page number). As a consequence of these findings, the 2013 National Curriculum underwent "major revisions" with regard to its subject content, (Roberts, 2018, p. 3). The intention was to create a "world class education system" which would entail schools adopting "a radically and more rigorous approach" (Gove, 2011, no page number).

To inform the changes, the government looked to the Pacific rim countries that feature in the top seven PISA rankings. The teaching for mastery approach that has been utilised in Singapore and China was introduced as a policy initiative that accompanied the 2013 National Curriculum. Teaching for mastery is aimed at developing teachers' mathematics teaching and raising pupils' attainment (Education Endowment Foundation, 2015). Pupils could develop 'deep conceptual knowledge alongside developing procedural fluency' (National Centre for Excellence in the Teaching of Mathematics [NCETM], 2014, p. 2). Teaching for mastery was adopted by many, but not all, primary schools in England. For those schools that adopted a mastery approach, the teaching of mathematics changed considerably, and moved towards teaching for depth and breadth of understanding ((NCETM, 2014).

Topics are covered in greater depth, through different contexts and with a range of structures and representations (NCETM, 2015, p. 5). Differentiation occurs not through attainment groupings, as pupils work at broadly the same pace, but through teachers' questioning, support and the teaching of a range of structures and representations (National Association of Mathematical Advisers [NAMA], 2016). Alongside the introduction of the 2013 National Curriculum the government created a list and provided funding for the purchase of recommended published textbooks (Truss, 2014).

To better understand teachers' experiences of the policy changes from NNS, to PNS and then to the 2013 National Curriculum and teaching for mastery period, the research addresses the following research questions:

- What are teachers' perceptions of their MKT as they enact the requirements of government policy?
- What are the effects of these perceptions as teachers moved to a new policy?

Materials and methods

The data presented in this article originate from a larger doctoral study in which 29 teachers from five London based schools participated (Penfold, 2020). They were selected to characterise the hierarchical professional status of teachers. We anticipated that the extent to which a teacher was a leader would affect his/her perceptions of policy. We drew on a qualitative methodology using semi-structured interviews as our research tool. We examined the teachers' responses through the lenses of policy enactment and social constructionism, focussing on their references to MKT. The data collection occurred in 2015, within the academic year in which the 2013 National Curriculum was first being taught. This study received ethics approval from the University's Research Student committee in August 2014.

Sample

Purposive sampling requires a specific selection of participants, based upon their current role and length of time within the profession (Cohen et al., 2018). It was important that all of the participants had been teaching since at least 2006. They would have experienced, at the very least, the introduction and removal of the PNS. We wanted to explore responses from teachers with a broad range of experiences and responsibilities and asked for the head teacher, the mathematics coordinator and at least two class teachers to participate from five primary schools in London. Five deputy head teachers also participated and they provided diverse perspectives of those whose leadership differs from head teachers. The greater number of class teachers (14) was pertinent as they had experienced the contrast within the three policy phases while maintaining their teaching position, thus their experiences of teaching mathematics were both historic and contemporary. Evelyn distributed participant consent forms during the introductory meeting and collected a signed copy at each teacher's interview.

Purposive sampling was used for the purpose of this paper in order to reduce the original data. We examined the responses in which teachers spoke about MKT and selected those that capture the nuances within each phase and illuminate the contrasting perceptions from one phase to another. There are responses from 3 head teachers, 2 deputy head teachers, 1 mathematics coordinator and 7 class teachers. This distribution is reasonable to present an even number of responses within the three phases and ensure representation across the hierarchical teaching positions. The greater number of class teachers is representative of the original sample in two ways. They make up 14 of the 29 participants and the responses to phase three were dominated by class teachers who perceived that their MKT affected and was affected by their enactments of the 2013 National Curriculum.

Table one provides key information of the 13 participants referred to in this article. The names of the teachers and schools are pseudonyms. The teaching position can be determined by the initial of the teachers' names. H for head teachers, D for deputy head teachers, M for mathematics coordinators and T for class teachers. Details of the full sample can be found in Penfold's (2020) doctoral thesis.

Table one: Key information of the participants

Name	**School**	**Started teaching**	**Year groups taught**	**Classroom based teacher?**	**Leadership details**	**Became head/deputy head/mathematics coordinator**
Deanna	Pemberton	1994	KS2	Y	SLT	2006
Dom	Armstrong	2003	3, 4, 5, 6	N	SLT	2015
Harry	Armstrong	2000	ALL	N	SLT	2014
Hasnia	Lethbridge	1995	ALL	N	SLT	2007
Heather	Bellingham	1976	N, R, 2, 3	N	SLT	2010

Maisie	Kersley	1992	ALL	Y	SLT	2008
Tallula	Pemberton	2006	1, 2, 3, 4, 6	Y		
Taluja	Lethbridge	2004	N, R, 1, 4, 5	Y	SLT	
Tara	Pemberton	2004	4, 5, 6	Y		
Terry	Armstrong	1996	3, 4, 5, 6, 7	Y	SLT	
Tessa	Pemberton	2005	KS2	Y		
Tianna	Lethbridge	2005	2, 3, 4, 5, 6	Y	SLT	
Tracey	Armstrong	2000	4, 5, 6	Y	SLT	

Theoretical considerations

We drew on two theoretical frameworks; policy enactment and social constructionism to develop an understanding of the teachers' experiences and explore their responses to policy.

Policy enactment theory relates to the ways in which teachers make sense of policy. The outcome of this can be seen in the changes teachers make to their practice (Ball et al., 2012). There are four stages to this theory, interpretation, translation, reconstruction and remaking of policy.

Interpretation of policy relates to the language of policy, which teachers make sense of by considering what action, if any, they need to take. Teachers' interpretations will be affected by their "policy biographies" (Ball et al., 2012, p. 43) that include their previous policy enactments and their current level of MKT. Teachers' translations of policy are affected by messages from colleagues within school meetings, lesson observations, the tracking of pupils' progress and other professional conversations (e.g. during a planning meeting). Reconstruction and remaking of policy relate to what teachers do, i.e. their enactment. As teachers reconstruct policy they decide how they will "enact or respond" which includes them "producing, reviewing and updating" policy through their routines and actions (Ball et al.,

2012, p. 109). Their reconstructions are affected by their differing understandings of policy and their current pedagogical approaches. The remaking of policy occurs within "the pragmatics of practice" that is the ways in which teachers present their policy enactments (Ball et al., 2012, p. 113). Parts of policy are selected while others are ignored. Enactment now has two applications. First as an encompassing term that includes interpretation, translation, reconstruction and remaking of policy. The second application is teachers' reconstruction and remaking of policy, changes they make to their practice (if any) and the resultant outcomes.

Social constructionism provides a theoretical lens for researchers to explore people's construction of an account that leads to an understanding of their experiences. Burr (2015) argues that researchers should include their participants' responses verbatim to provide context and demonstrate the different perspectives of their experiences. There is no 'ultimate truth' to be discovered as 'all perspectives are equally valid' (Burr, 2003, p. 204). Within the context of this study the teachers socially constructed their understanding of their responses to each policy phase throughout their interview. Talking for 30-40 minutes provided teachers with a sustained focus on their experiences, which enabled them to recall events. As teachers continued to talk, they recalled more detail and clarified their understanding of their experiences. As people construct their understanding they are influenced by when and where events took place (Burr, 2003). We considered how teachers viewed their retrospective actions through the lens of their current teaching position, which Burr (2015, p. 3) refers to as "historical and cultural specificity". This was useful to an extent in enabling us to recognise how teachers' perceptions could (but did not always) alter according to their different responsibilities.

Data collection – semi structured interviews

To gather the data for the doctoral study semi-structured interviews were used. Power relationships exist between the interviewer and the participants, according to Creswell (2013). Evelyn spoke of receiving the PNS to show that there was a shared experience, which facilitated what McKie (2002) refers to as a 'power with' relationship between herself and the participants. A conversational approach was utilised to create a 'positive and trusting relationship' (Goodson & Sikes, 2001, p. 29) and further mitigate the issue of power.

There was a scripted set of interview questions designed to focus the teachers to consider their autonomy, MKT and their professional development. Evelyn employed what Kvale and Brinkmann (2009, p. 130) refer to as 'judgement and tact' to draw on the interview questions within a conversation that ensured ensure that each question was addressed over the course of a 30-40 minute conversation. She acted as an interviewer and as a traveller (Kvale & Brinkmann, 2009) who accompanied the teachers through the journey they took as they described their experiences.

To facilitate conversation the questions were sorted into topic areas; professional information, historic context, current context and teacher autonomy. Mathematics related questions included 'how well did the policy address the current situation of mathematics teaching in your classroom?' and 'how did the removal of the PNS affect your mathematics teaching?'

A generic question that was asked towards the close of each interview was 'do you expect policy to be specific in mathematics content?' In response, teachers constructed their understanding by considering similar or related experiences from one or more phases, which added meaning to their interpretations. However we accept that the conversations were defined and controlled by the questions Evelyn asked and the responses she chose to pursue.

Data analysis

Using a qualitative methodology complements social constructionism with regard to gathering 'the experience and accounts' of the participants (Burr, 2015, p.170). Qualitative data are rich in description and contain the many realities of participants (Newby, 2014). Researchers can give 'voices to participants' (Cohen et al., 2018, p. 288). We accept that the teachers' responses are valid in terms of their experiences and that there is no external reality or 'ultimate truth' to discover (Burr, 2003, p. 204).

In order for a research study to be valid, Mason (2002) suggests that researchers collect data which both addresses and provides explanations in order to address their research questions. Gilbert (2008) claims that when asking participants to recollect an event from the past, they could give a different response each time they are asked. Thus the validity of our study could have been compromised by the expectation that the participants needed to recollect events from 2006 and earlier. In order to reduce the impact of this the teachers were asked to describe their experiences of how they believed they responded in the past, borne from their understanding at the current time of their interview. This action enabled teachers to simultaneously recall and explain their experiences, i.e. they socially constructed their understanding of events at the same time as they explained to another person (Burr, 2015).

Within the initial analysis a thematic analysis occurred, drawing upon the models of Braun and Clarke (2006) and Bryman (2016). Data analysis started immediately after each interview took place, which was aided by Evelyn creating the transcripts. Reading the transcripts in a different order from their accumulation and from different points in the text, as recommended by Newby (2014), enabled us to maintain a fresh approach, rather than becoming very familiar with the early transcripts/pages, and fatigued later on.

We undertook a systematic process of identifying responses that showed teachers' perceptions of their policy enactments. We created three tables using Microsoft Word, one

for each policy phase. We copied and pasted responses from the transcripts, which led to each row containing responses regarding the same topic. Bryman (2016, p. 586) refers to this collation process as the identification of 'topics that recur again and again' that become themes. We drew on our policy enactment framework to examine how teachers made sense of each policy phase, their perceptions of the MKT content, their own MKT and how they reconstructed and remade policy. Through this theoretical lens we identified that teachers' perceptions of mathematics policy altered with their enactments. The first theme recognises that the NNS presented a source of MKT. However, seven years later there was a shift as teachers' interpretations of the PNS included their professional judgements of how they should enact this new policy. The introduction of the 2013 National Curriculum and the teaching for mastery policy caused some teachers to doubt their MKT. Others stated that they were now able to draw on their MKT, which suggests that they had previously been constrained.

Findings

The participants' responses are presented by phase in order to develop a chronology covering the periods when the NNS and the PNS were in situ and following the removal of the NS.

Policy as a source of MKT in phase one

This section examines if and how the NNS policy could have operated as a source of MKT. According to Ball et al. (2008, p. 400) teachers' specialised content knowledge that is 'unique to teaching' needs to exceed their pupils' mathematical knowledge. The following responses show how teachers perceived that the NNS policy provided the required, or additional MKT. They constructed their understanding of their responses during interviews that took place in 2015. Thus, the teachers' perceptions of their MKT during 1999-2006 were considered through the lens of their current MKT and practice.

Taluja and Tessa started teaching in 2004 and 2005 respectively and their mathematics teaching coincided with the NNS. To exemplify their practice, they referred to the vocabulary booklet. Taluja said that she could "just look to see ok I'm in year one, these are the vocabulary and things like that". Tessa suggested that there was a need for the vocabulary booklet when she referred to it as "like the law to tell you that this is what you are supposed to be covering".

Hasnia's response suggests that her prior knowledge of mathematics was developed through her engagement with the examples in the Framework. She said:

> I remember clearly learning long addition for example and long multiplication and I was just told lay your numbers out in the right place and then you do that and you get the right answer. Cross the number out, borrow it, even now at our age as I'm doing it I think I do that, I borrow from the next number. What I liked about the National [Numeracy Strategy] it was breaking it down and understanding what is happening to the number. I can't tell you how old I was when I went 'oh is that what happens?'.

Hasnia, a teacher with four years' experience at the start of the NNS, had the capacity to review and update her knowledge of mathematical structures by engaging with the NNS' requirements. Prior to receiving the NNS she had followed steps but had not made "connections within mathematical concepts" (Askew et al., 1997, p. 341). As she spoke she made sense of how the calculations in the Framework had been different from her own methods. She had compared the methods to her own procedural practice and adjusted her understanding of the structure of long multiplication calculations.

Deanna had been teaching for five years when the NNS was introduced. She referred to the progression within the Framework in terms of developing pupils' understanding of concepts. Her response was:

> The old NNS, there were lots of different types of calculation that they expected you to move through quite, not quickly but then there's different levels, I'm thinking of division when they were teaching number lines and then the chunking method, which I really liked.

There appears to have been an acceptance of the division concepts within the Framework that Deanna 'liked'. While we do not know how Deanna was teaching division prior to the NNS, her MKT enabled her to recognise the value of progressing from the newly introduced number line method to chunking.

Maisie, with seven years' teaching experience when the NNS was introduced, appears to have drawn on her professional judgement when she told me:

> There were too many stages in between before getting them to formal methods of addition, subtraction, multiplication and division which I don't think helped initially.

Maisie accepted the Framework as a source of MKT but she perceived that there was a misalignment with pupils' prior knowledge and potential progress. The expectations of the Framework were challenging for Maisie to accept.

Teachers made sense of the policy by evaluating their current level of MKT, the learning and attainment needs of their pupils and the content of the policy documents. They recognised that the policy provided MKT that otherwise may not have been known or practiced. The responses support Basit's (2003) suggestion that the NNS was a source of professional

development and MKT, particularly in terms of the vocabulary booklet and Framework resources.

Professional judgements of MKT in phase two

Teachers' MKT involves selecting the most appropriate representation, considering why one method is more appropriate than another, and knowing why it is better suited for their particular domain (Suzuka, 2009; Carrillo-Yañez, et al., 2018; Friesen & Kuntze, 2020). Ball et al. (2008) refer to this MKT as specialised due to the fact that teachers know the learning and attainment needs of their pupils.

The PNS, introduced in 2006 focussed on disseminating the National Curriculum into two or three week planning blocks. The following responses suggest that there was tension within teachers' perceptions of their MKT and their policy enactments. Teachers were concerned about the pace of progression. They needed to prepare their pupils for the national tests. Alternatively they perceived that they only needed reassurance in terms of planning. We argue that teachers perceived that their MKT was more appropriate than the PNS, hence they made professional judgements as they interpreted the policy.

Deanna, with 12 years' experience at the start of the PNS spoke of the expected pace of progression when she said:

> Looking at how the units and blocks fitted together it seems to me that it was very prescriptive and very time bound, I think that was a worry at the time, but what if the children haven't got it and we've got to move on to the next unit or block?

Deanna's reference to the Framework being 'prescriptive' indicates that the content was specific and detailed. Her response suggests that the PNS' suggested timescale was too swift and did not align with the learning and attainment needs of her pupils. Her concern that a

national policy could not cater for individual cohorts of pupils implied that her MKT was more appropriate in terms of making judgements as to when she moved her pupils on.

Harry, Maisie and Terry reflected on preparing their pupils for the national tests. Their knowledge of the tests along with their assessments of their pupils informed them of how they could develop their pupils' understanding.

Harry had been teaching for six years when the PNS was introduced. He said:

> I tended to work more from individual children's abilities and groups and would tailor the support or the teaching to what they actually needed and there was a lot of filling gaps and a lot of catch up and a lot of intensive support for some children.

Maisie, with a total of 14 years' teaching experience, told me:

> Actually, I found it quite useful from February half term onwards when I thought, I wasn't told, I thought do you know what, these children don't need this. I'm sorry but these children don't need this, they've got SATs tests to get through.

Terry taught for ten years before the introduction of the PNS. His response shows that he enacted the PNS and adapted the policy:

> So we knew at the end of the year we had to get the children to a specific level in SATs, so we would pick and use parts of various blocks and units and so on that we needed to use. I would say that we used it when we needed to and adapted as necessary.

The PNS, as a national policy, could not provide detail that addressed the specific needs of year six pupils. Teachers considered the pupils' current understanding and drew on their

knowledge of previous national tests in order to plan and teach the necessary coverage. Harry and Maisie perceived that their MKT was more appropriate in order to provide specific, bespoke teaching content. In contrast Terry drew on the PNS for initial ideas that he adapted to meet his pupils' needs.

Dom, who had three years' teaching experience, referred to how the PNS was useful to some extent as it contained planning coverage:

> I don't think I referred to it. I knew what I needed, wanted to teach, I knew how I needed to teach it. I would refer to it for planning just to make sure that we are covering everything.

Dom suggested that the PNS contained the appropriate MKT in terms of planning coverage. Similarly to Terry he used his professional judgement and selected what he considered appropriate in terms of the coverage of topics. Heather's thirty years of teaching experience at the time of interview and her position as head teacher led to her considering her colleagues' responses.

Heather said:

> I think before [the NNS] it had been quite clear about how children of different abilities, you went by their ability and if I remember rightly, tell me if I've got this wrong, it came in as what you would do in year groups. So I seem to remember staff who actually knew how to teach being thrown because they had children in particular year groups who were not performing in that year group's work.

Heather was concerned that the PNS' planning indicated an expected level of pupils' prior attainment alongside prospective attainment. Heather indicated that experienced teachers in her school had doubted their ability to teach, which raises questions about the MKT in the

PNS. She suggests that her colleagues doubted their MKT as their pupils were not at the PNS' expected level, yet the MKT of these experienced teachers should have been more appropriate than policy.

Teachers' professional judgements regarding their pupils' learning and attainment needs were apparent in phase two. Teachers perceived they had acted upon their professional judgements, which were based on their assessment of their pupils' learning and attainment needs. They considered the PNS Framework as a source of MKT that did not always align with their professional judgements regarding appropriate planning and teaching. This supports, while simultaneously refuting the idea that policy cannot have knowledge. As planning is informed by pupils' current levels of understanding (DfE, 2012) it is unsurprising that the policy misaligned with teachers' professional judgements.

Change and challenge to MKT in phase three

Phase three relates to the period following the removal of the PNS in 2011 up until 2015 when the semi-structured interviews took place. The dominant topic of this phase was the 2013 National Curriculum. This was significantly different to the NNS and the PNS in two ways. Firstly, the National Curriculum is a statutory policy document, whereas the NS policies were non-statutory. Secondly, a National Curriculum states the expected coverage for each year group, provided through programmes of study and attainment targets. Unlike the NNS and the PNS the Curriculum does not state how or when the programmes of study should be taught. While it is reasonable to say that the Curriculum cannot be compared to the National Strategies they are connected by the fact that as policy documents they were enacted by teachers. There are comparisons to be made in terms of teachers' perceptions of MKT; their own and that within each policy.

When the 2013 National Curriculum was introduced the teachers in our sample had seven to 14 years' experience of enacting NS policies. The new Curriculum disrupted teachers' practice (Scott, 2000) in two ways. It was significantly different from its predecessor due to the more demanding attainment targets. In addition there was no accompanying policy guidance to support teachers' planning and teaching. Tension occurred when teachers perceived that they did not have the MKT to teach the National Curriculum. Three teachers did not draw on their previous practice, which suggests that any development of MKT that occurred during phases one and two had been temporal and rooted in policy. In contrast, two teachers benefitted from the lack of policy guidance, their responses suggest that they were previously constrained in terms of drawing on their MKT.

Tallula made reference to policy makers' assumptions that teachers' MKT would be sufficient to teach the new objectives. She had been teaching for seven years in 2013, her response was:

> I always felt like they assumed that you would know how to deliver a lesson based on that objective and I think that is quite hard to think 'how do I? Some of the year six Curriculum we have been throwing some comments around and I think, 'I have never taught this, I don't know the teaching steps'.

Tallula suggests that she would have benefitted from additional guidance to ensure that the new learning objective for the lesson was met. By purchasing textbooks teachers took action in order to produce certain outcomes (Ball et al., 2012), i.e. enacting the statutory Curriculum. Textbooks provide teaching strategies and activities that are considered by teachers as authoritative and legitimate support (Haggarty & Pepin, 2002).

Teachers are required to disseminate the Curriculum's objectives in order to develop pupils' mastery of mathematics. The following responses by Terry and Tracey include their concerns that they could not teach with depth and breadth. Terry, who had been teaching for eighteen years, spoke of policy makers' assumptions when he said:

> Each term, well at first glance, well it looks great, but when you look more closely the same objectives are just repeated with new ones introduced every so often and we've been told, "Oh you have to look at depth." It's assuming that there is, there's a whole range of teachers, a whole range of experience, so is everybody, how do we know if there is consistency across the year group and we are all building on the objectives?

Similarly, Tracey's 13 years' experience did not equate to MKT in terms of mathematics mastery. Her response was:

> There doesn't seem to be any ideas out there in terms of, people just keep saying to me, "it's depth not breadth" and I'm thinking, 'well could you show me?'

Terry and Tracey's responses suggest that they experienced tension when there was not a source of MKT that could support their transition to teaching with mastery. They perceived that they did not have the knowledge needed for this new approach of teaching with depth and breadth.

Two teachers perceived that they could draw on their MKT to teach the Curriculum. They reflected that previously the NNS and the PNS had possibly restricted their teaching. They now had the chance to make professional judgements. Tara taught for nine years prior to the introduction of the 2013 Curriculum. She said:

> Because there's not a definite this has to be taught in this number of weeks or this number of days, I find that a lot easier, that we can just do that ourselves, we can manage that and judge that from our own professional judgement.

Tianna, a teacher with eight years' experience reflected that she could utilise a range of teaching methods. Her response was:

> I have lots of ways of teaching the same thing in different ways and one of them will work. So anything now you've got more experience to draw on, and you have, it's less rigid so it's kind of an ideal situation really.

The 2013 National Curriculum was difficult to teach for three teachers. Their previous policy enactment experiences did not appear to have developed their MKT in a sustainable manner and they sought guidance. In contrast two teachers could draw on their MKT and make professional judgements regarding appropriate planning timescales and teaching methods.

Discussion

Policy enactment theory enabled us to explore the teachers' interpretations, along with their perceived actions. We focussed our exploration of the transcripts to teachers' references to MKT, i.e. gaining new knowledge, applying their own MKT or needing guidance. Focussing on how teachers made sense of policy enabled us to understand their perceptions of their MKT. We heard of teachers' previous actions and policy enactments that formed part of their 'policy biographies' (Ball et al., 2012, p. 43). We were also able to consider the teachers' perceptions of their 'pragmatics of practice' (Ball et al., 2012, p. 113) through their descriptions of their actions, particularly in their selection of or ignoring parts of policy.

Burr's (2015) idea that participants view their experiences through the lens of their current (teaching) positions was useful. Teachers socially constructed an understanding of their

experiences, from at least nine years ago, throughout their interview conversations. Arranging the interview questions into topic areas facilitated the conversational approach in which Evelyn interviewed as a traveller as recommended by Kvale and Brinkmann (2009).

Including hierarchical teaching positions within the sample was advantageous. Different perspectives were evident in the cases of Deanna and Maisie who spoke of their responsibility to their colleagues and the pupils. We cannot claim that the level of leadership always affected teachers' responses. Class teachers with significant teaching experience, such as Tessa and Terry also considered their colleagues. A limitation of this study is the small sample of teachers and schools. While we can offer our findings as representative of teachers' perceptions, this can only be on a very small scale. We cannot generalise our findings on a national basis.

There were implications for teachers who associated MKT with policy. First, the MKT gained during their enactments was temporal, i.e. useful, yet only appropriate while a policy is in situ. Second, and most concerning, is that teachers perceived that their MKT could be sourced, or superseded by policy, which happened in each of the three phases. In phase two teachers made professional judgements, drawing on what they considered appropriate MKT, particularly with regard to their pupils' learning and attainment needs and they ignored or adapted the policy. The third implication relates to the three teachers who perceived that they did not have the MKT to teach the 2013 National Curriculum. The document contained new attainment targets, there was no additional guidance and it coincided with the introduction of the teaching for mastery policy. Our concern is that teachers do not always perceive that they have ownership of their MKT. Instead policy can be perceived as a source, which supports Webb et al.'s (2004, p. 90) idea that the government knows 'what works' and therefore teachers should utilise the guidance. It is very difficult to resist policy due to accountability mechanisms (Ball et al., 2012).

Teachers' knowledge of 'students and knowing about mathematics' (Ball et al, 2008, p. 401) cannot be provided by a policy or textbook that are driven by the English government's economic priorities and foci on raising standards. However as Matić & Gracin (2021) argue, policy and/or a textbook can be useful if used as a guide for planning. If teachers take ownership of their MKT and utilise policy and textbooks in order to benefit but not drive their practice we believe they can develop and/or sustain their knowledge. Four policy changes have occurred in England since 1999 and each transition to a new policy phase was affected by teachers' professional judgements. As policy continues to be introduced teachers can recognise and value their MKT, which can affect their enactments to the extent they consider appropriate.

Teachers in England are currently in an era of teaching for mastery and the National Strategies Programme is significantly historic. Future research could include the effect of mathematics mastery upon teachers' MKT. It would be interesting to understand how the current professional development resources affect teachers' practice and their perceptions of their MKT. The role of textbooks could also be researched to explore teachers' perceptions of sources of MKT as something that is perhaps intrinsic to their role as a teacher or something that can be purchased and utilised.

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Declaration of Interest

There is no potential conflict of interest reported.

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