Mind the gap: Mathematics teaching and learning in Power Maths primary schools in a pandemic autumn.

Ellen Barrow[1], Jennie Golding[2], Grace Grima[1]

[1]Pearson UK, [2]UCL Institute of Education

We report Autumn 2020 findings from a 2019-2021 study of impact and use of a 'mastery'-oriented primary (ages 4-11) mathematics resource, 'Power Maths'. The study follows 40 classes of primary children and their teachers, in 20 schools, over two years. Following earlier pandemic evidence, more recent data show schools and teachers responding to Autumn 'mathematics recovery' challenges in very different ways, with a range of creativity, of solution-focus, and of alignment with the Power Maths-promoted 'mastery' approaches, although more complex mathematical processes commonly remained marginalised. Teachers reported that new classroom guidelines severely restricted 'carpet' and group work and use of manipulatives. They pervasively referenced identification and addressing of gaps in children's prior learning. While most teachers expressed concern about the continuing impact on mathematical development, and reduction in confidence, they reported children usually still responding positively to mathematical opportunities to learn, and confidence slowly returning.

Keywords: primary mathematics; remote learning; learning loss.

Introduction: the policy and pandemic contexts

Power Maths is designed as a coherent set of mathematics materials for use by teachers and children in years R-6 (children age 4-11) in England. Sustained UK school closures from March 2020 meant that schools, teachers and families had to formulate a response to remote learning. From September 2020, when schools physically reopened, adaptations were then required to meet government safety guidelines. We have poor understanding of the long-term impacts of sustained school closures, although there is some evidence they can be significant, affecting mathematics learning particularly hard (Kuhfeld et al., 2020). Furthermore, school closures could further reinforce inequalities already prevalent before the pandemic (EPI/Renaissance Learning, 2021). Emerging evidence in 2020/21 in England has usually been generic, pointing to predominantly asynchronous teaching, very variable engagement, and challenges in digital access (internet or device) and working conditions, and some widening of disadvantage gaps (e.g. EPI/Renaissance Learning, 2021). Recent evidence on primary children's age-related learning has evidenced decreased attainment, again highlighting mathematics as particularly affected (e.g. Juniper Education, 2021). Our study provides mathematics-specific qualitative evidence related to the nature and origin of such gaps, and how they are being identified and addressed in Power Maths-using schools.

Research questions and theoretical frameworks

We draw on findings from a two-year study (2019-2021) conducted by Pearson in collaboration with UCL. Field researchers are experienced subject- and phase-specialists independent of Pearson. We adopted an institutional ethnographic approach (Smith, 2005) in an effort to understand the lived experiences of teachers' and children's early use of Power Maths, first published in 2017, and the impact on mathematics learning. Serendipitously, we were able to evidence mathematics provision during the March-June 2020 lockdown (Golding & Grima, 2020) and in autumn 2020, we further asked: *'What was the Autumn 2020 emerging evidence of the mathematics learning impact of the pandemic, what approaches (including resource use) were teachers taking to address that, and with what effect?'* We focus here on high-level findings, contextualising those within earlier study data.

Methodology

As indicated in Table 1 which outlines data collection for the first full year of the study, each yearly cycle was planned to comprise 3 phases:

Phase 1: Autumn 2019	- Results from 40 classes of year 1, 3 or 5 baseline assessments - Transcriptions of interviews with 40 year 1, 3 or 5 class teachers and 6 other school mathematics coordinators (MCs).
Phase 2: Spring 2020 (school visits, curtailed by pandemic)	- Plans and observation notes from 34 whole lesson observations - 34 post-observation class teacher and 2 other MC interview transcripts - 34 children's post-observation focus group transcripts - 17 sets of visit notes
Phase 3: July 2020	- Completed surveys from 36 class teachers and 4 school mathematics coordinators - Transcripts of 17 school MC interviews

Table 1: Data Collection for first year of study (2019-2020)

As a result of the pandemic, all data from March 2020 were collected remotely. To ease the burden on participating teachers, we offered a choice of audio recorded interview and survey. Two schools were unable to continue, so data were from 18 schools:

Late Autumn 2020	49 extended responses with 38 year 2, 4 or 6 teachers as well as 11 other school mathematics coordinators: - 25 teacher survey responses - 24 class teacher telephone interviews

Table 2: Autumn 2020 Data Collection

The sample was representative in a number of characteristics known to affect teaching and learning (catchment type, socio-economic profile of pupils, previous attainment levels, inspection outcomes, governance). Standing alone, surveys are not ideal for institutional ethnographic purposes, but well-established relationships with teachers supported rich and often extensive survey responses following already longitudinal engagement via interviews and observations. All interviews were recorded and transcribed; all qualitative data were then iteratively analysed by research question and then using an open grounded approach (Charmaz, 2006) to expose sub-themes. In parallel, documentary analysis of lesson plans, the Power Maths materials used, and

other local documents were analysed in an attempt to understand enactment with an 'institutional ethnographic' lens (Smith, 2005): data could then be interpreted within a much wider grasp of schools' personnel, and in-school and broader working context/constraints.

Findings

Context, Approach and Resources

Main study findings from Summer 2020's data collection (Golding & Grima, 2020) evidenced challenges in assessing pupil mathematics learning during the period of home-learning. Typically very limited synchronous teaching, inconsistencies in pupil contact, and highly variable levels of parental support, evidenced also in more generic work such as the EPI/Renaissance Learning (2021) report, produced an unreliable picture of mathematics learning. Between 5% and 50% of children in study classes did not obviously engage at all, and for nearly all children, curriculum coverage had been severely reduced. Almost all teachers expressed concern about anticipated knowledge gaps. Anticipated plans for Autumn 2020 were usually motivated by a need for flexibility to adapt to the individual emerging needs of pupils.

By Autumn 2020, government guidance meant there were significant practical restraints that acted as key barriers to learning in classrooms. For example, restrictions around seating plans, close group work and sharing of manipulatives meant a disruption to what were previously normal classroom activities:

> In Key Stage 1 *(to year 2),* children cannot sit on the carpet, like they would previously, to be closer to the teacher and have access to the interactive whiteboard. They must sit in rows, at tables, and cannot complete traditional group work because they must all face the same direction (MC1, Autumn Survey).

Constraints on staffing and behaviour in classrooms, class 'bubble' systems, and teacher and pupil absence limited both close contact with pupils and the spaces, staffing and approaches available for small-group intervention, severely limiting the addressing of diverse emergent mathematical needs.

Teachers were also having to adapt their pedagogical approach to mathematics and their use of Power Maths resources. 35 of 49 respondents (71%) indicated they were attempting to provide as much normalcy as possible in their approach and resource use, although Power Maths was often used in combination with other resources – stated by at least 17 teachers to be a response to children's need for more support/less challenge. Where significant use of Power Maths resources was attempted, it was in parallel with revisiting of previous content: "I have carried on as normal, however, realise that the Y5 curriculum has to be revisited/taught in addition due to lockdown" (Year 6 teacher 6, Autumn Survey). At least half of responding teachers reported a slower pace of coverage as a result, and a majority said they edited materials, usually reducing or omitting work targeted at conceptual challenge, problem solving or reasoning.

Learning loss remained a big concern, and teachers were sometimes able to put a timeframe of learning loss (from one to six months) but it was evident that this is a complex picture: loss was often reported to depend on children's lockdown circumstances, and many teachers reported a wider range of mathematical needs: "There seems to be fewer middley children, and more at the top or at the bottom" (MC19, Autumn Survey);

> *(My main concern is)* the huge gaps the children have and the range of abilities there are in the class. It is very difficult to support all children with their individual needs within maths. The differentiation is huge and unmanageable (MC17, Autumn Survey)

Perceived impact on pupils in Autumn term

Autumn data suggested that "anything that is not the four operations" (Year 6 teacher Autumn Survey) had often marginalized during home-schooling. Limitations in teacher experience of remote teaching and in teacher or pupil digital access meant more complex, or known harder-to-learn topics had often been omitted or skimped, so there was a significant knowledge gap once pupils returned to school. For example:

> The children in my class seem to have struggled with fractions the most. They have been adding and subtracting fractions recently and there have been a lot of groups of children who have needed smaller group work to build their confidence (Year 6 teacher 7, Autumn Survey).

Teachers reported that significant work on reasoning and problem solving had usually not been attempted. Additionally, pupils had very typically struggled to maintain mathematical vocabulary or fluency during home-schooling:

> Fluency has dropped massively… if you haven't got that fluency, then you're not going ..to be able to hold everything together and apply it in the same way....so fluency's been a big one (MC13, Autumn Interview).

Such learning loss depended on part on school provision, but that was itself often (in at least 35 of 49 teachers' accounts) influenced by perceptions of the parental support and engagement, as well as resources, available to children:

> It is very dependent on the home situation and ability of the child as well as the carers.. carers are not always equipped with the knowledge needed to support their children and therefore maths is easy to set aside (Year 6 teacher 2, Autumn Survey).

Parents were often perceived to lack knowledge and confidence for mathematics pedagogy, especially in relation to mastery: "Parents often lack confidence with maths, particularly with problem solving. Parents seem to prefer to stick to number work or life skills such as money and time" (MC10, Autumn Survey) – though, given the abrupt move to remote learning, in only two of the 18 schools did the suggested remote curriculum focus on such 'home opportunities'. Additionally, teachers sometimes felt there were opportunities for parents to teach a concept incorrectly, forming habits that then needed to be 'un-taught' once pupils had returned to school. Such considerations, compounded by the lack of structure and routine whilst at home, meant that children had often returned having 'forgotten how to learn' in a classroom.

While children were generally said to be happy to be back at school and responding positively to their mathematics lessons, at least 28 of the 49 teachers (57%) reported a loss in confidence in pupils as well as an aversion to "taking on the challenge" of the mathematics learning provided by Power Maths, and mathematics learning in general: "Children are still enjoying maths but their confidence has been knocked because they are finding concepts harder than they may do usually, which has meant the resilience has suffered slightly" (MC11, Autumn Survey). There appeared to be a reduced growth mindset amongst some pupils upon their return to school, though, with at least ten teachers noting a distinct shift in attitude towards mathematics:

> Generally you see there's now a real fear of getting things wrong from children and they will copy until the cows come home in that fear of getting it wrong. And then when you ask them how they came to an answer…they're like a rabbit in the

> headlights and they freeze and they don't understand. That's just come on since the home schooling, but you can't blame the parents, they just think it's the answer that matters, not the process… (Year 2 teacher 9, Autumn Interview)

However, there were also occasional mentions of children who had thrived, emotionally and/or academically, on the support and more flexible schedule at home, or of previously high-attaining children who were struggling to catch up. Those able to attend school over lockdown had also typically benefitted from small group learning.

At least 35 of the 49 teachers (71%) were running regular interventions in order to support gaps in pupil knowledge and to build mathematics confidence. There were, though, constraints: teachers reported that diagnostic assessment is more difficult without close contact and they often did not have access to usual spaces previously used for intervention; further, teachers were also intervening to support emotional wellbeing: "We have done ad hoc maths interventions as well as basic skills. We are now doing interventions to help support emotional difficulties when in class" (Year 4 teacher 18, Autumn Survey). The need for "lots of positive praise and encouragement" was considered crucial, as well as "awarding certificates each week for resilience and trying their best" (MC7, Autumn Survey), together with a 'slow and steady' approach to addressing gaps: "Careful modelling, showing exactly what reasoning questions are asking and how to answer them fully" (Year 6 teacher 2, Autumn Interview).

At least 95% of responding teachers said that their pupils' attainment was lower than they would usually expect at this stage in the Autumn term: "Much lower for nearly all children apart from those who had a great deal of parental support during lockdown." (Year 4 teacher 18, Autumn Survey); the rest said it was too early to know reliably. Despite this, teachers had a relatively positive outlook on children's progression for the rest of the academic year, although at this stage (late Autumn 2020) there was no knowledge of the January 2021 lockdown and consequential school closures. There was at that time a fairly widespread confidence that the return to school was an adjustment period for pupils and that regular revisiting of content and a focus on fluency would see pupils develop adequately over the year, though it is not clear how teachers expected the deeper, more complex aspects of children's mathematical learning to develop.

Teacher learning and forward planning

Teachers reported that they were now more digitally-knowledgeable and more confident to harness different learning platforms; that they had formed better relationships with parents and understood more of their children's home backgrounds and, in some instances, potential. Over 70% of respondents felt aspects of their first lockdown provision could be improved, and often would be in case of future remote provision. Teachers were usually keen to retain enhanced, educationally-complementary relationships with parents, and more flexible and children-responsive ways of working, as well as making some routine use of learning platforms. Nearly 60% of respondents said they had already attempted near-normal use of Power Maths, although most of these were also both editing use and harnessing other resources also. In late Autumn, most anticipated returning to full use of the Power Maths level of challenge and aspiration this academic year, though about 20% were working on a longer timescale.

Reflections

The Autumn study findings have suggested that many teachers were faced with highly complex classroom situations and were having to be flexible to mitigate the emerging gaps in learning. The identification and addressing of such gaps is demanding of teachers' subject knowledge and pedagogy even when they have the normal range of physical choices available, and the ongoing pandemic constrained many such choices. Teachers were tackling many children's reduced fluency and gaps in exposure, as well as commonly reduced confidence and resilience, but this appeared to be often at the expense of deep conceptual grasp and more complex mathematical processes such as problem solving and reasoning. Such gaps will inevitably take some time to address, although many teachers in late Autumn were optimistic about progress for the rest of the year. They were also often upbeat about the enhanced potential for any future lockdowns, and it will be interesting to see if such optimism was later realised. We shall report at a later stage on the impact on the range of these outcomes of the January-March 2021 lockdown, as revealed by our Spring 2021 data collection.

References

Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative analysis.* Sage.

Education Policy Institute and Renaissance Learning (2021). *Understanding progress in the 2020/21 academic year – Interim findings (January 2021).* Department for Education. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/962330/Learning_Loss_Report_1A_-_FINAL.pdf

Golding, J. and Grima, G. (2020). A pandemic summer: Impact on teaching and learning for mastery in Power Maths primary schools. *Proceedings of the British Society for Research into Learning Mathematics 40* (3) 1-6. http://www.bsrlm.org.uk/publications/proceedings-of-day-conference/ip40-3/

Juniper Education (2021). *The Impact of the Covid-19 pandemic on primary school children's learning.* https://junipereducation.org/national-dataset-report/

Kuhfeld, M., Soland J., Tarasawa B., Johnson A., Ruzek E., & Liu J. (2020). Projecting the potential impacts of Covid-19 school closures on academic achievement. *Educational Researcher 49*(8), 549-565.

Smith, D. E. (2005). *Institutional ethnography: A sociology for people.* AltaMira.