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Reassembling teachers' professional knowledge: a socio-material view of the role of intertextual hierarchies during a change to primary mathematics teaching

Abstract

The formation of teachers' professional knowledge has been discussed in relation to a wide variety of often interlinking and at times opposing influences. Ethnographic research adds to this discourse studies of knowledge as relationally formed within the cultures, societies and physical worlds of different collectives. Set within 3 months of ethnographic study of knowledge formation within one English primary school, this paper explores the role of intertextual hierarchies during a period of change to teachers' professional knowledge for the teaching of primary mathematics. Intertextual hierarchies are defined here as an interrelated network of texts and people: texts used and created collaboratively by teachers, leaders and policy makers during the knowledge change process. Drawing on actor-network theory and literacy studies, the act of changing a knowledge base through using and creating a series of texts is explored. I highlight how intertextual hierarchies can carry knowledge from policy into practice, whilst also describing the localisation of knowledge which occurs in the socio-material use and creation of each text. Data reported on draws primarily on fieldwork notes and document analysis, enhanced by semi-structured interviews with 3 of the 12 research participants.

Setting the scene

Influences on teachers' professional knowledge have been recognised as multi-faceted, sometimes conflicting and ever-morphing (Stronach *et al.*, 2002; Lunt, 2008). Practical, experiential gleaning of professional knowledge has often been contrasted with the influence of government control of professional knowledge and action, which has been seen as deprofessionalising (Hargreaves and Goodson, 1996). And yet government initiatives and policies, accountability measures and politically-controlled curricula continue to exert influence on the professional knowledge required of teachers to enact their roles.

One government-driven initiative which has gained much press over the past few years is the changing of professional knowledge for the teaching of primary mathematics into an approach commonly referred to as 'the mastery approach'. The mastery approach stems from Asian nations who perform highly in international testing progammes such as PISA. The mastery-based 'Maths No Problem!' website describes the approach as follows:

> 'When taught to master maths, children develop their mathematical fluency without resorting to rote learning and are able to solve non-routine maths problems without having to memorise procedures.' (Maths No Problem!, 2019)

It is the purpose of this paper, not to critique the approach (there are many others who have done this before me), but to describe how, in one English primary school, teachers' knowledge for the teaching of maths was changed. It is hoped that by understanding how an initiative moved from the domains of policy into practice, that schools may, through awareness of the knowledge formation process, be able to take greater control of the development of their teachers' professional knowledge within the requirements of the political era, going some way to counteract any feeling of deprofessionalisation. As part of a wider PhD study exploring influences at work on forming teachers' professional knowledge, this paper focuses on one of these influences: the network of related texts which are both used and created by teachers, school leaders and policy makers during the process of changing knowledge. Using actor-network theory (ANT) and Literacy Studies, I will

describe how documents are used to gain teachers' interest, to pass on new knowledge to be used collectively, to summarise collectively-agreed understandings of the new knowledge (and thereby opening this knowledge up to being itself changed by existing professional knowledge) and to move knowledge from policy into practice. I will show how this process of enrolment involves a continuous disassembling and reassembling of the original initiative and how this suggests that the initiative has not been blindly followed, but appropriated into, and affected by, pre-existing actors from within the context.

The school

Happy School teaches children between 3 and 11 years old, with 3 classes per year group. It is situated within an area of diverse socio-economic challenges and is highly regarded within the local community. The school has historically performed highly in nationally-reported tests at age 7 and 11, and has inspection reports of the highest grade. Following the introduction of a new mathematics curriculum and national assessment system in 2014, the school experienced a 'dip' in percentages of children achieving higher levels of attainment in maths. In 2015, a decision was made by the then school leaders to follow the government-promoted initiative of training teachers to teach maths using the mastery approach. Wallace, a current school leader, has been key in the continuation of this project.

The school at first invested in training in Asia for two teachers, one of whom became the maths specialist for the group of schools – the Multi-Academy Trust (MAT) - of which Happy School is part. Following this process, in-school specialists were given regional training over the course of a year, run by the government-funded National Centre for the Teaching of Mathematics (NCETM). Laurie, one of the teachers you will meet in this paper, is one of these teachers. Laurie is maths subject leader for Happy School. Simultaneously, teachers enthusiastic to be involved in the project were enrolled into NCETM-funded 'Teacher Research Groups (TRGs)'. The TRGs gather together groups of schools locally, with teachers in each school acting as hosts to the other members. Members gather at each school in turn, watching a live mastery lesson – in the classroom of the host teachers – and discussing the techniques used and the learning observed. Happy School's Frances is one of these teachers. He is also a head of one of the year groups chosen to be trained first in the roll-out of the approach in Happy School.

2 years into their journey, teachers in 6 out of 8 year groups have received between 1 and 2 years' initial in-school training in the approach. Training has taken the form of regular staff meetings which are run by Frances and Laurie, focusing on introducing aspects of the approach one at a time. Gap tasks and projects are set for year groups between meetings and they are asked to report back on these at subsequent meetings. A new lesson planning format has been introduced and school maths policies have been redrafted to reflect the approach. Laurie has been working with year group leaders to develop planning guides which bring together the mastery approach and collectively-used resources. Year group leaders lead planning sessions with their teachers each week, using the planning format, resources and guides which either Laurie has created, have been gleaned from the NCETM website or have been introduced in a TRG booklet.

In the summer term of the second year of introduction, I spent 3 months in Happy School, shadowing year groups and school leaders. Field notes (n = 12 weeks) were made during and after shadowed lessons, planning sessions, staff meetings, staff internal and external training events and informal discussions with teachers in groups and individually. Interviews with teachers, school leaders and other professionals (n = 12) were semi-structured, allowing for the discussion of elements of knowledge, action or beliefs which had arisen during observations. I noted physical

aspects of the school such as documents, displays, resources, the building, which formed part of action and interaction in fieldnotes, photographs (n = 37) and original documents (n = 76). The findings reported in this paper are drawn predominantly from analysis of documents used and created during the process of reframing teachers' professional knowledge for the teaching of mathematics into the mastery approach, as well as observations of staff developing their use of the mastery approach, maths lesson planning and lesson delivery, and extracts from interviews with Laurie, Wallace and Frances, who talk through the process of implementation.

Theoretical framework

Data has been seen through the socio-material lens of ANT and Literacy Studies, both of which offer the opportunity to view the associative relationship between the documents used in the change process and the people using and creating the documents. Associations which help us to understand how the change in knowledge has been achieved – the work that has 'done' the development of new professional knowledge.

ANT has been described as a sociology of associations (Latour, 1987). Meaning and knowledge are seen as the product of the organisation and associations of both human and non-human actors. Associations between actors lead to *assemblages* (Latour, 1987; Law, 2009) of meaning which 'perform into being' (Fenwick, 2016) collective understandings, knowledge, beliefs. ANT offers analytical tools with which to describe these *assemblages*, such as the idea of *translation* utilised here (detailed below), and thus to describe society in its continual making and remaking. This aligns with ethnography well – both ANT and ethnography explore knowledge from a constructivist standpoint, situating meaning within a continuously developing social network through the interrelations of individuals within social groups and physical contexts. Both ethnography and ANT have been used to highlight the formation of knowledge through the interactions of the practitioner within the social and material contexts of teaching (Nespor, 1994; Plum, 2017).

In ANT terms, a*ssemblages* are seen as temporarily stabilised, until the actor-network holding them together shifts and changes, destabilising and reconfiguring understandings into a new form, much like the constantly changing collective understandings of teachers' professional knowledge. Here, I deliberately distinguish the knowledge I discuss in this paper as *collective understandings*, because what I am exploring is the professional knowledge which is predominantly advocated at this particular moment in the teaching profession in English schools. This knowledge may, of course, differ from the professional knowledge for teaching maths which individual teachers individually believe is best – a belief which grows over time, through the many influences each teacher is exposed to. Undoubtedly, training in, and experience of, the mastery approach may act upon this individually-held belief, and a study of the extent of the influence of the re-assembling of pedagogical knowledge for maths on these teachers' personally-held professional knowledge beliefs would be an interesting extension to the study. For the purposes of this paper – to show the role of texts as actors in a socio-material network of knowledge creation – I shall limit myself to discussing collective understandings.

From ANT, I particularly draw upon the work of Callon (1984), who sets out the idea of *translation* through his description of

> 'the attempts by three marine biologists to develop a conservation strategy [for the scallops and fishermen of St Brieuc Bay]... Four 'moments' of translation are discerned in the

attempts by these researchers to impose themselves and their definition of the situation on others.' (p.196)

Translation, and its *four moments of translation,* essentially offers a way of viewing how an imposed alteration (the ideas of the researchers) to pre-existing practices (the actions of the fishermen and scallops) is achieved (or in Callon's case, is not achieved). In detailing each of the four moments of translation, Callon describes the interplay of existing and introduced actors, producing successful, or unsuccessful, use of the developed strategy through a process of interaction. First in the process is *problematisation*, in which the current issue is problematised as needing change. Second, *interessement* weakens links between previous actors, achieving buy-in from some key actors. Third, *enrolment*, whereby actors are enrolled into the ways of the new knowledge; and finally *mobilisation*: actors act – or do not act – within the new knowledge parameters, either stabilising or destroying the network holding the new knowledge together. Within each moment of translation, both human and non-human actors interact, creating either a socio-material achievement, or dissolution, of the intended development. In this paper, I use Callon's notion of the 4 moments of translation to trace how the nationally-promoted initiative of teaching using concepts from maths mastery is translated into the practice of teachers. I explore each moment of translation in terms of the key actors working together to exert influence.

As influences were traced during fieldwork, it became clear that a wealth of text-based actors were at play. In seeking an analysis of texts which aligned with ANT, I drew on literacy studies. As in ANT, texts from a literacy studies standpoint contain the potential to carry meaning and intention across distances and sites which it is unfeasible for humans to achieve. As in ANT, literacy studies offers a similarly socio-material outlook to knowledge formation:

> 'Textual analysis of all sorts can lull people into believing that texts themselves do things, and to forget the people behind the texts.' (Barton, 2017, p. 82).

Basing document analysis on the creation and use of texts, rather than limiting analysis to the words on the page, was achieved through observing their use and creation (noted in fieldnotes) and probing use and creation in interviews. Of particular synthesis with Callon's notion of translation was Barton's literacy studies-based notion of *intertextual hierarchies*, which describes how texts can be seen in a series of interlinked socio-material acts of use and creation (of new, linked texts), carrying and transforming meaning from an original idea to a final, distant practice. Texts in this sense, are discussed in this paper simultaneously as possible actors upon human understanding, through interpretation, and as methods of capturing and carrying interpretations over a distance and wide-spread area otherwise unfeasible for a single human.

Problematisation

In Happy School, the first step in changing teachers' professional knowledge for the teaching of maths was to identify a convincing reason for the change - to *problematise* current practice and make explicit the need for adaptation. In Happy School, problematisation of the mastery approach was linked to another government-driven change: the renewed assessment system, which moved from numerical grades to statements of attainment:

> In 2014, the English national curriculum for primary mathematics (DfE, 2014) was renewed with increased content and skills for each year group. Subsequent revision of national assessments at end of key stages 1 and 2 reflected this expected knowledge and skills increase, shaping these into descriptions of whether a pupil had 'met the expected standard' for the end of the key stage, or had attained the higher standard of 'working at greater

depth' (STA, 2018). In Happy School, this change brought a decline in children achieving higher levels of assessment for maths, whereas previous years had consistently high attainment in this area. In 2015, the school sent two teachers on a DfE-funded visit to Shanghai, to study the teaching methods involved in the mastery approach, which was advertised by the UK government as supporting learners to think in depth about maths. Meanwhile, the Department for Education funded the National Centre for Excellence in the Teaching of Mathematics (NCETM), whose remit was to roll out national training and advice on the mastery approach. Selected teachers from Happy School were invited by school leaders to attend several layers of training run by the NCETM: specialist maths leader training, Maths Hub meetings for regional gatherings of and training of teachers, and Teacher Research Groups, which focused on developing elements of the mastery approach. *(Excerpt from fieldwork notes, 15th May 2018)*

Wallace, a school leader, describes the adoption of the mastery approach:

'I'm not saying that everything is results-based, because it isn't, but our rationale for looking at maths mastery and greater depth has been looking at actually we need to increase the number of children who are coming through working at greater depth. We can see that there's disparity there and it gets greater over time.' *(Interview with Wallace Grey, 7th June 2018)*

The political initiative advocating the mastery approach is offered by school leaders to teachers as a solution to the effects of politically-decided changes to national accountability measures and performance data. Teachers who become the first to be trained in the approach began to change how they saw and talked about the learning of the children in their class, highlighting the problems of current practice and the possibilities of the new practice to others:

In a staff meeting, teachers from all year groups gather to discuss how children can learn 'in depth' in maths using the mastery approach. One teacher, Frances, talks through the background of a child's learning: 'She doesn't grasp a lot of things in a rote learning way and might, under the old system, have been viewed as 'lower ability', but is now not as she is considered able to 'think at depth''. *(Excerpt from fieldwork notes, 15th May 2018)*

At this stage, government-driven initiative is promoted by an already-emerging barrage of (also government-driven) texts, acting in the background – publications of school data; published descriptions of what it means to achieve the standard of 'at greater depth'; the myriad of documents surrounding the renewed national assessment system. Whilst their influence is discussed indirectly and in summary, both their use and creation ascertain that the adoption of the mastery approach is promoted as a result of actions within the political domain.

Interessement

Callon describes the next stage of adapting knowledge as *interessement*, involving the weakening of links between existing actors, in this case in the current collective understanding of the knowledge needed to teach primary maths, and achieving buy-in from actors key to the change. *Interessement* is achieved in this case through NCETM-run training opportunities which are structured for group discussion and interaction with the materials – texts and teaching resources – for teaching using the mastery approach. During these training sessions, pre-existing knowledge is actively questioned and compared to the usurping mastery approach.

Laurie has been one of the school's maths subject leaders for a year. He has attended subject leader training run by the government-funded NCETM - a 4 day course – and he invited me to go with him to the final day of training, held at a local secondary school… One trainer points out sections which are 'probably quite different to how we have taught or how we expected children to think.' Explanations are given as to why these different ways of teaching/ thinking about fractions are preferred to those of the past. 'I really have to train myself to do this,' the course trainer says as she models a concept again, writing on a whiteboard. She repeatedly phrases her explanations as: 'I used to…. And now I insist on…. That has made a difference to the children's understanding.' Delegates work through the new knowledge as set out in the slide decks, articles and textbooks provided on tables (all centred around the mastery approach), with current understandings and delegates'/trainers' own experiences juxtaposed explicitly with examples in the texts. *(Excerpt from fieldnotes, Laurie, 8th June 2018)*

Hamilton (2011) discusses this notion of weakening links between actors as the faults in a previous system being highlighted, whilst the new system is praised. In this case, this is achieved through the juxtaposition of practical experiences of the teachers and course trainers with examples of the promoted mastery pedagogy in texts such as training slides, articles and a mastery approach textbook. As delegates meet challenges to their current thinking, they read these texts and bring them into dialogue or make notes about them:

Laurie and other delegates comment that they struggle to understand some of the aspects of mastery presented on the course. During these moments, the course trainers reassure them:

'We need to develop teachers' own understanding. It's about subject knowledge and delving really deep. It's one thing understanding, but another to understand it well enough to teach it.'

As Laurie works to understand a concept, he makes notes on the slide deck handout and refers back to previous slides, to the provided textbook and an article recommended for pre-reading by the NCETM. He says to me, 'I need to get my head around this, change own thinking.' *(Excerpt from fieldnotes, Laurie, 8th June 2018)*

Laurie's change to thinking is mediated by the provided texts, guided by explanations verbally given by the course trainers. Laurie's buy-in is seen as a need – 'I need to…'. He later explains that it is part of his role to understand the approach so that he can take the materials provided back into school and pass the knowledge on to others. The texts which have interpreted the mastery approach for the delegates now continue on their journey, carrying knowledge into schools.

Enrolment

In passing on the knowledge of teaching using the mastery approach, however, Laurie does not simply repeat verbatim the trainers' comments, nor does he give teachers every document he has been given, unchanged. Whilst he uses a similar model of discussion, challenge and documented example in delivering regular staff training, he draws on discussions held in these spaces and in wider contexts to create a series of new documents to support teachers. Documents which blend NCETM texts, government-produced texts, mastery-focused published texts and training materials given to him with existing documents, resource and websites in popular current usage by teachers. Elements of the mastery approach are chosen to focus on, rather than the whole approach in one go. A chain of texts results, which forms a central part of the actor-network of the shared

understanding of mastery in the school. It is to this textual 'infrastructure' (Hamilton, 2011, p. 61) that we now turn (see Figure 1).

National level, produced by government, government-funded agencies or independent publishers	Multi-academy trust level, produced by school and MAT leaders in liaison with school and MAT specialist teachers	School level, produced by specialist teachers in liaison with middle leaders and MAT/NCETM trainers	Teaching team planning level, produced by teams of teachers	Classroom level, produced by teaching teams and individual teachers
National curriculum and national assessment statements

NCETM planning documents, website and training materials

Mastery approach textbooks

Web-based planning documents | 'Landmarks' document

'Small steps' planning guidance

Maths policy documents, i.e. calculation policy

Teacher Research Group reflection journal (NCETM-based) | Year group planning guidance

Staff training slide-decks and handouts

Reasoning icons for use across school

Planning format ('S plan') for use across school

School development and action plans | Weekly collaboratively-planned slide decks and resources

Weekly planning using S planning format for small steps

Team/ individual research project reflections linked to school development plans | Slide-decks used to structure lessons and 'maths voice' of teacher and students

'Live marking' concept in books

Reasoning icons

Paper resources and other materials represent concepts and shape learning

Working wall collects language and central ideas |

Figure 1: Intertextual hierarchy created during the process of changing teachers' professional knowledge for the teaching of maths to the mastery approach.

> Over morning break, Laurie talks me through the documents created during the process of the adoption of the mastery approach. The first level of these are school and MAT-based policy documents, which set out minimum expectations for pupil attainment and teaching methodology. These school and MAT-wide texts were created through discussions involving school and MAT leaders and trained in-MAT specialists. *(Excerpt from fieldnotes, 6th June 2018)*

Crucially, these are not exact copies of the mastery approach or the national curriculum or assessment documents into MAT policy. Their contents blend pre-existing school aims and priorities with mastery and national curriculum/assessment framework information. Pre-existing understandings of professional knowledge for the teaching of maths can be seen in the example of the 'Landmarks' document, which sets out the essential knowledge and skills pupils should achieve by the end of each school year. The 'Landmarks' document draws on a pre-mastery tool from the national curriculum for setting pupil attainment expectations by year group - key performance indicators (KPIs):

Year 1- Landmarks

Key Objectives

Number and place value
- Counts to and across 100, forwards and backwards, beginning with 0 or one, or from any given number
- Counts, reads and writes numbers to 100 in numerals; counts in multiples of twos, fives and tens
- Given a number, identifies one more and one Less

Addition and subtraction
- Represents and uses number bonds and related subtraction facts within 20

Fractions (including decimals)
- Recognises, finds and names a half as one of two equal parts of an object, shape or quantity

Measurement
- Compares, describes and solves practical

problems for:
1. lengths and heights eg long/short, longer/shorter, tall/short, double/half;
2. mass/weight eg heavy/light, heavier than, lighter than;
3. capacity and volume eg full/empty, more than, less than, half, half full, quarter; and
4. time eg quicker, slower, earlier, later.

- Tells the time to the hour and half past the hour and draws the hands on a clock face to show these times

Properties of shape
- Recognises and names common 2-D and 3-D

shapes, including:
1. 2-D shapes eg rectangles (including squares), circles and triangles;
2. 3-D shapes eg cuboids (including cubes), pyramids and spheres.

Summary Statements
With reference to the KPIs. By the end of the year:
- a child should be fluent with whole numbers and counting
- A child has a developing knowledge of addition and subtraction using concrete objects and pictorial representations
- A child can describe and compare different quantities such as length, mass and capacity/volume.
- A child is beginning to recognise simple fractions
- A child is beginning to tell the time
- Children should read and spell mathematical vocabulary at a level consistent with their increasing word reading and spelling knowledge

Figure 2: Landmarks MAT document

The Landmarks document is part of a suite of MAT-level documents created by school and subject leaders, which are used in unison to reflect on practice. Linked documents within the suite support teachers in designing teaching activities which will achieve these landmarks, and it is in these documents that mastery methodology is blended most evidently with pre-existing maths pedagogy. One such document is the Progression in Calculations document:
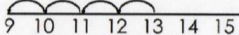
Progression in Calculations

Objective and Strategies	Concrete	Pictorial	Abstract	Mental
Counting back	Use counters and move them away from the group as you take them away counting backwards as you go. 12 – 4 = 8	Count back on a number line or number track 9 10 11 12 13 14 15 Start at the bigger number and count back the smaller number showing the jumps on the number line. This can progress all the way to counting back using two 2 digit numbers.	Put 13 in your head, count back 4. What number are you at? Use your fingers to help.	

Figure 3: Progression in Calculations document

This document links the pre-existing national curriculum objectives to mastery approach methodology – concrete, pictorial and abstract presentations of the same learning being a key approach of the mastery method. In addition, ideas for what these activities could look like are drawn from training materials, online banks of mastery resources and the current practices of the teachers who created the documents.

> Laurie continues, detailing how the need for a new calculations policy was identified as the school began to adopt the mastery approach, to reflect the new methods being introduced for the teaching of maths, whilst taking into account the elements of existing maths teaching which were going well. *(Excerpt from fieldnotes, 6th June 2018)*

Throughout the creation of these tiers of texts, sections of the mastery approach are woven into existing policy guidance, currently well-used resource banks and teachers' experiences of what has worked in the past, morphing the approach to the pre-existing understandings and priorities of the context. As a group, these texts are *enrolled* as actors, embodying aspects of both mastery and current knowledge for usage in planning lessons, the teachers and leaders creating the texts performing what Hamilton calls 'localising moves' (Hamilton, 2011, p. 67) on the mastery approach.

This appropriation continues throughout the next tier of texts; those created by middle leaders in the school:

> Laurie explains how he created the Year Group Planning Guidance documents in discussion with year group leaders. The documents rearranged the order of the national curriculum learning objectives to an order which year group leaders felt worked better for progression of learning, based on their experiences of teaching that age range. Resource banks were included which teachers already found valuable, as well as ones they had been introduced to from the NCETM training and discussions at TRGs. Expectations were aligned with those set out in the MAT documents, such as the Landmarks document. *(Excerpt from fieldnotes, 6th June 2018)*

Figure 4: Excerpt from Year Group Planning Guidance document

Documents at this tier merge school policies from the previous tier of texts with information from documents from the original tier: NCETM mastery materials and the national curriculum. Also included are currently used resource banks and the whole sequence of learning is structured by drawing on teachers' experiences of teaching maths within each year group.

It is through discussions at each tier that documents such as the 'Landmarks', 'Calculation Policy' and 'Year Group Planning Guides' are created, to be used in future discussions. The intertextual hierarchy which emerges provides the infrastructure for the new professional knowledge, with the mastery approach disassembles and reassembled at each stage, appropriated alongside national expectations and the pre-existing knowledge of teachers.

The influence of this text-based knowledge infrastructure relies on the co-existence of both texts *and* people to continue in its journey from policy to practice. Whilst texts from previous tiers carry understandings of the new knowledge into professional dialogue, people need to use them in order for the texts to exert influence. It is the active use of these documents as reference points in discussing maths teaching which both moves the mastery approach into professional dialogue and action whilst simultaneously achieves a level of buy-in to the future use of the approach:

> 'I went and taught in Year 2 using some of the activities from the Year Group Planning Guidance and they watched and evaluated using the Landmarks document. And then we

saw it in a different lesson and we evaluated somebody else and then they've seen me teach my class because they wanted to see it in a class where it's been happening all year. Then they could see where the impact is. And because it was children that they knew, they were a little bit blown away by what the children were capable of… 'But so and so couldn't do this before' and I was like 'but they can do this now.' And that was a big buy-in. A massive buy-in.' *(Excerpt from interview with Laurie, 7th June 2018)*

Texts are enrolled as bases for comparison – they become representatives of what the children can do using this approach, in relation to teachers' knowledge of what children can do using existing pedagogies.

Mobilisation

Teachers also actively use texts in weekly year group planning sessions and in classrooms, whilst teaching using the approach. Teachers' active use of mastery-based texts from the intertextual hierarchy reframes their dialogue into knowledge of the mastery approach, mobilising the knowledge. Callon defines *mobilisation* as the final stage of translation, whereby actors act – or do not act – within the new knowledge parameters, either stabilising or destroying the network holding the new knowledge and practice together.

In weekly planning sessions, previous tier documents are used in deciding the pedagogical approach for the next week's maths lessons:

In an afternoon year group planning session, four teachers gather to plan a maths unit. The year group leader reads out the non-statutory guidance from the national curriculum print-out, then asks the others where they think they should start with these things in mind. One teacher suggests doing one week on halves and then a further week on quarters. Another suggests doing one week on objects and shapes with both halves and quarters, followed by a week on quantities. Faced with two ideas, the year group leader refers to the 'Small Steps' school document and planning guidance document as well as a NCETM planning guide. 'What do they do? Let's have a look.' One teacher brings into the conversation an activity from the teacher research group she attended recently, explaining it step by step to the others, who agree that it sounds like a good idea. Children's current understandings, emotional barriers to learning and activities used in the past are brought into the dialogue. A written plan takes shape as elements are agreed upon during discussion. *(Excerpt from field notes, 8th May 2018)*

Here, texts from previous tiers form key parts of the discussion and appear in resulting texts which are created to represent agreed understanding and planned action, such as the concrete approach included in the planning notes from the above planning meeting:
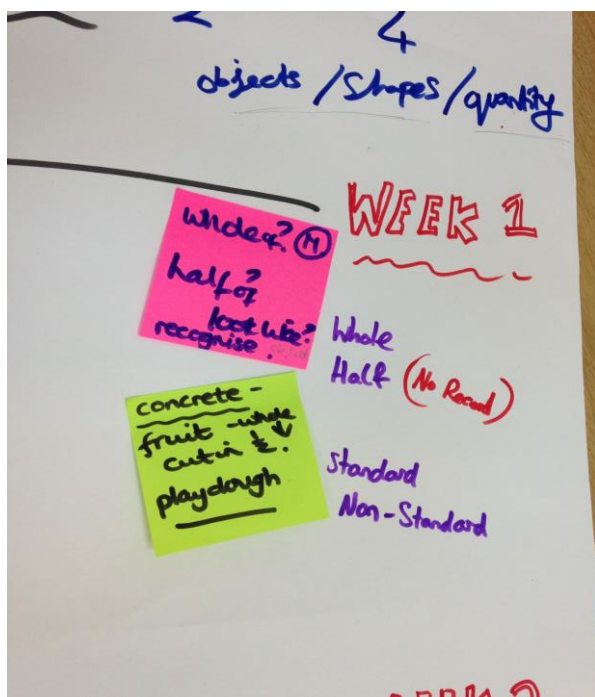
Figure 5: Section of planning notes from Year 1 team, 8th May 2018

As texts from previous tiers act as reference points in discussions, active usage of these texts embeds the language of mastery into professional dialogue, reframing teachers' written/mental model of the knowledge of teaching maths. Barton highlights the importance of language usage in constructing thought, language being a central actor in 'the mental models people construct of the world' (Barton, 2017, p. 73).

Earlier appropriation continues as mastery texts act alongside existent professional knowledge –of children's learning and emotional needs, of teaching strategies which have engaged learners in the past. As in MAT and whole school tiers, texts are interpreted into situated professional dialogues in order to generate shared understanding around the new professional knowledge, which is in turn turned into a new tier of texts – planning notes and lesson slide decks. Continual interpretation of previous tier documents generates a sense of vulnerability of the original initiative. We can see this vulnerability and interpretability elsewhere in studies of attempts to determine professional knowledge through texts (Mulcahy, 2011; Tummons, 2016). Here, the mastery approach as an initiative has not been directly followed, but assimilated into the needs and current understandings of the school, problematising the consistency with which nationwide policies and initiatives can travel unchanged from publication into practice.

However, there are some elements of mastery which retain consistency of meaning throughout the intertextual hierarchy, through the choice of the people creating the documents to include them. Key phrases appear on staff meeting slides, in resources, in year group planning guides, in classroom displays, in reasoning resources, on lesson slides, in planning. These phrases signal parts of the mastery approach – for example:

> On a maths display in a Year 1 classroom, key phrases are written, which are used in classroom dialogue in this and other classes:
>
> o   Change one thing (pictures of a circle, a rectangle, a rectangle with rounded edges)
> o   What's the same? What's different? (???)

- o Do, then explain… (picture of cartoon face and speech bubble, alongside a pencil)
- o Prove it! (tick symbol)

(A selection of the key phrases - Excerpt from fieldnotes, 8th May 2018)

These phrases are used in training resources, created into a reasoning mat for classroom usage, are added to planning guides, to lesson slide decks:

> The next slide is clicked onto, which is entitled: Review: 15 XIV. *Change one thing* in this statement to make it correct. Laurie asks, 'What else could you do?' *(Excerpt from fieldnotes, 6th June 2018)*

and used in professional dialogue about maths lessons:

> Meri, a Reception class teacher, asks for clarification on the maths lesson from her year group leader, Jamie. Jamie sits down with her at the PC, clicking through the slides. 'Here, they have to *prove it* using a number line.' *(Excerpt from fieldnotes, 22nd May 2018)*

When asked about mastery teaching in mathematics, teachers refer to these key phrases, use them in planning conversations, and Frances tells me about them that,

> 'Our complete culture shift in our approach has been driven by change in vocabulary'. *(Interview with Frances, 17th May 2018)*

The occurrence of these phrases across the intertextual hierarchy and in professional dialogue signals a certain level of stabilisation (temporary, until further knowledge is introduced) of collectively-agreed and localised meaning around the approach. Unlike Callon's fishermen and approaches to the domestication of scallops, at the time of writing, the network I have traced showed a growing stability in collective understanding and usage of the approach. It is, however, important to remember that as actors within the network – texts, school priorities and funding for the initiative itself – change, the network, as for any network, remains unstable in its vulnerability to change.

Conclusion

It has been highlighted here that texts have played a key role in the formation of, or adaptation of, teachers' professional knowledge. Documents were used to gain teachers' buy-in, to pass on new knowledge to be used collectively, to act as reference points for this knowledge. New texts created from discussions of previous tiers of texts summarised discursively-agreed understandings of the new knowledge, creating an intertextual hierarchy which became the infrastructure of the change. The people using and creating the texts brought into discussions existing knowledge around the teaching of maths, along with existing wider professional knowledge around children's needs and teaching activities used successfully in the past. The original initiative and content of the mastery approach was thereby opened up to being itself changed by pre-existing professional knowledge and became localised, interpreted specifically for this school.

In conclusion, for those considering the influence of policy on practice, or making a change to collective professional knowledge bases, this paper highlights the need to consider *how* knowledge is changed. Greater awareness of methods used to change knowledge allows for greater consideration of how control of knowledge development may be assumed by schools. It will be key to remember the influence that non-human, text-based actors may have upon the formation or change of teachers' professional knowledge. Through active use and creation of texts during the knowledge change process, an intertextual hierarchy may be used to carry new knowledge and ideas

across distance and space. It may also influence teachers' ways of talking about, mentally modelling, and acting within their profession. Knowledge gleaned from an initiative or policy may be made appropriate for the context through localising moves. It is to be assumed by policy makers in the creation of original initiative texts, that an intertextual hierarchy may ensue through which will schools will localise the initiative, creating a contextualised version in each school. Thus, when implementing change to professional knowledge, it is crucial to consider the entire infrastructure of knowledge translation and how this may support or hinder the success of the change.

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