What's the same and what's different: The use of the Mathematics Mastery programme in a special school for pupils with moderate learning difficulties

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In recent years, drawing on successful models of mathematics teaching in jurisdictions such as Shanghai and Singapore, mastery teaching in mathematics has become commonplace in England, yet there has been little research into the effectiveness of this method for students in English schools. Moreover, there is no research into its appropriateness for pupils with special educational needs. This paper outlines a case study carried out in one primary special school in outer London and discusses the approach taken by the school which had implemented a mastery teaching approach to mathematics. It examines the features of mastery teaching, the challenges faced by pupils with moderate learning difficulties and the adaptations needed in order to make the programme successful. The findings suggest further work may be needed in evaluating the effectiveness of this approach in special schools.

Key words: mastery, special educational needs, moderate learning difficulties, adaptation

Introduction

Although I am now working as a teacher educator, in my previous role as programme director for the Mathematics Mastery programme, a professional development programme based around principles of mastery teaching, several special schools for pupils with moderate learning difficulties contacted me to find out whether the approach was suited for children with special educational needs. Mindful of the requirements of the 2014 National Curriculum, that the "majority of pupils will move through the programmes of study at broadly the same pace" (DfE, 2013, p.3), I was sceptical as to whether this would indeed be appropriate.

The Code of Practice for Special Educational Needs (DfE, 2015, pp.15-16) states:

> A child of compulsory school age is defined as having a learning difficulty or disability if he or she has a significantly greater difficulty in learning than the **majority** of others of the same age… and if they have a learning difficulty or disability which calls for special educational provision to be made for him or her.

This group of children that do not make up the 'majority', in other words those who have a significantly greater difficulty in learning than their peers, is significant in number at around 15% of the school population, with the proportion having an Education and Health Care plan (EHCP) remaining stable at just under 3% of all pupils. There is little evaluation into the effectiveness of mastery teaching approaches

in this country (although see Jerrim, & Vignoles, 2015, Hall , Lindorff, & Sammons, 2016) and none relating specifically to pupils with special educational needs and disabilities (SEND). This study explores some of the similarities and differences around the principles of mastery teaching in both mainstream and special schools and any adaptations that may be needed when teaching pupils with SEND.

Features of mastery teaching

There are many definitions of 'mastery' teaching; I shall use here a definition drawing on that of the National Centre for Excellence in the Teaching of Mathematics (NCETM), in 'The essence of maths teaching for mastery' (2016) and from the Mathematics Mastery programme (Drury, 2014), namely that all children believe they can succeed and go on to achieve their full potential in mathematics. Key propositions include procedural fluency (being able to draw upon and use mathematical procedures accurately in differing contexts) and conceptual understanding (having a deeper understanding of mathematics and how procedures link to one another), which are taught alongside one another. Conceptual understanding is deepened through using pictorial and concrete representations, emphasising the structure and the connections within mathematics; pupils then justify the mathematics used in differing situations. Questions such as: "What is the same and what is different?" allow pupils to examine more closely elements that may be related and consider why some examples may be different. In order to avoid cognitive overload, facts such as multiplication tables and number bonds are learned to automaticity.

Special educational needs: a definition

The definition of those pupils defined as having a moderate learning difficulty (MLD) varies, with children having a range of needs along a continuum. However, for the purpose of this paper, I have drawn on the work of Norwich (2013) and Fletcher-Campbell (2004) as those pupils who:

- have low academic achievement in English and mathematics
- have low conceptual understanding
- have difficulties with visual and auditory memory for information, processes and instructions
- tend to have a short attention span
- have difficulties transferring knowledge from one domain to another.

Using this definition, it can be seen that pupils with MLD may be deemed to be 'insufficiently fluent' in terms of the national curriculum if they are struggling to learn number facts due to poor working memory, if they have low conceptual understanding and are unable to transfer learned processes into differing mathematical domains.

Research questions and methodology

In order to investigate whether a mastery approach to teaching mathematics, maintaining the principles of the whole class taught together, use of multiple representations and use of rich language was suitable for pupils with SEND, I carried out an exploratory case study in a special school in outer London for pupils with

MLD. Nearly all pupils in this 5-19 special school have EHCPs. The research was carried out after the school had been using the Mathematics Mastery programme for ten months in its primary department. I wanted to examine the evidence to exemplify features of mastery teaching of mathematics, specifically the use of pictorial representations; the use of concrete apparatus; and structured language use. I also wanted to discover to what extent, if any, the school had adapted the Mathematics Mastery approach to teaching mathematics.

The research took the form of semi-structured interviews with three class teachers, (one of whom was the mathematics subject leader), the school's leadership team, two systematic classroom observations, and a teacher-led photographic journal. As one of the limitations of a systematic classroom observation is that the observation categories are not always generalisable, (McIntyre, & Macleod, 1994) I devised my own categories based around the features of mastery teaching I might expect to see and coded the classroom interactions at two-minute intervals. In order to limit observer bias, as the Mathematics Mastery programme was one I knew well and had belief in, I decided to use a participant-only photo collection method to add greater validity. This is growing in use as an educational research method as it allows the researcher to be 'present', since the context for the photographs is set by the researcher (Holm, 2014). Photographs also offer a method that can be less restrictive and may be more accurate than other methods, since they capture what is going on in classrooms over a period of time. I left a digital camera and memory card in the school for the teacher to use and gave clear guidelines to guide the teacher-researcher including the ethical considerations of ensuring pupils were not identifiable, either by face or from the school logo.

Data analysis

Using a thematic network approach (Braun, & Clark, 2006) transcripts were manually transcribed and then coded, looking for patterns. These emerging themes were then cross-referenced with the classroom observations and photo journal, matching similarities. There was a high degree of consistency across the methods used.

Findings

Data showed the programme was well received by teachers and leaders. Classroom observations showed that many features of mastery teaching were present, backed up by the photo journal. This section briefly summarises the findings.

Consistency of approach

School leaders, the mathematics subject leader and teachers all agreed that the programme had given them greater consistency across the classes in the way mathematics was taught and in the use of mathematical vocabulary by both teachers and pupils. Comments such as "We never had an approach before where all teachers are using the same language, the same approach" and "Everybody is using the same vocabulary and there's consistency across the board with the language and the language structures that we use", were also borne out in the classroom observations and the photo journal. The school had used highly structured 'talk tasks', a feature of

the Mathematics Mastery programme, and had given pupils specific sentence stems to use, initially in talking to an adult and then in working with other pupils.

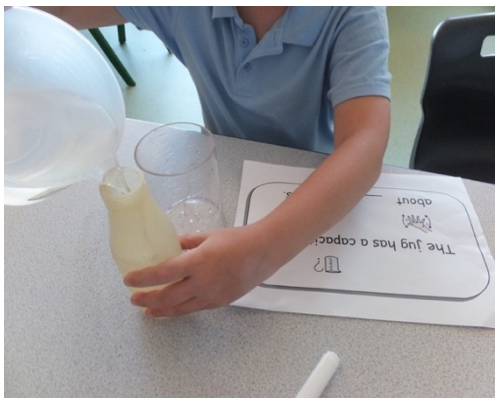

Figure 1: Pupil using structured talk task in a capacity lesson

Impact on teaching

Teachers felt the initial training and the suggested resources, especially the emphasis on using different concrete materials, had contributed to their own confidence and enjoyment of teaching maths. The use of concrete resources was now a mainstay of all teachers' repertoires. All teachers felt that this element of mastery teaching had had a significant impact on pupil understanding and pupils were able to use concrete resources to illustrate their understanding, even when they lacked the language to explain their reasoning. Teachers suggested that concrete materials had deepened pupils' understanding of mathematical structures. They also experimented with whole class teaching in ways they had not before, since previously mathematics teaching had been done very much at an individual pupil level. Teachers discussed how the use of the programme had given them and their teaching assistants (TAs) greater confidence:

> I feel quite confident now going into next year because I think I know how I can simplify it for the children that need it; I know how I can challenge for the children that need that.
>
> My TA loves the maths mastery programme, and she's picked up on it and learned with it as we've been going and she's very, very enthusiastic about it as well.

As this special school had large numbers of TAs, it suggests that the training element of the programme is likely to be of importance.

Impact on learning

Teachers and school leaders noted that pupils were now enjoying mathematics more. Previously, there had not been a culture of creative and open-ended mathematical investigations in the school.

> We've been doing all kinds of investigative lessons recently; they've really enjoyed it and they'll say things like 'I want to do an investigation! I want to do this!'
>
> When I do learning walks, there's just a little bit more buzz and the children are more engaged because it's a little bit more creative than we had before.

Lesson observations too, showed that there was almost no off-task behaviour and pupils were focused and engaged for almost the whole 55-minute lesson. Although the teacher very much took the lead in terms of questioning, demonstrating and praising, because pupils were required to demonstrate their understanding through using concrete resources, answering questions, working in pairs, groups and independently, they were actively involved in learning in all parts of the lesson.

What's the same and what's different?

These findings could also be said to be applicable to many schools implementing a mastery approach to teaching mathematics for the first time, mainstream or special. In considering what might be different, it is important to consider how this special school had adapted the programme for its pupils.

Mathematics Mastery (Drury, 2014) is designed as an age specific programme for mainstream pupils, in other words, the pupils in a year group follow the programme of study for that same age group, matched to the relevant national curriculum expectations. The case study school, however, had made an early decision to follow the programme of study most suited to the needs of its pupils, based on teacher assessment. Hence pupils in a mixed class comprising pupils between the ages of 7 to 10 years were following the Year 1 curriculum, originally written for 5-6 year-old pupils. Another class, comprised of pupils with autistic spectrum disorder, were aged 6-8 and were also successfully following the Year 1 programme of study. This suggests that those pupils with the greatest learning needs, being well below the level of the national curriculum, could still benefit from the mastery approaches promoted by approaches such as the Mathematics Mastery programme.

The one finding that did not appear to be positive, was that teachers and school leaders felt the programme was too fast-paced, although they were positive nevertheless about the fact that the children had a broad range of interconnected mathematical experiences. They worried that the pace, of both the lesson content and the curriculum coverage, would disadvantage their children:

> We weren't certain about whether the children would cope with the pace and the amount that you're trying to deliver in one session and we could see that there was a lot to do… and whether our children would manage and cope with that.

The school mitigated the effect of this by consolidating prior learning and pre-teaching certain concepts in an additional 15 minute daily slot, the element of the Mathematics Mastery programme known as 'Maths Meetings' adapting these slightly from the programme's original aims.

Conclusions

This study explored whether a mastery approach to teaching mathematics could be replicated with pupils with special educational needs. Through an exploration of one school's approach, it can be seen that generally the programme appeared to have a

positive effect on teaching and learning, although the programme could not be delivered in the age-specific manner intended. More in-depth analysis using data from several schools will be needed in order to draw more specific conclusions.

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