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Access to mathematics learning for lower secondary students in England during school closures: implications for equity and quality

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ABSTRACT

During the initial period of 'lockdown' in response to the COVID-19 pandemic, schools in England were closed to the majority of pupils for 15 weeks. We examine how during this time schools provided emergency remote teaching in mathematics to lower secondary pupils with different levels of prior attainment and advantage. Drawing on a mixed-methods study including a survey (N = 49) and interviews (N = 17) with Heads of Mathematics, we analyse schools' remote learning practices and how school closures have impacted on pupils' opportunity to learn mathematics (OTL). We find that inequitable distribution of engaged time, mathematical content and quality teaching has disproportionately negatively affected lower-attaining and disadvantaged pupils and is likely to have contributed to a widened attainment gap. We identify opportunities for HOMs to improve remote learning for subsequent school closures and enact equitable policies of distribution that improve OTL for lower-attaining and disadvantaged pupils.

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COVID-19; opportunity to learn; mathematics education; disadvantage; low attainers; secondary schools

In common with many educational systems around the world, schools in England closed to the majority of pupils in early 2020 due to the Covid-19 pandemic. In England, school closures began on 20th March, with school-based provision only for vulnerable pupils and children whose parents' work was deemed critical to the pandemic response (e.g., those working in health, care, education, security and food supply). Although some secondary schools partially reopened in June, this only affected some year groups. As a result, the vast majority of pupils missed around 15 weeks of normal schooling, just under 40% of the entire school year.

In an attempt to mitigate this loss, schools provided remote, or distance, teaching for pupils. This was uncharted territory for schools, teachers, pupils and parents. There was little time to prepare and, initially at least, almost no guidance or expertise available to help schools and teachers implement remote teaching.

Research internationally indicates that school closures have had significant and substantial negative effects on educational attainment (e.g., Kuhfeld et al., 2020) and the learning loss in England has been estimated at between 6–10% of a standard

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deviation (DELVE Initiative, 2020). Moreover, these effects have been inequitable, and the consensus is that, in England, the existing attainment gap between pupils from more and less disadvantaged backgrounds is likely to increase substantially (Education Endowment Foundation, 2020; Müller & Goldenberg, 2020). One reason for this widening gap is that pupils' access to and participation in remote learning has been inequitable. Research conducted during the school closure period indicates that pupils from disadvantaged backgrounds are more likely to spend less time on remote learning than their more affluent peers (Eivers et al., 2020; Moss et al., 2020). Lucas et al. (2020) found that, although teachers from schools in the most deprived areas reported high levels of school leadership support for remote teaching, these schools struggled most to cover the curriculum. Teachers in the most disadvantaged primary schools felt it initially necessary to prioritise pupils' health, safety and wellbeing over remote teaching and learning, while those in the least disadvantaged primary schools have been more able to adapt learning activities to be enjoyable and engage the whole family (Moss et al., 2020).

Much of the research during lockdown has been based on large-scale surveys and has only examined schools' approaches to remote teaching in very broad terms. A better understanding of schools' and teachers' approaches to pedagogy, curriculum and assessment is important to develop guidance and support for schools in providing 'catch-up' support for all pupils; it is particularly critical to ensure support for disadvantaged pupils is best designed to ameliorate the negative impact on the attainment gap. Although previous studies have considered the effects of the lockdown on disadvantaged pupils in terms of socio-economic status, little attention has been given to the impact on pupils with low prior attainment.

In England, the attainment gap between the lowest and the highest attaining pupils in mathematics widens over the first three years of secondary school (Hodgen, Coe, et al., 2020). Typically, secondary schools place pupils in homogeneous 'ability' classes or sets (Taylor et al., 2020) and, indeed, many schools use setting as part of an overall approach to raising the attainment of disadvantaged pupils (Macleod et al., 2015), although the research evidence suggests that setting has no overall benefit on attainment and appears to have a slight negative impact on low attaining pupils (Higgins et al., 2018).

In this paper, using the case of lower secondary mathematics, we examine the extent to which mathematics learning varied for pupils of different prior attainment levels, how this differed (if at all) between schools, and the challenges faced by teachers in addressing these issues.

Theoretical background

We draw on Fraser's (2008) conception of justice as 'parity of participation' (p. 16), where all individuals are of 'equal moral worth' and all are permitted to 'participate as peers in social life' (ibid.). Unequal participation may be caused by inequitable distribution of a limited resource (such as teacher quality or curriculum time) or by misrecognition of pupil's learning needs (such as a restricted curriculum offer for some). Misrecognition is particularly important, because restricting pupils' access to 'powerful and useful mathematics' (Schoenfeld, 2002, p. 14) limits the extent to which those pupils can then go on to

fully participate in society. Taylor et al. (in preparation) uses Fraser's conceptualisation of misrepresentation as misframing in order to emphasise how the process of misrecognition is institutionalised as neutral and natural.

In this article we focus on the role of distributive justice (Fraser, 1995), or the extent to which learning resources are distributed equitably. Specifically, we consider the opportunity to learn (OTL) afforded to different pupils using a framework developed by Kurz (2011). According to Kurz, OTL can be conceived of in terms of three dimensions: time on instruction, instructional content and quality of instruction. Pupils' learning experiences are facilitated, or limited, by the time allocated for instruction, the breadth of content covered and the range and nature of pedagogical approaches used.

We conceive of time on instruction as the amount of engaged time which pupils are involved in learning relative to the time they need to learn that content (Carroll, 1963). Content refers not simply to the breadth of mathematical topics covered, but also to the nature and richness of the content. In order to learn mathematics with understanding, pupils need access to more than a set of facts and procedures; they also need the opportunity to develop conceptual knowledge, competence with problem solving strategies and the ability to reason and communicate using mathematics (Kilpatrick et al., 2001). Typically, instructional content and time are allocated differently (and inequitably) to different pupils through strategies such as attainment grouping (e.g., Francis et al., 2017) and classroom studies indicate that the mathematics curriculum offered to pupils of low prior attainment tends to be characterised by a restricted curriculum and a slow pace (e.g., Boaler et al., 2000; Straehler-Pohl et al., 2014). Instructional quality, or the quality of teaching, is widely acknowledged as key to successful learning (Coe et al., 2014). This includes a wide range of evidence-based teaching practice, including the quantity of feedback, formative assessment, questioning and teacher scaffolding (Hodgen, Coe et al., 2020; Schoenfeld, 2014).

Typically, the OTL literature conceives of OTL as 'controlled' by the teacher through the decisions teachers make by allocating time for instruction, deciding on the breadth of content and selecting the pedagogical approaches (e.g., Kurz, 2011). Such decisions are in part influenced by teachers' professional values, knowledge and beliefs. Yet, teacher professionalism is itself shaped by systemic and other factors, which limits teacher agentic capacity to decide what and how to teach (Sachs, 2016) and thus to influence the extent to which resources are allocated equitably. In this context, our paper focuses on how remote teaching prevented teachers from enacting their entire planned mathematics curriculum and the range of pedagogic strategies they would normally use for pupils at different prior attainment levels. To understand how remote teaching constrained teachers' ability to fully enact their normal curriculum, we draw on situated cognition, which emphasises the ways in which teachers' professional knowledge and values are located in social practice (Hodgen, 2011; Putnam & Borko, 2000). Hence, teacher knowledge, and their ability to act (and teach) in classrooms is deeply embedded in what Ruthven (2009) terms the structuring features of classroom practice: the familiar routines, activities and resources through which teaching and learning takes place. In remote teaching contexts, in which these structuring features are not present, teachers' professional knowledge and values are likely then to be much weaker.

Methods

The research that we report is conducted in the context of a large project comparing the impact of two forms of attainment grouping, setting and mixed attainment,[1] on pupils' mathematical attainment and self-confidence over the first two years of secondary school using the entire cohort of pupils in two groups of schools: one group of schools that use mixed attainment grouping in mathematics (N = 33) and a matched comparison group of schools that use setting (N = 82) (see, Hodgen et al., 2019).

For the research conducted during the school closure, we adopted a mixed methods design that suited the time-sensitive nature of the study. We administered a survey, sent to Heads of Mathematics (HOMs) in all participating schools, and immediately after conducted follow-up online semi-structured interviews with a sample of HOMs. The survey was also used to invite respondents to participate in the qualitative interviews.

A total of 49 HOMs responded to the survey, which is just over 40% of the schools in the main project. Of these, 18 were from mixed attainment schools and 31 from setting schools. The interview sample consisted of ten HOM from mixed attainment schools and seven from setting schools.

The research took the form of a sequential mixed methods design in which the quantitative survey analysis informed the qualitative interview design and analysis (Johnson & Onwuegbuzie, 2004). The goal of the quantitative phase was to identify the schools' practices in relation to remote learning in mathematics for Year 7, with a particular focus on: overall aims, learning delivery, meeting the needs of high and low attaining pupils, and assessment and feedback. Surveys were analysed using descriptive statistics. The Chi-square test ($\chi 2$) was used to analyse the differences between groups of schools.

The interviews aimed to explain why teachers used specific practices in their attempt to meet the needs of pupils with high and low prior attainment, as well as explore the impact of remote teaching on the experiences of different learners. As in the survey, the focus was on Year 7 pupils (ages 11–12). The interviews were conducted online by different paper authors. The recordings were transcribed verbatim and pseudonymised by a member of the research team prior to analysis. Each transcript was classified by school name, its grouping practices (mixing or setting) and its level of deprivation. This enabled comparing data from different categories of schools. (See, Table 1)

The interview analysis used a thematic approach. Structural coding was used to categorise the data to examine comparable segments' commonalities, differences and relationships with particular reference to the OTL framework (Guest et al., 2012). Two authors developed an initial codebook of deductive codes drawn largely from the research questions and interview questions. To check the reliability of the coding process, coding was validated at the early stages. All discrepancies were discussed and resolved prior to coding the following 15 transcripts.

Findings

In this section, we begin by providing an overview of the mathematics remote teaching based on the results of the survey. We report the findings from interviews with HOMs, focusing on the three dimensions of OTL, the professional challenges faced by teachers

Table 1. The sample of schools.

	Survey		Interview	
Attainment grouping practices for mathematics				
Mixed Attainment	18	37%	10	59%
Setting	31	63%	7	41%
Ofsted Category				
Outstanding	13	27%	3	18%
Good	27	55%	11	65%
Requires improvement	8	16%	3	18%
Inadequate	1	2%	0	0%
Level of deprivation (re national median proportion FSM)				
Above	28	57%	11	65%
Below	21	43%	6	35%
Location				
Urban	44	90%	14	82%
Rural	5	10%	3	18%
Total	49	100%	17	100%

and finally a brief consideration of the opportunities that we identified. For purposes of clarity, when reporting the survey findings, we refer to the views of schools since HOMs were asked to report school practices regarding mathematics teaching broadly in the surveys. When reporting findings from interviews we refer to HOMs.

Mathematics education during lockdown: survey results

The majority of schools were following the mathematics curriculum at a slower pace and/or with reduced content (35%), or aiming to review and consolidate previous learning (27%). We had expected to find significant differences between mixed attainment and setting schools, but did not find any, nor did we find differences between schools with higher/lower proportions of disadvantaged pupils.

Half of the schools surveyed expected pupils to spend the same amount of time on learning mathematics at home as they would when learning in school. Overall expectations of pupils' engagement with mathematics were high with only 6 (13%) schools expecting pupils to spend much less time than usual on learning mathematics. There was no difference between mixed attainment and setting schools, or schools with higher/lower proportions of disadvantaged pupils.

However, all HOMs in the study reported that, as a result of remote teaching, they had to make changes from how their pupils would usually experience mathematics, particularly in relation to content offered and the level of cognitive demand within tasks, as well as pedagogy. Whilst lockdown restricted the opportunity to learn mathematics for all pupils, low attaining and disadvantaged pupils were most affected. Around half (46%) of schools reported that pupils with low prior attainment in mathematics were likely to experience changes to their mathematics provision compared with normal, while this was the case for pupils with high prior attainment in a third of schools, X^2 (9, N = 49) = 41.83, $p < .001$. This effect was particularly pronounced for pupils attending schools with higher proportions of disadvantaged pupils, with 50% of HOMs in more disadvantaged schools reporting that low attaining pupils had a different experience to usual, compared with 43% of HOMs in less disadvantaged schools, X^2 (3, N = 49) = 9.14, $p = .027$.

Opportunity to learn: time on instruction

As noted above, HOMs were ambitious about the amount of time they expected pupils to spend on mathematics learning. In fact, HOMs reported that the actual time pupils spent on learning mathematics was markedly lower than hoped for. More than one-third of the HOMs interviewed estimated that at least 30% of Year 7 pupils were not participating regularly in remote learning, some citing non-participation rates as high as 90%:

> We've still got 40% of students not in Google Classroom and only 10% to 20% of students in Year 7 who are actually doing stuff. (Andrew, Goldfinch School)

In contrast, another third of the HOMs interviewed, predominantly from more advantaged schools, indicated that participation was over 70%. This supports findings from other research that pupil engagement during lockdown was closely linked to disadvantage (e.g., Green et al., 2020).

Uneven participation and engagement were mediated by two main factors: prior attainment and disadvantage. Pupils in low-attaining sets and nurture groups fell disproportionately into the low engagement group.

> We've definitely found that students with higher prior attainment are engaging more. The engagement rates, for example, in the top set are about 90%. [. . .] Engagement rate in the bottom set are around 30 to 40%. (Tom, Sparrow Academy)

Echoing findings from other research (e.g., Eivers et al., 2020), HOMs were highly aware that the opportunity to engage with mathematics learning was mediated by unequitable access to IT resources. For example, Jane, HOM at Robin School, noted that 'we've got about 50 [pupils] who are just trying to do the work on a mobile phone'. Other 'new' challenges for vulnerable pupils during pandemic included bereavement, having to move between households of separated parents, or living with older relatives who were shielding.

Opportunity to learn: instructional content

Curriculum aims and delivery were explored in depth in interviews. Reflecting the survey results, seven HOMs reported that they were continuing with their scheme of work as planned, with the remainder making adaptations such as consolidating prior learning, adapting or filtering the scheme of work, reordering material or taking a slower pace. These decisions were influenced by different factors such as the belief that consolidation work was easier to set while teachers adapted to the situation; avoiding a widening attainment gap between groups of pupils; attempting to ensure pupils' mathematical confidence was not damaged; or keeping pupils engaged.

> The general consensus that we were getting really early on was that the stuff that you're asking the children to do needs to be revisiting and not brand-new content because to try and get them to engage with brand-new content that they might not understand might really disengage them. (Jane, Robin School)

Several HOMs reported that they were offering pupils a more limited range of tasks than they would be offering in the classroom. In particular there were limited opportunities for pupils to engage in extended or problem-solving tasks, any activities involving discussion and metacognitive tasks, as well as anything 'inspirational'.

> There is a danger that the more that time goes on, the more that students think that maths is about [. . .] watching a clip and doing some maths, [. . .] the more likely we are to lose some of them. We're not able to do the inspirational stuff because it's just utterly unfair to set that sort of thing for parents to do. (Richard, Blackbird School)

The range of topics being taught was also restricted, with some HOMs choosing to focus on 'essentials', avoiding topics that required special equipment such as tracing paper, or focusing on procedural techniques involving number and calculation.

The level of disadvantage of the school intake further shaped the decisions about the content of the mathematics curriculum during lockdown. Some HOMs in schools serving disadvantaged communities adapted their schemes of work to allow for low levels of parental support and involvement with schoolwork.

> We have a high proportion of disadvantaged students, so our concern was to do with engagement at home. So, what we decided, as a school really, was we would just consolidate what we've done in Year 7 to start off with and then depending on the engagement of the students, then move on with the curriculum. (Ahmed, Dunnock School)

Our interviews indicated that low attaining, SEND and EAL pupils' opportunity to learn mathematics content suffered the most in the remote provision. For example, Aisling, HOM in Nuthatch School, pinpointed differences in curriculum coverage across attainment groups. While, in her words, 'we are keeping our middle to higher [pupils] on the same curriculum as they would be covering', 'the bottom sets aren't getting any new learning really, because we don't think they can access the videos'.

A number of HOMs explained that since low attaining pupils struggled to complete the tasks on their own due to, among other factors, low maths confidence, the teachers placed the emphasis on keeping up with and mastering their numeracy and other 'basics'. Moreover, even this content was often taught at a low level of cognitive demand, with a greater focus on more procedural tasks, and on operating rather than understanding these procedures. Typically, the teachers said that higher levels of cognitive demand could not be provided because scaffolding offered by interactions with other adults and/or pupils was not possible:

> The lower end, obviously in school, you'd have a really small group of students, you'd have a teacher, you'd have a teaching assistant in there with them, and if someone was really struggling, you could really offer them bespoke support. (Jane, Robin School)

HOMs also reported that the reduction in variety of tasks led to a reduced level of challenge for high-attaining pupils:

> There's again, less challenge in the independent work that students have to do [. . .] we've given less concern to students being challenged and more concern to making sure that everyone can access what's being put out there. (Martin, Goldcrest School)

Overall, HOMs' aims in approaching remote mathematics teaching during lockdown had the result of reducing pupils' opportunity to learn mathematical content. This affected all pupils but lower-attaining and disadvantaged pupils appear to have experienced the greatest reduction in OTL, due to changes in teaching and differential access to technology.

Opportunity to learn: instructional quality

The quality of pupils' learning experiences was severely restricted by the lack of opportunity for pupils to interact with teachers and with each other during their learning, thus further restricting the nature of pupil engagement with mathematics. Most HOMs reported that their assessment approaches centred around automatic marking built into online platforms such as Hegarty Maths[2] and MathWatch,[3] commonly used pre-lockdown as homework platforms to support classroom learning through practice and consolidation. It was accepted that pupils needed to be able to get on with work individually for the most part, without direct teacher support, so the most prevalent model in use was instructional input (either from the class teacher or a video) followed by individual practice. Only one school facilitated live interactions between pupils, with most citing safeguarding concerns rather than technical issues as the barrier.

A number of schools deployed online platforms for which they had developed routines that were already embedded for homework. For example, a school that had been using Show My Homework[4] to set homework started using the platform to collect work in as well and other schools extended use of Hegarty Maths and similar platforms. In general, these schools were able to implement remote learning more quickly, more efficiently and mostly with greater pupil engagement.

Pupil engagement with and participation in mathematics was limited to a restricted curriculum. One HOM was concerned that high attainers were missing out on opportunities 'to articulate, verbalise and question and quiz and wonder as much' (Tony, Woodpecker School). Low attainers in mixed attainment schools were missing out on being exposed 'to high quality maths language and answers' in the classroom:

> A low prior attaining student in a class [benefits] from listening to answers and conversations, mathematical conversations we're having in our classroom [...] Obviously, that is very difficult and doesn't really happen within the remote learning because we can't really get that side of the classroom to happen. (Mike, Tawny School)

Opportunities for feedback were severely limited. Our survey found that although pupils in 46 (93%) of schools received marks either from a teacher or through online automatic marking at least weekly, 23 (46%) of schools provided comments on pupils' work less frequently. The online platforms used by most schools enabled teachers to track the completion of the mathematical tasks as well as some provision for the analysis of mistakes. However, the feedback provided was to teachers rather than to pupils and this was general, high level feedback largely focused on common misconceptions across the whole class. One HOM stated that assessment had been most successful where teachers were 'engaging with the information that's coming back' (Victoria, Lapwing School). Several HOMs stressed that teachers were setting subsequent work based on the data derived from work completed by pupils online.

Some teachers expressed frustration about providing formative feedback due to lack of live interaction with pupils. While their classroom approach typically involved questioning pupils 'to help them get to that point' and 'to really unlock what they are doing', in remote provision pupils were passively observing and following 'a modelled explanation

of how to do something' (Georgia, Jay School). Feedback was delayed and usually limited to answering pupils' questions over email or a weekly live session that disadvantaged pupils were less likely to attend.

Professional values, knowledge and beliefs: the challenges faced by teachers

All the HOMs were frustrated. All had a strong professional desire to address the inequities that had arisen for pupils from disadvantaged backgrounds and for those with low prior attainment. But it was clear they felt that factors such as pupil engagement, access to technology and struggles with managing effective support for pupils through remote learning were difficult to overcome.

> The problem for us is that we've got loads and loads of things in place and our massive issue is pupil engagement. I don't think it's through a lack of willingness on their part but just the difficulty of the situation. (Georgia, Jay School)

Certainly all the HOMs felt that remote teaching was of a vastly inferior quality to classroom teaching, even when the approach was similar, citing examples such as the slower turnaround time for, or sheer impossibility of, feedback and the restricted range of activities and resources that they believed could be used. Moreover, teachers were resourceful in finding alternatives to techniques they would use in the classroom, such as using Microsoft Forms rather than mini-whiteboards to assess learning. Yet, actually addressing the issue of instructional quality was a very significant challenge. This difficulty was compounded by the fact that remote teaching lacked the recognisable structuring features of the classroom practice such as routines, time, resources and being able to respond in the moment to pupils (Ruthven, 2009). In fact, for many teachers the situation they found themselves in was so unlike typical classroom practice that some struggled to recognise it as 'teaching' at all:

> It's not us teaching. It's a video that someone else has set up [. . .] [Teachers] aren't being able to use any teaching approach. (Aisling, Nuthatch School)

A key difficulty for many were the limited opportunities for interactions and responding to pupils. As one HOM put it:

> Teaching is not just about delivery of material and explanations, it's fundamentally about [a] human relationship between teacher and students [. . .] and we miss that enormously. [. . .] I think that particularly affects your ability to engage with some of the lower attainment students, the ability to go over and sit down with them and say: "Okay, what's the problem here, what are you thinking about, show me where you've got to, come on have a go at this, maybe you should have a look at that, try this." and then you see what they're doing and then you come back to them [. . .] Those constant little interactions you're having (Andrew, Goldfinch School)

Some mixed attainment schools were considering some use of attainment grouping in order to address the needs of low attainers:

> I think we will stay mixed ability next year, however, we will have periods of the year where we go into attainment groups based on, sort of based on engagement during closure. That would be the plan, to try and plug holes. (Arthur, Magpie Academy)

Whilst this strategy is very commonly used and with the best intentions (e.g., Macleod et al., 2015), the evidence does suggest that it is unlikely to be an effective solution (e.g., Higgins et al., 2018). Indeed, the mixed attainment HOMs were aware of this and considered it a challenge to their professional values:

> Mixed attainment is almost, I feel, like a moral duty to ensure that students have got the right access to the right level of maths up to a certain age in order to put every single student [. . .] to at least have the opportunity to get a grade four and above. [. . .] there may just be too much distance between some of the ones that have been [learning] and some of the ones that haven't. We may have to go to some sort of hybrid model of when the exposition of new topics comes then they're all together and when the practice is there they might have to be separate so they can get the support that they need. (Richard, Blackbird School)

A further challenge for teachers was the reduction in their interactions with each other, given that the majority were working from home. With informal opportunities to catch up with colleagues between lessons unavailable, HOMs depended on department meetings to work with and develop their teams.

> What we do is we regularly meet up as a maths department to go through what we're expecting and the problems we have. So, we have an online meeting every couple of weeks where we look at what issues there have been and how we can move forward. (Mike, Tawny School)

Some Mathematics departments had also created more informal opportunities to socialise with and support each other online, such as 'a fortnightly department quiz on an evening where we all have a beer or a glass of wine together' (Graham, Kestrel School). However, despite these efforts, many of the mechanisms by which teachers improve their teaching—or simply 'cope' with enforced change were limited. There are, for example, few opportunities during an online meeting to tell and retell the 'war stories' that are important to make sense of, and adapt to, change (e.g., Lave & Wenger, 1991).

Opportunities

While HOMs reported many challenges, they were also able to identify some limited opportunities. There were benefits for a small number of pupils, particularly those who struggled with learning in busy classrooms. Similarly, some felt that groups that might be overlooked in the traditional classroom, such as 'quiet girls', were getting an opportunity to be recognised for their work.

Other opportunities included the development of teachers' skills in using ICT. A number of HOMs described how teachers with prior experience with education technology had been able to share their expertise across the department. HOMs also identified benefits arising from the careful and creative planning that teachers had done in order to maximise pupil engagement. Many schools planned to continue to use their newly-developed online resources after returning to classroom-based teaching. Finally, one HOM found the delays in remote teaching valuable in facilitating reflection and adaptation in the approaches.

Discussion

We have presented evidence that during the period of lockdown, schools were forced to adopt an *emergency* remote teaching approach (Hodges et al., 2020) with little or no opportunity to consider what approaches and strategies might be effective. Largely, this attempted to continue their existing curriculum offer, albeit for many at a slower pace and/or reduced content, with the result that for the majority of Year 7 pupils there was a reduced opportunity to learn mathematics (OTL) for all. Furthermore, we have shown that OTL was highly inequitable for pupils, with lower-attaining and disadvantaged pupils less able to engage with remote learning due to the technological and self-regulation requirements, and, moreover, provided with a more restricted remote learning 'offer' in terms of curriculum and pedagogy.

We had anticipated that we might find some differences in practices between setting and mixed attainment schools, however all schools suffered similarly from the challenges pupils experienced with accessing work, and the limited opportunities for interactions between pupils. The latter may have been particularly detrimental to mixed attainment schools where interactions between learners form a central part of the pedagogy (Francome & Hewitt, 2018).

Since the lockdown, there has been ample acknowledgement of these effects on disadvantaged and low-attaining groups, particularly in terms of time and computer access. Our study demonstrates that as a result of these challenges, teachers were largely powerless to distribute resources in the form of OTL equitably in the context of remote learning, resulting in increasing inequality in access to powerful mathematics learning in our schools. Moreover, restrictions on feedback and interaction with pupils are likely to have exacerbated pre-existing misframings within mathematics classrooms. The challenge for schools going forward is how to enact distributive justice in order to ensure disadvantaged pupils catch up on the entirety of their missed opportunities to learn and crucially how to equitably distribute instructional content and quality, the most important factor in redressing underachievement.

The UK Government's principal strategy for redistribution of OTL is the provision of a National Tutoring Programme[5] (NTP), which is an approach with considerable potential (Dietrichson et al., 2017). However, previous research on the use of teaching assistant-led interventions (Webster & Blatchford, 2017) has demonstrated the potential risks in poorly designed or structured programmes, including the withdrawal of pupils from classes and social activities, a focus on the 'basics', reduced access to the instructional quality offered by qualified teachers, and reduced access to a broad curriculum. Thus, well-meaning attempts to distribute OTL fairly may actually result in compounding inequities in instructional content and quality. Our research has also found that high-attaining disadvantaged pupils struggled to engage with remote learning, and catch-up resources will also need to be targeted to this group. The implementation of the NTP is, therefore, of paramount importance.

Many schools believe that introducing elements of attainment grouping will raise outcomes for disadvantaged pupils (Macleod et al., 2015) and this belief was also present in some of our schools, although it often ran counter to the HOM's professional values and beliefs. However, attainment grouping is associated with an inequitable distribution of resources, with lower attaining groups less likely to be taught by specialist teachers and

more likely to be taught a restricted curriculum with a restricted range of pedagogies (Francis et al., 2020). There is a significant risk that if schools do attempt to mitigate the effects of lockdown by introducing more attainment grouping, that OTL will be reduced even further for groups that have already been disproportionately disadvantaged by school closures.

Since the research reported here was conducted, English schools have been subject to a second lockdown closure to most pupils, and most schools have experienced partial ('bubble') closures due to the need for pupils and/or teachers to self-isolate. The need for high quality teaching during periods of remote learning remains therefore a highly salient issue. Teachers need to be able to see practices as teaching in order to improve it: There is little doubt that during the first lockdown the learning experiences of most pupils were poor, even where pupils were able to engage in the remote teaching. However, equitable distribution of educational resources, such as OTL, is difficult even in ordinary face-to-face teaching for experienced teachers who are deeply committed to improving equity and social justice (e.g., Rubin, 2003); doing so in the absence of the familiar structuring features of classroom practice makes this even more difficult. To make the much-needed improvements, teachers will need help to recognise aspects of remote teaching as teaching.

Notes

1. Setting is a form of attainment grouping where pupils are grouped for teaching in a subject by their attainment in that subject alone. Mixed attainment grouping involves grouping pupils such that there is a broad range of prior attainment in all teaching groups. See, Taylor et al. (2020) for a more detailed account of current grouping practices in English schools.
2. hegartymaths.com
3. www.mathswatch.co.uk
4. www.satchelone.com
5. www.nationaltutoring.org.uk

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