Maths Mastery: the key to pedagogical liberation?

Dave Benson evaluates emerging themes from a recent CPD programme exploring *Mastery in Mathematics* with primary and secondary teachers.

The email discussion in MT251 entitled *What does mastery mean to me?* offers interesting and helpful insights into the complexity of defining *mastery*. To my mind, it crystallises the challenges, contradictions and tensions we face in exploring and implementing *mastery* approaches to the learning and teaching of mathematics. My personal journey towards a possible interpretation of *mastery* and of its potential implications for my own pedagogical principles and practices came to a head in November 2015. Supported by reading of some key literature about *variation theory* as well as other ideas potentially related to *mastery*, I developed some personal thoughts.

Despite its potentially divisive label there was, for me, something positive and pedagogically persuasive in the intentions of the idea of *mastery*. Its emphasis on depth of understanding over breadth of knowledge, for example, chimed with my personal philosophy of mathematics teaching and learning. However, as for so many teachers of mathematics with whom I have discussed *mastery*, I do not regard an emphasis on understanding as either new or revolutionary as an idea.

My thinking also led me to consider 'official' developments in mathematics education since the advent of the National Numeracy Strategy in 1999. My deliberations suggested that, at best unwittingly and at worst intentionally, the Primary and Secondary Strategies had contributed to a 'de-professionalisation' of classroom teachers. Rigid planning and assessment structures had undermined teachers' confidence to take control of the direction of learning and teaching in their classrooms and restricted their potential to generate children's conceptual understanding of mathematics effectively.

Additionally, although I felt that justification for professed key ideas underpinning *mastery* such as the merits of 'intelligent practice' had emerged, so had a realisation that many of these ideas were, in fact, not new but reassuringly familiar. 'Exposing structure' would be another case in point. Although apparently presented by some as a new departure for positive pedagogical practice, many mathematics educators have emphasised the importance of this and similar ideas for many years. One need only consider Skemp (1976) and his exploration of *instrumental versus relational* learning. More precisely still, Mason *et al* (2009) remind us,

Appreciation of mathematical structure is vital for understanding and well within the grasp of learners at all ages.

That said, though not new, the potential for impact on learning of 'exposing structure' had become more persuasively explicit in my thinking.

In response to these thoughts and within the context of the three key principles of the 2014 National Curriculum for Mathematics (fluency, reasoning and problem-solving), I sensed a need to move on from debate about theory, interpretation and definition of *mastery* to classroom implementation and evaluation of experiences.

Structure of programme

In my role as Mathematics Education Coordinator at the University of Derby, I determined to develop a programme of CPD that would allow interested teachers in our extensive range of partnership schools (over 400!) not just to crystallise their interpretation of *mastery approaches* but also to experience some of the key ideas for themselves before trialling them in their own classrooms. With that in mind, participants committed to three two-hour sessions. Intentionally, the first two took place on consecutive weeks. This allowed the group to secure understanding of agreed principles for approaching learning and teaching of mathematics in a *masterly* way and mirrored the idea that their own teaching might involve longer periods of focus on any given topic.

The first session explored the merits and limitations of NCETM's interpretation of *mastery* as well as Helen Drury's (2015: 9) thinking that,

A mathematical concept or skill has been mastered when, through exploration, clarification, practice and application over time, a person can represent it in multiple ways, has the mathematical language to be able to communicate related ideas, and can think mathematically with the concept so that they can independently apply it to a totally new problem in an unfamiliar situation.

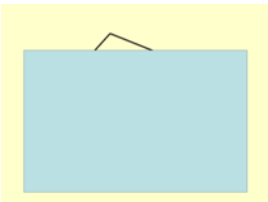
Over both of the first two sessions and with focussed intention, the group was immersed in mathematical activities which underscored the three key principles of the 2014 National Curriculum, particularly reasoning and problem-solving. The sessions also engaged participants actively in the professed key ideas underpinning *mastery approaches*. We began on the premise that we were not only working on a spiral and collaborative model of learning but were also aiming to build on existing good practice as well as expertise. In other words, we were not trying to re-invent any wheels!

With that in mind, we agreed on our own key guiding principles for *mastery* in theory and for practice. 'Exposing the structure' of mathematical concepts with clarity and simplicity in and through our teaching was immediately regarded as vital. We agreed that pupils' depth of understanding could be promoted by using a variety of representations of a concept in our expositions. For example, we felt it was important to represent calculations using an empty number line as well as using the bar method on the basis that each might emphasise different aspects of an operation (conceptual and procedural variation). We also recognised that, if depth of understanding and confidence in applications of skills was to be achieved, then pupils not only needed to be 'thinkers' and 'detectives' but also to develop 'connectionist' dispositions. In other words, it was important for them to 'see' the connections within and between mathematical concepts and procedures (e.g. multiplication and division within the concept of area). We also accepted that the notion of 'intelligent practice', which seeks to draw conceptual understanding and procedural fluency closer together, should be encouraged.

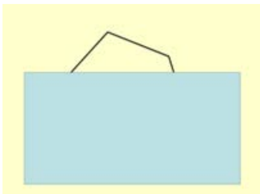
In order to embed these principles into our classroom practice, we identified some strategies which, though not exhaustive, we nonetheless regarded as key. For example, we perceived the importance of planning progressive and inter-related questions in our expositions and pupils' tasks. We also discussed the importance of allowing pupils time to 'make sense' of ideas and questions by building in time for discussion and thought. In addition, we explored the importance of predicting and actively undermining likely conceptual misconceptions. By considering examples from fraction, geometry and division, we generated ideas about how misconceptions may be successfully elicited and addressed.

The importance of providing pupils with the opportunity to reason and to articulate explanations and justifications for their thinking was also recognised. With this in mind, activities were integrated into the sessions that enabled participants to experience the value of dialogue and the importance of probing questions. We re-visited the scope of 'rich tasks' in this regard but also considered the notion of 'rich mathematics'. For us, the latter underscored the value of reasoning in **<u>all</u>** mathematics lessons not just on 'Problem-Solving Fridays' or when engaging with rich tasks. We agreed we needed to develop 'rich mathematical cultures' which were underpinned by a spirit of conjecture, opportunities to offer creative responses to mathematical problems and a variety of learning experiences.

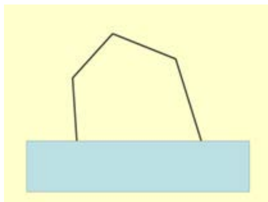
An example of the kind of activity we engaged in together was *Hide and Reveal.* This allowed us to explore *conceptual variation* and how it might help to deepen understanding. Using the following images, we explored how children's conception of 2D shape might be challenged by the strategy, in particular with regard to regularity and orientation.



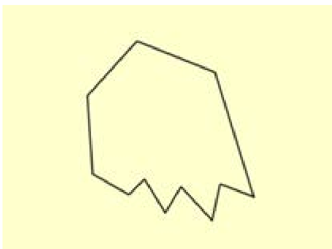
Stage 1



Stage 2



Stage 3



Stage 4: Irregular hendecagon!

At Stage 1, I asked the group to consider and justify whether a rectangle could be emerging. Could it be an equilateral triangle and how would they justify their thinking? At Stage 2, might a hexagon be possible. How did they 'see' the possibilities and how might they be justified? By Stage 3, was the outcome obvious? Could they imagine it being a centagon? Although by no means a new idea, we discussed the widely accepted potential of irregularity over regularity in developing children's appreciation of the properties of 2D shapes. At the same time, we emphasised the point that variation in our representation of shapes, however fine, might serve to challenge and enhance learning. This idea was extrapolated to concepts in number, number patterns and other aspects of early algebra. We considered how variation in representation might encourage the learner to 'notice' [Watson & Mason (2006)] different elements, characteristics or properties of a concept.

The second session also allowed participants to generate planning for a forthcoming topic in their teaching which incorporated some of our agreed principles and desirable practices. The third session took place six weeks later. This encouraged participants to share and evaluate their experiences of delivering in a *masterly* way as well as to identify next steps.

Outcomes and emerging themes

From my perspective, one of the most noticeable developments that emerged from participants' evaluations was their strengthening levels of professional confidence to use planning flexibly, proactively and dynamically. It appeared many felt less constrained by planning structures and at ease with the idea of carrying more in their head with less detail in their written plans. They also perceived the value of 'dwelling on' topics for longer periods of time than may previously have been the case. They argued that this seemed to help provide a more secure basis for promoting pupils' learning and depth of understanding.

They also suggested that pace of lessons had sometimes been sacrificed for pace in learning. Experiences appeared to suggest that a balance between 'pacey' activities to support computational fluency and richer exposition as well as tasks, which demand more reasoning and problem-solving skills, could be beneficial to pupils' progress.

Furthermore, differentiation by initial task had been widely rejected and superseded in importance by three alternative strategies: differentiation by resource, outcome and observation. Participants showed a growing awareness of the potential of *concrete, pictorial and abstract* representations. This appeared to be guiding their approach to probing exposition and differentiated experiences of tasks. Many discussed how common starting points for all pupils had become the norm but that differentiated, sometimes unexpected, outcomes for pupils had frequently resulted. The phrase 'by observation' was coined by one of the participants. It refers to her growing confidence to 'notice' as well as respond to pupils' progress within lessons and to provide opportunities to move pupils onto more challenging aspects of a given concept.

Many appeared to suggest that levels of confidence in their own subject knowledge of mathematics had improved by engaging with a *mastery* approach. Although there was no sense they felt they had arrived, they suggested they were becoming more skilled in asking good questions, promoting reasoning and challenging understanding. Many felt more at ease with the idea of pupils offering unexpected responses or alternative approaches and asserted this was an important and positive part of effective learning and teaching.

A number related stories of how they had experimented with grouping pupils in alternative ways. Although grouping by ability within classes was still used, particularly in order to focus teaching assistant effectively, many had begun to recognise the potential benefits to learning of mixed ability groupings or pairings. Generally, participants reported that children were strengthening verbal reasoning skills more obviously than developing confident written explanations of their thinking. Overall, pupil response to the approach had been positive.

Participants also identified and explored some of the tensions and challenges that had emerged for their classroom practice. For instance, some feared that, in the long term, a tendency to lose creativity in pedagogical approach might grow. Some wondered, for example, whether opportunities to use outdoor environments might be regarded as superfluous in the quest of depth of understanding. Others contradicted that idea and felt that longer units of work provided more opportunity for a variety of learning experiences.

Many felt unsettled by the question of how to provide and keep track of intervention for those pupils falling behind the expected pace of learning. Concerns surrounding headteachers', parents' and Ofsted's views of the changes in approach, particularly with regard to differentiation, also remained uppermost in participants' minds. Understandably, they wondered whether the rationale for and intentions of the changes will be shared and understood, particularly with regard to grouping of pupils. Paradoxically, they sensed progress in their professional practice yet felt concerned about how they would be judged, particularly if measured outcomes for their pupils had not improve.

Final thoughts and next steps

My experience of working with this group of nearly forty committed teachers, suggests that the advent of *mastery approaches* to learning and teaching in mathematics has presented many cultural challenges, 'cultural' in a broad sense. These teachers have, for example, accepted the challenge of adapting the culture of their mathematical classrooms from one that is dominated and driven by official national guidance to one which is shaped much more strongly by their own professional judgement and the ongoing responses from their pupils. For some, this has required a leap of faith but many appear to have been rewarded by a growing sense of self-belief about their ability to develop effective learning in their pupils. They also appear to perceive a liberating sense of professional independence in themselves. Many have articulated a more convincing understanding of the benefits of focussing on sequences of thinking rather than sequences of lessons.

I would also suggest that much can be, and is being, learned from East Asian approaches to the teaching of mathematics. For example, judging by the positive response of the participants on the programme, the Singapore Bar Method would seem to have much to offer. That said, the group recognised its limitations, particularly if used as the dominant form of representation of concepts in number and calculation. Forms of representation more rooted in our own or other European cultures, they felt, still fitted into the idea of 'variety of representation'. The use of the empty number line for scaffolding mental strategies would be a case in point.

Echoing some of the comments in the email discussion in MT251, many of the participants objected to the term *mastery*. Their observations generated interesting discussion about alternatives and also reminded us of similar debates about the term 'Gifted and Talented' (G&T) over 'more-able' pupils. It could be argued that the term *mastery* tends to generate unnecessary obstacles and deflect thinking from important ideas. Outcomes from the programme suggest that many teachers enjoy the intellectual challenge of exploring **effective pedagogy** and see the benefit of dovetailing theory with reflective practice. For me, this poses another cultural question: to what extent do we regard CPD as an opportunity for professional debate and as an intellectual opportunity to explore a mutual understanding of effective pedagogy in mathematics?

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