Developing frameworks for evaluating and researching the Shanghai mathematics teacher exchange: practices or assemblage

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There is currently much interest in 'mastery' pedagogies in mathematics in England. To promote teaching for mastery the government has funded an exchange programme with primary teachers and headteachers from 48 schools visiting Shanghai and/or hosting Shanghai teachers in 2014/15. Schools have, to varying extents, continued to both adopt and implement Shanghai practices. To support the longitudinal evaluation of the exchange a conceptual framework categorises aspects of practice in terms of systemic, school and classroom practices. This allows for change in specific practices in different schools to be compared and evaluation of the extent of implementation of Shanghai informed approaches. However, such an approach has limitations in understanding how different practices interrelate and the relational effects of changes. An alternative is to consider primary mathematics education as an assemblage.

Keywords: Mastery; Shanghai; methodology; evaluation; assemblage; primary mathematics

Introduction

In order to promote mastery teaching in mathematics the government has funded the *Mathematics Teacher Exchange: China-England*, referred to here as the 'exchange'. Teachers and headteachers from 48 primary schools in England visited Shanghai and then hosted Shanghai teachers in their schools. The exchange is funded and managed by the Department for Education. The National Centre for Excellence in the Teaching of Mathematics (NCETM) leads the implementation of the exchange through the national network of Maths Hubs. The NCETM produce guidance, contribute to events and lead a specific CPD programme to develop/designate a cadre of primary mastery specialist teachers. In June 2016, the government announced a further expansion of the exchange programme (DfE, 2016). A team from Sheffield Hallam University is undertaking a longitudinal mixed methods evaluation focusing on the implementation of the exchange and changes in practices in the participating schools, as well as changes in other schools not directly involved in the exchange. This is complemented by a three year study of impact on KS1 and KS2 assessment outcomes in the exchange schools in comparison with a matched sample of contrast schools.

Here, I consider challenges in researching and evaluating changes that have happened in schools involved since the exchange visits. I consider the value of two different ways to conceptualise mathematics education, the process of why and how things happen, and who and what generate these happenings. The first way is a framework of categories of practices. This approach is compatible with both a post-positivist framework of evaluation that is broadly atheoretical as well as a realist evaluation approach (Pawson & Tilly, 1997). In realist evaluation theoretical understandings of social rules and institutions are important to understanding the role

of context. The second way is an alternative sociomaterial approach that invokes the concept of assemblage rooted in ontological multiplicity.

The concept of assemblage is self-referentially applicable to evaluation processes themselves (Burnett, 2016) - methods enact realities in evaluations: 'the argument is no longer that methods discover and depict realities, instead they participate in the enactment of those realities' (Law, 2004, p.45). The process of assemblage, in relation to methods at least, is not only epistemological but also ethico-political. In the context of the Shanghai evaluation a descriptive reading/narration of the world fits into a policy discourse of remedying deficit, simplifying complexity and propagating 'what works'. Context here is seen as mediating influence of what otherwise would be relatively linear causation. Descriptions of Shanghai mathematics education are themselves assemblages that cannot be separated from the processes of inscription and purposes of actors, and so are political.

Meanings of mastery

The Shanghai exchange is part of an attempt to 'transform mathematics teaching' (DfE, 2014) in England by adopting or adapting aspects of Shanghai mathematics education identified as 'teaching for mastery'. 'Mastery' is a malleable term and as it has become more prevalent in English mathematics education discourse a process of translation (Callon, 1986) leads to its inscription with contested meanings.

As part of the evaluation processes a definition of Shanghai pedagogy has been developed informed by a review of research literature, exchange participant experiences, the needs of the evaluation, and through process of negotiation with representatives of the Department for Education influenced by members of the evaluation project steering group. The working definition is:

> Shanghai whole class interactive teaching aims to develop conceptual understanding and procedural fluency. This is achieved through lessons designed to be accessible to all through teacher questioning and incremental progression. It is supported by well-crafted mathematical models and exemplar problems, as well as practice materials that focus on critical aspects of mathematical learning. To ensure pupils progress together, tasks are designed to allow for extension by deepening understanding and, daily intervention is used to support those needing extra tuition. Curricula progression, lesson timing, and teacher roles and responsibilities are organised at a school level to support these approaches to mathematics teaching and learning. (Boylan et al., 2016, p. 15)

It should be noted that this definition has implied boundaries for the evaluation in terms of a focus on teacher practice and the school level system rather than how this is embedded in national systems and culture.

Change processes

The Mathematics Teacher Exchange can be conceptualised in two different ways in terms of the nature of innovation. Firstly, the exchange has features of the implementation of a relatively well defined innovation. From this perspective, the aim of the exchange is to *adopt* at least aspects of the Shanghai teaching approach. This is represented in the figure below.

Figure 8 The Mathematics Teacher Exchange as an adoptive innovation
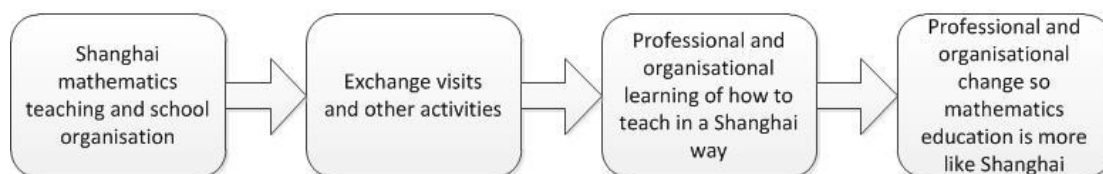
The expectation would be that implementation is similar across schools and hubs and the intermediate success criteria for the exchange would be the extent to which aspects of the Shanghai approach are found in both lead primary schools and other schools. In other words, the success of the exchange would relate in part to the degree of fidelity of implementation of Shanghai approaches. The longer term evaluation criterion is how the degree of adoption of Shanghai approaches relates to pupil impact. An adoptive approach allows for a clear focus on what is to change but requires a relatively tight coupling or relationship between actors and clear agreement over goals. To achieve such an agreement there is a risk of change being minor. Such an approach is more likely to be successful in a stable environment.

Alternatively, the exchange can be viewed as aiming to *adapt and develop* aspects of Shanghai mathematics education. This is shown in the figure below.

Figure 9 The Mathematics Teacher Exchange as an adaptive innovation
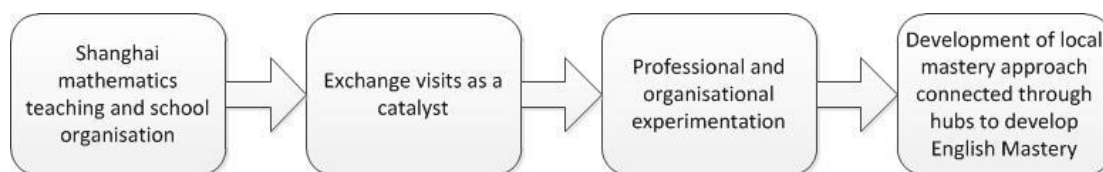
From this perspective, the primary aim of exchange visits and other activities is not to lead to professional learning of how to teach or organise learning in a Shanghai way. Rather, it is to provide a stimulus to catalyse change that leads to professional and organisation learning through adaptation. Through the hubs and NCETM coordination, an English approach to teaching for mastery may develop appropriate to this culture, circumstance and situation, including currently the context of the development of, what is characterised, as a school-led system. This is likely to have features of Shanghai mathematics education but also be different in significant ways. The expectation is that the innovation would be local and diverse. Intermediate success criteria would be the development of local adaptations for different contexts and the evaluation of these would focus on assessing the relationship between this diversity and impact. Adaptive implementation is appropriate to complex and unstable change environments (Funnell & Rogers, 2011).

Modelling systemic change

To evaluate the Shanghai exchange we have used a relatively simple conceptual framework that categorises different aspects of mathematics education. This is rooted in a mono-realist epistemology and ontology embedded in tradition of policy evaluation of linear causality operating within and through distinct, bounded, identifiable and relatively stable objects.

From this perspective a policy innovation is like a kernel that then encounters and is encircled within a containing context (Nespor, 2002). Whether this kernel subsequently grows and how it grows can be described and then explained in relation to the kernel's principles and practices and the context and other influences identified as salient. Both of the diagrams showing an adoptive and an adaptive approach fit with the kernel metaphor. In the first, the aim is to reproduce the parent plant from the

kernel. The second allows that in the particular ecology of English education the plant may grow differently whilst being recognisably of the same species and, further, growth may vary from instance to instance within the English context depending on local circumstances.

Some practices, for example lesson length, are imported whilst others, such as the amount of time a teacher teaches each day, are not (Shanghai primary specialist mathematics teachers have considerably less contact time than English primary generalist teachers). However, as practices are seen as separate and distinct the imported practices are considered as relatively solid and immutable and so not significantly changed when separated from linked practices. Each Shanghai practice acts upon or is brought into relationship with a corresponding English practice with actors (teachers and schools) adopting it to a greater or lesser extent. Adaptation is allowed for but in the sense that what manifests is an alternative version of the original practice.

The evaluation is focused on changes in classroom practices and school practice. The particular practices where participation in the Shanghai project is influencing changes in schools are.

School practices	*Classroom practices*
Assessment	Lesson planning and structure
Pupil grouping	Use of visual and concrete models
Homework	
Intervention	Pace and tempo
Specialist mathematics teachers	Questioning and engaging pupils in mathematical talk
Teacher collaboration and professional development	Differentiation
Timetabling	Resources (e.g. textbooks)
	Seating arrangements

A distinction is made between practices which are likely to be determined as school policy and one where an individual teacher might determine their own practices. However, such a distinction is artificial and made for efficiency of data collection and analysis and influenced by a policy of promoting 'teaching for mastery' rather than an alternative of 'mastery education' that might imply more systemic (and costly) approaches to change including to teacher training and professionality.

Assemblage thinking

An alternative, sociomaterial, approach considers realities rather than a reality through its embrace of ontological multiplicity and conceptualises these multiplicities through concepts such as networks, fluidity and assemblage with attention paid to materiality (Fenwick, 2011; Law, 2004; Law & Singleton, 2014). As a philosophical perspective the concept of assemblage is most associated with the writing of Deleuze and Guattari (1987) (also see De Landa, 2006 for realist reinterpretation). In this paper, I use assemblage in a more empirical manner (Müller, 2015) akin to sociomaterial approaches associated with actor network theory, or, given the revisions and internal disputes about the meaning of that, what Fenwick (2011) refers to as 'ANTish' accounts.

There are three aspects that I highlight from these traditions.

1. Sociomateriality - the stuff of assemblages consist of people, things, beliefs and ideas. In the context of the Shanghai exchange the many changes in materialities such as timetabling of lessons, the greater use of mathematical models, and the use of textbooks are not (only) products of commitment to mastery but are productive of it and the meaning of mastery in the schools. Beliefs about differentiation are not (only) contextual factors that act as barriers to implementation but are meaningful in relation to sociomaterial practices that are in flux. The programme logic method seeks to separate out complex interrelated processes as ontologically distinct components. A sociomaterial approach focuses on these interrelationships and seeks to trace how they are more than interrelated distinct parts but are both relational effects of each other - relations of interiority - and of relationships beyond the assemblage - exteriority. The latter perspective disrupts notions of context as container.

2. Heterogeneity - it is not known a priori or assumed that different types of components are more important than others in terms of generative power (agency) or within types that some are more important than others. In a linear causal model we might suppose that lesson planning is the means by which new beliefs are enacted. However, early analysis indicates that changes in lesson planning appear to be secondary and enmeshed with changes in classroom activity such as changes in lesson tempo, curriculum pace and greater use of mathematical models.

3. Translation - meaning is continually negotiated, with multiple moments of translation. From this perspective the Shanghai exchange has the potential to interrupt and disrupt existing assemblages and catalyse actors to mobilise new linkages. Such processes are likely to involve enrolment and translation (Callon, 1986) as new networks and assemblages form. This happens at different scales (de Landa, 2006) - such as policy, individual school, individual teacher and individual lesson. An example of this is the way in which the Shanghai emphasis on visual mathematical models has been translated to lead to greater use of concrete materials. Here we see the outcomes of the encounter of Shanghai pedagogical practices in which concrete materials are not widely used (see Huang & Leung, 2004) with existing English mathematics education use of manipulatives (at least with younger primary children), as well as recent and current influences of Singaporean interpretations of Bruner's forms of representation - concrete - pictorial - abstract (Hoong, Kin & Pien, 2015).

Conclusion

There is value in both methodological approaches. The first guides collection, organisation and analysis of data in relatively efficient ways to meet evaluation aims. It generates descriptions of change that is accessible by policy makers and teachers involved in the project; the model and categories are recognisable and meaningful to practitioners. However, this approach, in its simplification metaphorically, skims over the complexity of interrelationships. The second method allows a more subtle tracing of difference and diversity that arises from the exchange programme and generating richer understandings of cause and agency. From a position of epistemological pragmatism, and seemingly paradoxically, the implication of accepting ontological multiplicity is that the post-positivist or mono-realist conceptualisation is no more or less epistemologically valid than the multiple one. Simple conceptual maps do have their uses. Burnett (2016) calls for a generous approach to evaluation. The generosity that is called for is an encouragement of methodological diversification in contrast to the predominance of narrowly defined impact studies. I suggest that once a mono-realistic framework is critiqued then a qualified generosity can also be extended to

this form, providing the limitations are appreciated and its hegemony challenged. Nevertheless, other methodologies are needed to trace the complexity of change that is currently occurring in English primary mathematics classrooms.

Acknowledgement

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