The Prevalence and Use of Textbooks and Curriculum Resources in Primary Mathematics

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Funded by the Nuffield Foundation

Report Date: March 2023

Acknowledgements

The authors would like to acknowledge the support of several individuals and institutions, without whose help this project would not have been possible.

Firstly, we would like to reiterate our thanks to all involved in our pilot project: *Examining Newly Qualified Teachers' use of Textbooks to Support a Mastery Approach to Mathematics Teaching in Primary Schools: A case-study.* Without their support, the impetus and excitement for this current project would not have arisen. We would also like to thank members of the Early Years and Primary Mathematics Working Group at the British Society for Research into Learning Mathematics, whose involvement uncovered important foci for the project and helped us shape our Research Questions.

In developing and ensuring the robustness of our Main Survey instrument, we are indebted to our Expert Teacher Panel who came together on multiple occasions, willingly giving their time and expertise, to help us develop our understanding of what is currently happening in primary mathematics – particularly in light of the Covid-19 pandemic – and ensured we were asking the right questions in the right ways. Throughout the project our Advisory Group have given their time and expert guidance at key moments, providing us with a sounding board and helping to ensure the success of the project. They have provided constructive challenge, given guidance on our methodological approach, and provided quality assurance on the project.

Any project can only be as strong as the support network underpinning it, and as such we wish to thank the many people and teams who have provided information and guidance, including, but not limited to: The Nuffield Foundation's Programme Head and Grants Co-Ordinator and The University of Brighton's Research Office, Data Protection advisors, Ethics Panel and Communications Office.

Lastly, and arguably most importantly, we wish to extend our sincerest thanks to the 710 Mathematics Subject Leaders from across England who freely gave their time to complete our Main Survey, to the class teachers who responded to our Subsidiary Survey, and to the 12 Mathematics Subject Leaders who engaged in our interviews, providing us with the detail needed to really understand what is currently happening in primary mathematics and to allow us to draw out important recommendations.

The Nuffield Foundation is an independent charitable trust with a mission to advance social well-being. It funds research that informs social policy, primarily in Education, Welfare, and Justice. It also funds student programmes that provide opportunities for young people to develop skills in quantitative and scientific methods. The Nuffield Foundation is the founder and co-funder of the Nuffield Council on Bioethics and the Ada Lovelace Institute. The Foundation has funded this project, but the views expressed are those of the authors and not necessarily the Foundation. Visit www.nuffieldfoundation.org

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Key Terms

In the title of this report, we refer to **textbooks** and **curriculum resources**. Different terminology is found in policy and research documents which can result in confusion as authors include different resources in their definitions and subsequent studies. We wanted to capture the breath of curriculum resources found in mathematics in primary schools; this was particularly important in relation to the Covid-19 pandemic when schools experienced shifts in the curriculum resources they could – and chose to – use.

Our definition of curriculum resources draws on CGR/DfE (2018, p.4) research to include online/printed, digital and physical resources "linked directly to curriculum delivery". This concurs with other recent definitions (e.g., Rezat, Fan and Pepin, 2021). Given that we were interested in the association between the Department for Education (DfE) funding initiatives on the choice and use of curriculum resources, it seemed appropriate to use a definition currently in use, aligning us with the policy landscape. Being "linked directly to curriculum delivery" is important; it is outside of the scope of this project to examine, for example, the use of virtual manipulatives or picture books as an impetus to mathematics teaching. Such resources are used to support curriculum delivery but are not actively linked to it.

For ease, we refer to curriculum resources, and their various forms and uses, thus:

Curriculum resources	A general term for all mathematics curriculum resources, including mathematics schemes, linked to curriculum delivery (see above). These include, for example, textbooks, workbooks, worksheets, teacher materials, whole class teaching materials (e.g., PowerPoints), interactive materials, and Apps.
Textbooks	Physical textbooks.
(Mathematics) scheme	A set of sequenced curriculum resources from one publisher/provider written to cover the full mathematics curriculum across the whole primary phase without the need for supplementation.
Textbook-scheme	A mathematics scheme which includes physical textbooks.
Online-scheme	A mathematics scheme which is available predominantly online and specifically does not include physical textbooks.
Central spine	The main mathematics curriculum resource (which is usually, but not always, a scheme) adopted by a school. This may be used as the sole curriculum resource, or it may be supplemented with additional curriculum resources (including other schemes in whole or part).
Curation	To pull together a range of curriculum resources – or parts thereof – from different publishers/providers (potentially including parts of schemes).
Supplementation	To add other curriculum resources – or parts thereof – to the curriculum resources (including mathematics schemes) being used.
Adaptation	To change the curriculum resources being used (including mathematics schemes) in some way. This can include supplementation.

Executive Summary

About this research

This project focuses on teaching and learning in primary mathematics (5–11-year-olds) in England. Following longstanding concerns about mathematics attainment and drawing on evidence from international comparisons of teaching practices in high-performing jurisdictions, the Department for Education (DfE) invested substantial funding from 2016 – instigated through the National Centre for Excellence in the Teaching of Mathematics (NCETM) and its Maths Hubs – in providing primary schools in England with support to purchase DfE-approved textbook-schemes for teaching mathematics.

This was a bold and interesting move. Textbook use is somewhat controversial in primary mathematics in England, with textbooks tending to take a marginal role rather than being the main basis for instruction. Primary teachers have traditionally curated curriculum resources from a range of places. While there has been some concern about the quality of some resources, there has been little focus on developing high quality primary mathematics textbooks. Previously available textbooks were assessed as unstructured, simple, and routine, with a focus on repetition of procedures rather than application and investigation. Concerns have been such that the Office for Standards in Education, Children's Services and Skills (Ofsted) in its earlier inspections suggested teachers were over-reliant on such textbooks.

The DfE initiative to bring textbook-schemes into schools represents a substantial change, organisationally, culturally, and pedagogically, from what was happening in many primary schools. With no recent research to help us understand how such textbook-schemes might be received in England, or the broader landscape of teachers' mathematics curriculum resource choices into which they are being parachuted, the DfE initiative raised many questions.

Research questions

Within the context of the DfE funding initiatives and the increasing emphasis on the use of textbook-schemes in primary mathematics in England, this project sought to establish the prevalence of textbook-scheme and other curriculum resource use across England and to understand current use.

We addressed the following research questions:

RQ1 What are the current trends in the national and regional uptake of curriculum resources in primary mathematics in England?
RQ2 How are curriculum resources being used in English primary schools?
RQ3 How does eligibility for DfE-approved textbook-scheme funding affect (RQ1) and (RQ2)?

This project addressed these questions, providing high quality robust evidence in surveying the landscape of curriculum resource prevalence and use in primary mathematics in England.

Research sample and approach

The DfE funding initiatives targeted state-funded primary schools in England (including Academies and Free Schools). As such, this represents our scope. We included all National Curriculum Years 1-6 (5-11-year-olds). We excluded Reception (ages 4-5) classes, special schools, pupil referral units, and other alternative provision. Our research approach involved three phases:

1. **A Main Survey:** this was an online population-wide survey of current school-level practices, capturing trends and influencing factors in the uptake and use of mathematics curriculum resources. The survey involved multiple-choice, ratings and free-text questions. It was open to all 17,038 schools educating pupils in the primary phases between November 2021 and January 2022. We received 664 valid responses, with this sample being demographically representative of, and allowing us to make valid inferences about, the population.

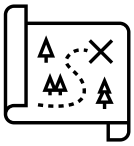
2. **A Subsidiary Survey:** this was a short, closed-question, online survey of primary class teachers, allowing us to understand how school-level practices reported in the Main Survey played out at a classroom level. Many of these questions had the same or similar wording to the Main Survey to allow for analysis of congruence. 10 survey questions were asked to class teachers about their mathematics curriculum resource use in March 2022. On average, 1972 teachers in mainstream state-funded primary schools responded to each question.

3. **Semi-structured interviews:** Following the surveys, we conducted 12 interviews with Mathematics Subject Leaders. The interview questions were developed to elicit the reasons underpinning schools' decision making in relation to the findings from the Main and Subsidiary Surveys. These interviews were conducted between October 2022 and November 2022.

Contribution to evidence

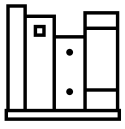
Our central finding is that school leaders and class teachers put a considerable amount of time, thought and effort into decisions about devising their curriculum map, which curriculum resource(s) to use, and how they are used. The pedagogic approach underpinning the sole use of a textbook scheme – such as those included in the DfE funding initiatives – represents a significant cultural shift in primary teaching and learning, and one schools and Mathematics Subject Leaders reported feeling uncomfortable with.

CURRICULUM MAP



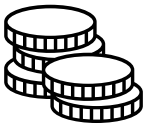
- 90% of schools take their curriculum map from a mathematics scheme.
- Rationale given by schools for using a curriculum map from a scheme include ensuring curriculum coverage and promoting consistency and progression.
- Of the 90% of schools taking their curriculum map from a scheme, 59% find the need to adapt it in some way.
- Common reasons for adapting a curriculum map – or creating one from scratch – were to better meet pupils' needs and to respect teacher autonomy and expertise.

RESOURCE CHOICE



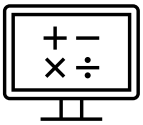
- 3% of schools use one scheme, without supplementation, for all teaching and learning in mathematics across their school.
- A further 51% of schools use a main scheme as a central spine, but supplement it as required.
- In 75% of the schools which have a central spine, the scheme is selected by the Mathematics Subject Leader or Senior Leadership Team. 2% of class-teachers in these schools are involved in deciding which scheme to use.
- 46% of schools do not have a main scheme. They use resources from various places.
- We found 107 different curriculum resources in use across schools in England. The degree of quality assurance and research support across these resources varies.

FUNDING



- 44% of schools had heard of the DfE funding initiatives.
- Of those who were eligible, 33% made a purchase under the initiatives.
- Ongoing costs and ideological preferences were reasons schools decided not to participate in the DfE funding initiatives.
- 37% of schools who had made a purchase supported by DfE funding have fully or largely stopped using the DfE-approved textbook-scheme.

RESOURCE USE



- 1% of schools rarely or never adapt their curriculum resources.
- 70% of schools make adaptations on a more than occasional basis.
- In the survey week, 36% of class teachers adapted resources for every lesson.
- In the survey week, 33% of class teachers created resources from scratch.
- 92% of schools adapted resources to match pupils' attainment and reading levels.
- Substantial time is involved in curating, creating, and adapting resources.

VERY SMALL SCHOOLS, RURAL SCHOOLS, AND MIXED-AGED TEACHING

- 34% of very small schools had heard of the DfE funding initiatives. 47% of both medium and large schools had heard of the initiatives.
- 38% of schools in rural locations had heard of the DfE funding initiatives. 46% of schools in urban locations had heard of the DfE funding initiatives.
- Those engaged in mixed-age teaching find they have to curate, create, and adapt curriculum resources carefully to meet their needs.

Implications and recommendations

DfE

- Consider fewer, full or majority-funded, strategically targeted, funding initiatives.
- Tailor initiatives to ensure accessibility and applicability for smaller schools.
- Extend the Textbook Assessment Criteria to cover a wider range of curriculum resources.

NCETM

- Establish and support workgroups to critically evaluate the quality of curriculum resources.
- Support schools to match or tailor existing resources to their pedagogic approach.
- Support schools to adapt curriculum materials for mixed-age teaching.

Publishers

- Further investigate why teachers adapt materials and provide support for this.
- Continue to explore ways to reduce ongoing costs of schemes and permit purchase of part schemes.
- Augment provision of curriculum resources for mixed-age teaching.

School Leaders

- Enable teachers to be involved in decisions about which scheme to adopt and how / when to use it.
- Develop a bank of 'approved' resources to tie in with the school's mathematical approaches.
- Examine teacher workload involved in curating, creating, and adapting curriculum resources.

Researchers

- Deepen understanding of uptake and attrition patterns in the DfE textbook-funding, to enhance the implementation of future initiatives.
- Develop a taxonomy of quality to assess and assure current and future educational resources.
- Ensure future research is inclusive of smaller and rural schools and those with mixed-age teaching.

1 Introduction and Overview

This project focuses on teaching and learning in England. As education is devolved in the United Kingdom, policies, funding, and subsequent practices are distinct to the four nations. Historically, the use of textbooks in teaching the primary mathematics National Curriculum in England (currently: Department for Education [DfE], 2013, for pupils aged 5 – 11) has been minimal. This limited use sits in stark contrast to many other jurisdictions where a textbook, or a small selection of textbooks, is/are mandated by the Government of Department/Ministry of Education for use across all schools (Mullis et al., 2008).

In England, primary teachers – who are usually generalists teaching across all curriculum subjects – have traditionally curated curriculum resources from a range of places, and at different times have been swayed, or more forcefully required, to use curriculum resources from, or related to, specific policy initiatives. The legacy of these directives remains, overtly or more implicitly, in many of the curriculum resources available. Lately, teachers may also find themselves directed to particular curriculum resources as Multi-Academy Trusts or other school groups aim for a unified approach (Parker, 2022). The recent Covid-19 pandemic also swayed curriculum resource use (and availability) as teachers grappled with providing online and hybrid learning (see Annex 1: The Covid-19 pandemic).

Following longstanding concerns about mathematics attainment in England and drawing on evidence from international comparisons of teaching practices in high-performing jurisdictions (Askew et al., 2010; Oates, 2011), the Department for Education (DfE) in England invested substantial funding in 2016 in providing primary schools in England with matched-funding to support the purchase of DfE-approved textbook-schemes for teaching mathematics. This was a bold and interesting move; asking schools to shift towards the use of a textbook-scheme represents a substantial change, organisationally, culturally, and pedagogically from what was – and still is – happening in many primary schools. This initiative raised many questions, for example:

- What is happening in primary schools in relation to curriculum resource choice and use?
- Is there a relationship between eligibility for funding, other school demographics, and if or how schools use textbook-schemes in the immediate and longer-term?
- What decisions relating to curriculum resources are being made by schools not eligible for the DfE funding initiatives?

Whilst mathematics textbook and curriculum resource research is a developing and rapidly growing field of study (Trouche & Fan, 2018), most research has focused on secondary education and has adopted small-scale, qualitative approaches. Whilst these have contributed to our understanding, there is a need to understand, at scale, the curriculum resources that teachers use, how these are being used, and the rationale for the related decision making.

1.1 Aims and research questions

Within the context of the DfE funding initiatives and the increasing political emphasis on the use of textbook-schemes in primary mathematics in England, this project sought to establish the prevalence of textbook and other curriculum resource use in primary mathematics across England and to understand how these curriculum resources are currently used in primary mathematics.

To meet these aims, we addressed the following research questions:

RQ1	What are the current trends in the national and regional uptake of curriculum resources in primary mathematics in England?
RQ2	How are curriculum resources being used in English primary schools?
RQ3	How does eligibility for the DfE-approved textbook funding initiatives affect (RQ1) and (RQ2)?

1.2 Structure of this report

We begin this report in Section 2 with a selected literature review, identifying what is known – the state of knowledge – in relation to the use of different curriculum resources, including textbooks, in primary mathematics. We situate this discussion within its international location and look at where the current DfE funding initiatives are located within the current climate. In Section 3 we outline our methodological process and the development, implementation and analysis of data arising from, our three research instruments. In Sections 4, 5, and 6 we present the findings arising from across our data analysis, before drawing out recommendations arising from these findings in Section 7. These recommendations are directed at five key stakeholder groups.

2 Textbook and Curriculum Resource Use in Primary Mathematics

Concerns about mathematics teaching and the mathematical literacy standards of young people and adults in England are commonplace in the media. This comes despite England's performance at 4th grade (9-10-year-olds) (Mullis et al., 2020) showing a steady increase, with England currently sitting eighth (out of 58 jurisdictions) in international league-tables (Figure 1). However, there is a persistent gap in mathematical attainment between England and the highest performing jurisdictions (Singapore, for example, sits 69 points ahead of England on a 0-1000 scale). Further, there is a persistent gap in the mathematics attainment of pupils from disadvantaged backgrounds compared with those from non-disadvantaged backgrounds, with 40% of this gap accounted for in the pre-school years and a further 20% accounted for in the primary years, with a cumulative gap of up to 19 months by the age of 16 (Noyes et al., 2023), something which has been exacerbated by the Covid-19 Pandemic (DfE, 2022). It is these gaps which underpin ongoing calls to address mathematics standards in England.

Figure 1: International mathematics achievement (TIMSS, 2019, extracted from Mullis et al., 2020)[1]

Education sits high on the agenda of politicians as vested parties attempt to find the panacea to school improvement, with an aim being to move England up the international tables and close the disadvantage gap. Across recent history, schools and teachers have been subjected to a plethora of interventions and initiatives including (but not limited to): prescriptive pedagogies (such as those seen within the National Numeracy Strategy and the strong recommendation to use a Systematic Synthetic Phonics scheme), wider-school systems such as setting (Francis et al., 2017) and specific professional development

[1] This chart is produced from data available at https://timss2019.org/reports/achievement/#math-4 (TIMSS 2019, extracted from Mullis et al., 2020) and shows the average mathematics achievement in the ten highest scoring countries with the TIMSS Centrepoint and lowest performing jurisdiction for comparative purposes.

programmes (Askew et al. 1997). Most recently, political initiatives have looked towards the teaching and learning approaches in the highest performing jurisdictions for inspiration. It is from here that England has 'borrowed' its current mastery focussed approach to mathematics teaching and learning (Boylan, 2020), and it is within this context that the current DfE initiative to fund the provision of mathematics textbook-schemes, assessed by the DfE as "high-quality", in primary schools is based.

2.1 Textbook prevalence and access in England and internationally

Robust statistics on the prevalence of textbook use in primary mathematics are limited. This may be because, for countries where textbook use is either fully, or all but, mandated, the extent of textbook use simply is not a question, and such research is therefore not on the radar.

The last international survey of the prevalence of textbook use was conducted within the Trends in International Mathematics and Science Study [TIMSS] in 2007 (Mullis et al., 2008). At that time, internationally, 65% of 4th Grade (ages 9-10) teachers reported using a textbook as the primary basis of their lessons with a further 30% using it as a supplementary resource. Reported textbook use across selected jurisdictions is shown in Table 1. Of note, England fell into the three jurisdictions reporting the lowest use of textbooks.

Jurisdiction	% of teachers who reported using textbooks to teach mathematics: Primary source	% of teachers who reported using textbooks to teach mathematics: Supplementary source	% of teachers who reported that they do not use textbooks to teach mathematics
England	15	64	21
Singapore	75	24	1
Hong Kong SAR	84	15	2
US	59	33	8
International Average	65	30	5

Table 1: Textbook use in 4th Grade in selected jurisdictions (TIMSS 2007, extracted from Mullis et al., 2008)

The latest iteration of TIMSS (Mullis et al., 2020) focused on mathematics resources more generally. It is important to note that access to instructional materials, including textbooks, was considered within general resource provision (which may include everyday materials such as glue sticks), but two findings are of note:

- In England, 77% of 4th Grade (9-10-year-olds) teachers report that their mathematics instruction is somewhat affected by resource shortages.
- In the 25% of jurisdictions who did not report resource shortages, mathematics achievement was highest.

2.2 Textbook and curriculum resource quality and use

As seen in Section 2.1, textbooks are rarely used in England as the main basis for instruction, but instead fall within the multitude of "education artefacts" central to the work of the mathematics classroom and determining what is taught and when (Pepin & Gueudet, 2014, p.133). The limited reliance on textbooks

in primary mathematics likely reflects the fact that, historically, textbooks available for use in England have been evaluated as being of poor quality relative to other countries or even to those used in the more distant past (Hodgen et al., 2010). Previously available textbooks for use in the primary classroom have been assessed as unstructured, simple, and routine, with limited or no use of mathematical language and a focus on fluent repetition of procedures rather than application and investigation (Haggarty & Peppin, 2002). Concerns raised by the schools inspectorate (Office for Standards in Education, Children's Services and Skills – Ofsted) in its early inspections (based on reports produced between 2005 and 2009) suggested teachers were over-reliant on such textbooks (Bokhove & Jones, 2014); as a result, textbook use has more recently been low, with textbooks taking a marginal role rather than being the main basis for instruction (Ruthven, 2014).

Possibly because of the previously poor quality of texts available, textbook use is somewhat controversial in England, particularly in primary schools. Across the UK, pupils tend to hold critical views of textbooks (Wang & Fan, 2021), citing textbook-based teaching as 'boring' and 'tedious' (Ni Shuilleabhain et al., 2021). Indeed, it is concerns that textbooks may come across to pupils as dull which leads many teachers to supplement the resource (Silver, 2022). Further, while textbook-schemes have been demonstrated to increase teacher subject knowledge and confidence, resulting in pupils holding a more "robust understanding of mathematics" (National Centre for Excellence in the Teaching of Mathematics [NCETM], 2015, p.1), many teachers worry that such textbook- schemes have the potential to exert curricular and pedagogic directions. There is a fear that textbook-schemes have the potential to reduce the role of the teacher to that of a 'technician' (Boyd & Ash, 2018, p.221), delivering pre-packaged lessons to a compliant class and eroding teacher autonomy (Gear, 2022; Turvil, 2021).

As a result of misgivings around textbook-schemes – or even other mathematics schemes – many primary teachers opt to curate their mathematics curriculum resources, developing a 'patchwork' through creating their own or sourcing resources from various places. Recent research confirms that in England (and the US) nearly all primary teachers – pre-service, newly qualified, and experienced (Shapiro et al., 2019; Ulusoy, 2021) – supplement the curriculum resources available in school with others they find online (Polly, 2017; Silver, 2022). Recent survey data suggests that average primary school teachers spend between 1 and 3 hours a week searching online for supplementary mathematics curriculum resources (TeacherTapp, 2022). Concern has previously been raised around this patchwork of curriculum resources that teachers acquire. These resources may be of inherently dubious quality (Askew et al., 2010), with a particular concern about the poor quality and limited cognitive demand of resources uploaded to repositories for teachers to share curriculum resources (Polikoff & Dean, 2019; Sawyer et al., 2019). Further, such curriculum resources are often selected and used in uncritical "haphazard, fragmented" ways (Gustafson, 2019, n.p.), lacking coherence (Foster et al., 2021), and with a focus on the pupils' tasks, rather than the underpinning mathematical concepts. This fragmented use is just one of the ways teachers mediate mathematics curriculum resources (from physical textbooks to curriculum resources from online repositories). Teachers have a high degree of agency in how any curriculum resource is used (Pepin & Gueudet, 2014; Shield & Dole, 2013; Fan, Zhu & Miao, 2013), adding a further level of complexity to any attempt at understanding curriculum resource choice and use in primary mathematics.

It is against this complex and difficult backdrop that the current DfE funding initiatives were introduced.

2.3 Department for Education funding initiatives

Following the longstanding concerns about mathematics attainment detailed at the beginning of this section, from 2016 the Department for Education (DfE) in England invested substantial funding to provide primary schools in England with matched-funding to support the purchase of DfE-approved textbook-schemes. The DfE aspiration was that 8000 primary schools would be given access to "the south Asian 'mastery' approach to teaching maths … supported by the use of high-quality textbooks" (DfE, 2016, n.p., see also Pratt & Alderton, 2023). This national initiative sought to challenge the controversial view of textbook-scheme use, seeking to support primary schools in teaching primary mathematics. It promoted the use of textbook-schemes based on the idea that high-quality textbooks underpin teaching in the highest performing jurisdictions (NCETM, 2022a). "High-quality" is important here. Textbook-schemes are approved by a DfE panel; approved textbook-schemes must demonstrate a Teaching for Mastery approach grounded in the pedagogic principles of those jurisdictions performing highly in international comparisons, that is, they have a focus on carefully sequenced lessons, an emphasis on procedural fluency and automaticity, seek to embed deep conceptual understanding, and hold a philosophy that all pupils can succeed (Boylan et al., 2019; Simpson & Wang, 2023). Two textbook-schemes were approved by the DfE and purchases could be supported with the DfE funding: Maths – No Problem! and Power Maths (Key Stage 1 and Key Stage 2).[2] It is note-worthy that the approval process for these textbooks was different from the approval process applied to DfE-approved Systematic Synthetic Phonics (SSP) schemes (of which there are ten approved schemes), where schemes were evaluated as effective in developing pupils' phonics skills. This potentially opens up differing approval processes and notions of "high-quality" to evaluation.

DfE-approved textbook-scheme funding consisted of a one-off grant of up to £2000 which schools were required to match-fund. This funding could be used to purchase any or all aspects of either or both DfE-approved textbook-schemes, including online subscriptions, for any or all year groups in the school. Schools were able to make up any shortfall in funding themselves. To be eligible for this matched-funding, schools had to currently or previously have at least one member of staff involved in the free Teaching for Mastery Professional Development programmes provided by the NCETM.

While the original DfE matched-funding initiative was intended to run until 2023, the impact of the Covid-19 pandemic on schools, particularly on disadvantaged pupils, resulted in the DfE making some changes to the initiative. These changes were intended to allow as many schools as possible to benefit from the funding. From the 2020-21 academic year, the DfE introduced a subsidy-funding initiative. This funding has only been offered to the schools with the highest percentage of disadvantaged pupils where schools are additionally engaged with the Teaching for Mastery Professional Development programmes as evidenced through active engagement with the local Maths Hub. These schools are invited to submit an Expression of Interest, with successful schools receiving 80% of the costs of buying into one of the DfE-approved textbook-schemes. Unlike the matched-funding initiative, there was an exception under the subsidy-funding initiative that schools purchase an entire scheme, including textbooks, workbooks, and teacher guides. Funding could not cover the ongoing costs of a textbook-scheme, including, for example, replacing pupil workbooks or renewing online subscriptions (NCETM, 2022b). DfE-funding for the two

[2] The Textbook-scheme Assessment Criteria used by the DfE panel can be accessed here: https://www.ncetm.org.uk/media/fqtnm2xw/assessment-criteria-final-09012017.pdf (Accessed: 12th February 2023)

approved textbooks (Maths-No Problem! and Power Maths) has not been made available to schools through any initiative this (2022-23) academic year.

2.4 State of knowledge

The DfE funding initiatives, the curriculum resources they fund, and the pedagogic model they promote, represents a substantial change to primary mathematics teaching and learning in England. Despite this substantial change, understanding of the use of textbook-schemes in primary mathematics is limited. While textbook research is a developing field of study (Trouche & Fan, 2018), research into textbook use in England, particularly in primary schools, is still in its infancy. We do not know how an increased uptake of textbooks – through textbook-schemes – might affect teaching and learning in primary mathematics in England. While evidence suggests that the ways in which schools have implemented Teaching for Mastery and mastery-based textbook-schemes are not uniform and often messy, the success of these reforms is yet to be evaluated (Blausten et al., 2020). This limits the scope for evidence-driven pedagogy and policy.

Despite some notable, and now older, exceptions (Askew, 1996; Millett, Brown & Askew, 2004), much textbook research has focused on teachers' practices and on secondary education. For example, studies have sought to understand whether the textbook choice itself makes a difference in teaching a particular curricular area (e.g., Van den Ham & Heinze, 2018) or seek to evaluate how textbooks in different countries cover different curricular content (e.g., Zang & Siegler, 2022). While this has contributed to our understanding, there are now calls for further research, including "survey[ing] the full range of resources from which teachers select" and their reasons for selection (Siedel & Stylianides, 2018, p.123). Explicitly, Rezat et al., state that "there is a need for large scale, quantitative investigations … as we explore teachers' resource use at scale" (2018, p.356).

The 'full range' Siedel & Stylianides (2018) reference here is fundamental. Where studies do examine curriculum resources, many limit themselves to physical textbooks; current research into the use of supplementary curriculum resources, particularly the use of online or digital curriculum resources, is minimal (Darragh & Franke, 2021). More concerning, Silver's (2022, p.466) review found no "recent empirical work that focuses on teachers' self-created supplementation". This current project addressed these gaps and the above call, surveying the landscape of textbook and other (including digital) curriculum resource prevalence and use in primary mathematics in England.

2.5 The current state of play and looking to the future

Aside from the impact of the Covid-19 pandemic, it became swiftly apparent over the period within which this study was conducted that curriculum resource choice and use was a field built on shifting sands. Political changes, increased accountability concerns, and individuals' and schools' responses to these, have seen recent and rapid changes – or proposed changes – to curriculum resource availability, including the development of a national complete resource bank, and new schemes being heavily subsidised, bringing with them rumblings and discontent about future obligations or expectations to use such resources.

We cannot predict what curriculum resource choices will look like in five or ten years. If things shift considerably, it may be pertinent to rerun this study at an opportune moment. However, the rapidly

changing landscape makes the results of this current study even more important; they illustrate how and where policy and funding initiatives have – or do not have – an association with school practices, and fundamentally, they tell us what is important to teachers and schools and what should be considered whoever enacts future change.

3 Scope and Methodology

The DfE funding initiatives central to this project targeted state-funded primary schools in England (including Academies and Free Schools). As such, this represents the scope of the project. The primary phase is organised in slightly different ways across different localities, and we therefore included First, Infant, Junior, Primary, and some Middle and All-Through (3-19) schools, all educating pupils in the primary-phase and amounting to 17,038 institutions at the time of the Main Survey. Within these institutions we included all National Curriculum Years 1-6 (5-11-year-olds). While Reception classes (4-5-year-olds) make use of a range of curriculum resources – including some textbooks – they are not included in the DfE funding initiatives, and it would be disingenuous to merge their pedagogic practices with those in Years 1-6. To control complexity, we excluded special schools, pupil referral units and other alternative provision as noted in the DfE 'Get Information About Schools' data, where curriculum resource use may not be in-line with that expected or suggested by the publishers.

Our research approach involved three phases:

1. A Main Survey administered to Mathematics Subject Leaders telling us about their school.
2. A Subsidiary Survey administered to generalist class teachers telling us about their classroom practices.
3. Semi-structured interviews with Mathematics Subject Leaders telling us about their school.

We provide an outline of each phase below. More substantive detail is available in the Annexes to this report. For each phase, appropriate ethical approvals were obtained, and data protection and archival policies implemented, following institutional and British Educational Research Association guidelines.

3.1 Main Survey

Our Main Survey was an online population-wide survey of school-level practices, providing us with a robust account of current practices, and capturing trends and influencing factors in the uptake and use of curriculum resources. The target population for the Main Survey was Mathematics Subject Leaders, who would be able to comment on school-level mathematics practices, in all 17,038 identified schools.

The Main Survey involved multiple-choice, ratings and free-text questions. We developed questions in collaboration with our Expert Teacher Panel – a group of Mathematics Subject Leaders from across England – using a series of Delphi-like rounds. The Main Survey was developed using *JISC [Joint Information Systems Committee] Online Surveys* allowing us to pipe respondents to specific questions based on earlier responses. Prior to distribution we piloted the Main Survey both for sense-making and ease of access across multiple devices. The final survey questions are available in Annex 3: Main Survey. The Main Survey was distributed and promoted using a specialist education database provider (*Sprint Education*) who held direct contact details (names and emails) for Mathematics Subject Leaders across schools educating pupils in the primary-phase and as such were able to ensure the survey hit their inboxes directly. This was essential given the known low response rate for any education survey, something which we anticipated being exacerbated as schools grappled with the Covid-19 Pandemic. Further, we promoted the survey through engagement with our Advisory Group and professional networks, direct

communication with the NCETM and Maths Hubs (running professional development across schools) and targeted social media posts. The Main Survey was open between November 2021 and January 2022.

Raw response data were imported directly into Excel from the JISC survey dashboard. Through school Unique Reference Numbers and postcodes, we linked each Main Survey response to the DfE's database of school demographics and data provided by the DfE of schools' eligibility for the textbook funding initiatives. The database was cleaned to remove duplicate responses and responses from schools outside of our target population (e.g., independent schools). Qualitative data from our free-text responses were analysed using inductive content analysis. This entailed reading and rereading responses to identify patterns in responses. Responses were then coded into categories, with each free-text comment marked against these categories and allowing for identification of the most salient concepts in response to each question. This process was verified by a second coder and integrated into the database. The database was then prepared for analysis using Excel and IBM SPSS Statistics Version 27 (IBM Corporation, 2020).

The Main Survey returned 664 unique and valid responses, in excess of the minimum ideal sample size of 639 (based on a power calculation with a robust 99% power to detect an effect with a 5% margin of error). Chi-squared tests of our achieved sample against the known population demographics (using those collated within the DfE database) indicated that the distribution of sample proportions (respondents to the Main Survey) was not significantly different (at $\alpha = 0.01$) from the distribution of population proportions across all demographics. Based on this we can assume that our sample is representative of the population, and we are therefore able to make inferences about the population from our study sample where questions relate to all 664 Main Survey participating schools. The ability to make such inferences about the school population is important in a study such as this where we are mapping the landscape and expecting this to be used as a springboard for future research. Of course, our claim to generalisation is built on a specific range of demographics – those considered important and made available by the DfE in their 'get information about schools' database – but this database may miss characteristics of our sample which could make the responses atypical. A comparison of the demographics of the achieved sample and the population can be found in Annex 3: Main Survey.

The design of the survey – and the landscape it maps onto – means that some questions were only relevant to a particular subset of schools. Here we used piping within the online survey to ensure schools were only presented with applicable questions. In these cases, the respondents represent that sub-sample only (for example, schools participating in each DfE funding initiative).

We examined the data for each question set using descriptive statistics (means, standard deviations, median, quartiles and percentages as appropriate) and graphing of the full sample. This provided a robust account of current practices and trends across primary schools. Further, we repeated the analysis at a sub-group level for each held point of demographic and funding data, with Chi-squared tests used to ascertain whether responses from within demographic groups (e.g., different regions of England) sat within, or outside, the national picture. This allowed us to build up an understanding of where, and how, demographics, as predictor variables, are associated with curriculum resource choice and use.

3.2 Subsidiary Survey

To understand how the practices reported by schools in the Main Survey played out in the classroom, we conducted a Subsidiary Survey of primary class teachers using a short, closed-question instrument,

focusing on their classroom practices. This enabled us to analyse the congruence between reported school-level practices (in the Main Survey) and teacher practices (in the Subsidiary Survey); it enhanced the dataset as it provided information about how whole-school policy is enacted by class teachers in the primary mathematics classroom.

For this Subsidiary Survey, we commissioned *Teacher Tapp* (see Annex 4: Subsidiary Survey) to conduct a high-level nationally representative analysis of class teachers' mathematics curriculum resource use via their daily survey app. We developed questions in consultation with Teacher Tapp following analysis of our Main Survey. Many of these questions had the same or similar wording to the Main Survey to allow for analysis of congruence. 10 survey questions were asked to class teachers about mathematics curriculum resource use in the week beginning 14th March 2022. For contextualisation and to support analysis of our findings, Table 2 shows the mathematical topic areas being covered by each primary year group in those schools following the most common mathematics curriculum mapping used in primary schools in England (White Rose, 2023). Not all schools follow this curriculum mapping, and many will make adaptations, including reorganising when topics are covered for a variety of reasons, yet this gives an idea of the topic areas most likely to have been covered in the week in which class teachers responded to our Subsidiary Survey.

Primary Year Group	**Mathematical Topic covered in w/b 14th March 2022 as per the most used curriculum map**
Year 1 (5-6-year-olds)	Mass and Volume
Year 2 (6-7-year-olds)	Fractions
Year 3 (7-8-year-olds)	Fractions
Year 4 (8-9-year-olds)	Decimals
Year 5 (9-10-year-olds)	Decimals and percentages
Year 6 (10-11-year-olds)	Ratio

Table 2: Common mathematical topics covered in the Subsidiary Survey completion week

The count of valid responses for those who teach in state-funded mainstream primary schools (this includes academies and Free Schools) in England was between 1796 and 2017. The questions, and further details about the Subsidiary Survey, are available in Annex 4: Subsidiary Survey.

As with the Main Survey, weighted data (provided by Teacher Tapp) were exported into Excel. We analysed the proportion within each answer response using descriptive statistics and graphing. This provided a robust account of class teachers' current practices in relation to the use of mathematics curriculum resources across primary schools. We were then able to contrast these results with those from our Main Survey to explore where classroom practices aligned with, or diverged from, school-level policy and practices. To avoid data mining, we did not conduct sub-demographic group analysis as we had evidence from the Main Survey that this was not implicated in the variation in responses. In the analysis, we do not report margins of error to reflect sampling variation. This is because sampling error only represents one source of variation around the extent to which the reported statistics reflect true population values. Given the sample size responses in this study, the sampling *maximum* margins of error are around 3% overall.

3.3 Semi-structured interviews

12 semi-structured interviews with Mathematics Subject Leaders were conducted during the Autumn term of 2022. This phase of our data collection was designed to enable a deeper understanding of the reasons for the decisions made by schools in relation to the selection and use of mathematics curriculum resources. These interviews resulted in the construction of a series of vignettes that illustrate and augment the Main and Subsidiary Survey findings.

The interview questions were developed to elicit the reasons underpinning schools' decision making in relation to the findings from the Main and Subsidiary Surveys. The questions reflected the range of curriculum resources used by schools. The interview schedule was piloted with one participant who had recent experience of working in several schools that used an online-scheme and multiple supplementary curriculum resources. Based on the findings from the pilot interview, particular questions were adapted to create three variations to encompass the range of approaches schools took (an example is available in Annex 5: Subject Leader Interviews):

- Schedule A: Questions for schools who mainly used a textbook-scheme as a central spine.
- Schedule B: Questions for schools who mainly used an online-scheme as a central spine.
- Schedule C: Questions for schools who do not use a scheme, but curated curriculum resources from various places.

Interview participants were contacted in three ways, via the Advisory Group, the Expert Teacher Panel, and through the University of Brighton School of Education partnership database.

Prior to selecting participants, we requested the following information: school address, number on roll, and a response to a statement that best matched their use of curriculum resources. Participants were selected, based on the pre-interview information, to reflect the three approaches to using curriculum resources outlined in the schedules above, geographical location, school governance and school size. The participants' school characteristics are detailed in Annex 5: Subject Leader Interviews.

Interviews were conducted on Microsoft Teams with the transcription function enabled. They were additionally audio recorded to enable refinements to the accuracy of the transcriptions. Transcriptions were uploaded to Nvivo where data was thematically coded using codes drawn from the interview questions and from themes arising from analysis of the Main and Subsidiary Surveys. Vignettes drawing from across the interviews were constructed around each thematic code.

3.4 Presentation of data

In the following sections of the report (Sections 4, 5 and 6) we present our key findings. Each section begins with a quantitative discussion of findings from the Main Survey. This discussion is then supplemented as appropriate with findings from our Subsidiary Survey and Subject Leader Interviews, with discussion bringing these data sources together as a coherent whole.

To make the original sources of the data we present clear, we apply the following colour coding throughout:

Data and analysis related to our Main Survey are presented in blue (e.g. table header rows, graphs and charts) or demarcated by a blue strip to the left of the report page.

Data and analysis from the Subsidiary Survey of class teachers' classroom practices are presented in green boxes, with tables carrying green header rows, and graphs using green tones.

Illustrative vignettes drawn from our Mathematics Subject Leader interviews are presented in red text boxes with quotations in red text.

3.4.1 A note on data collection timings

The data collection for this project took place during a turbulent period in education in England. In reading the findings, we draw readers' attention to the following:

- → The Main Survey was open to participants between November 2021 and January 2022. At the beginning of the 2021-2022 academic year, England was under "Step 4" in relation to the Covid-19 pandemic, meaning "Most legal limits on social contact removed", seeing schools generally returning, physically, to normal, but being faced with high levels of absence and needing to identify, and address, important gaps in pupils' learning as a result of the UK government coronavirus lockdowns in place between March 2020 to December 2021. In December 2021, "Plan B" was put in place, bringing back some earlier requirements (such as the use of face masks in indoor venues). Absence levels continued to be high, and schools were, in many cases, still in "fire-fighting" mode at this time (see IfG, 2022).
- → The Subsidiary Survey was conducted in March 2022. At this time, absence levels continued to be high. Schools focussed heavily on their "catch-up" programmes and interventions to support gaps arising as a result of the Covid-19 pandemic, with support provided for these at a Governmental level.
- → The Mathematics Subject Leader Interviews were conducted during the Autumn term in 2022, i.e., in the academic year following that in which the Main and Subsidiary Surveys were distributed. While the Covid-19 pandemic had a limited direct impact at this time, its legacy, including catch-up, remained. Further, the political system in England (September to December 2022) was unstable, with the UK experiencing a change of monarch (and period of national mourning), three different Prime Ministers, and England having three different Secretaries of State for Education.

In some cases, we saw differences between the population-wide picture emerging from the Main Survey data and the "on the ground" picture emerging from our Subsidiary Survey and Mathematics Subject Leader Interviews. It may be that the time gap – particularly as schools moved to a post-pandemic phase, as well as the political situation – have a role to play here. The perceived impact of the Covid-19 pandemic is addressed separately in Annex 1: The Covid-19 pandemic. It is important to recognise that schools continue to face a turbulent time, now having to address considerable welfare issues in the context of a national cost of living crisis. One school explained this clearly at the end of their completed Main Survey:

"[I want to] stress the fact that children have undergone a significant trauma by not being in school for long periods. Before even attempting to focus on 'catch up' type learning, we have had, and continue to have, significant issues with children's mental health issues and readiness to learn. Until the 'powers that be' fully recognise the problems that schools are facing, catch up will continue to be a plaster covering the real challenges that children are facing. I think what I am trying to say is, until we meet children's needs with reference to mental health and being ready to learn, then they won't learn! You can throw as much money as you want at textbooks or other resources but until they are ready to learn, there is no point."

[Small urban LA maintained school, South-West England]

4 Key Findings: Policy and Funding

There now follow three sections presenting the key findings from the project. We stated in our explanation of our data analysis for the Main Survey (section 3.1), that we would be re-running each analysis to examine where and how school demographics are associated with the responses given across the Main Survey. The demographics of interest were:

- Establishment type (Local Authority maintained schools, academies, Free Schools)
- School size
- Number of pupils eligible for Free School Meals
- Latest Ofsted rating
- Geographical region
- Location (urban or rural setting)

DEMOGRAPHIC INFLUENCES

Only a school's size, and whether it is in a rural or urban location, are significantly associated with curriculum resource choice or use.

On running this demographic analysis, we were surprised to find that school demographics were generally not associated with schools' funding awareness, nor on their choice or use of curriculum resources. While this does, in part, fit with other recent findings in the literature, for example in showing that a school's Ofsted rating is a poor predictor of certain outcome variables (Von Stumm et al., 2021), it does run contrary to intuition; we may have expected, for example, that schools with a lower Ofsted rating may be more inclined to use an 'approved' scheme or that Multi-Academy Trusts would have been more likely to carve their own direction. This lack of demographic influence is an important finding as it means the key messages of this report are generally applicable to all, and it suggests that current policy and practices are not skewed towards, nor do they disadvantage, any group of schools.

Where we did find demographic influences, we discuss these in these findings sections, but they are notable by their absence. There is one exception. School size and location (urban/rural) were significantly associated with how schools reported some aspects of their curriculum resource choice or use. It is important to note that these demographics are not independent and are telling part of the same story. For example, 82% of the very small schools responding to our Main Survey were situated in rural locations, whereas 96% of the large schools responding to our Main Survey were situated in urban locations. We therefore consider these together, but do acknowledge, although it is outside the scope of this report and our possible analysis, that there is some contention over the use of 'small', 'rural' and 'sparsely populated areas' (Hargreaves, 2009). As these were demographics repeatedly appearing as being of import, they are dealt with separately in Section 6.

4.1 The importance of funding in curriculum resource decision making

In this first section we start by examining the association between funding and schools' decision making, looking specifically at schools' knowledge and uptake of the DfE funding initiatives. While our project broadly responds to Rezat et al.'s (2018, p.356) call for "large scale, quantitative investigations … as we explore teachers' resource use at scale", it cannot be ignored that curriculum resource use – particularly

that of textbook-schemes – in primary schools in England is currently skewed by the DfE-approved textbook-scheme funding initiatives. We therefore look, up front, at what our Main Survey reveals about schools' engagement with funding initiatives.

66%

The percentage of schools where funding is not at the forefront of their decision making around curriculum resources.

Before turning to the DfE funding initiatives specifically, it is important to understand the role of funding more broadly in schools' decision making around curriculum resources. Schools were asked how important funding is as a factor in making decisions about which curriculum resources to use and the ways in which they use them (e.g., buying physical books or projecting material onto a screen). There was an equal split between schools reporting funding to be less, equal, or more important than other factors in their decision making both about which curriculum resources to use, and the ways in which they used them (see Figure 2). School demographics had no association with the importance (or not) of funding to their decision making. Likewise, the importance that schools attached to funding within their decision making had no association with how they developed their curriculum map (see Section 5.1), whether they had a central spine, the curriculum resources they selected to use (including whether they used a DfE-approved textbook-scheme), or the ways in which these curriculum resources were used.

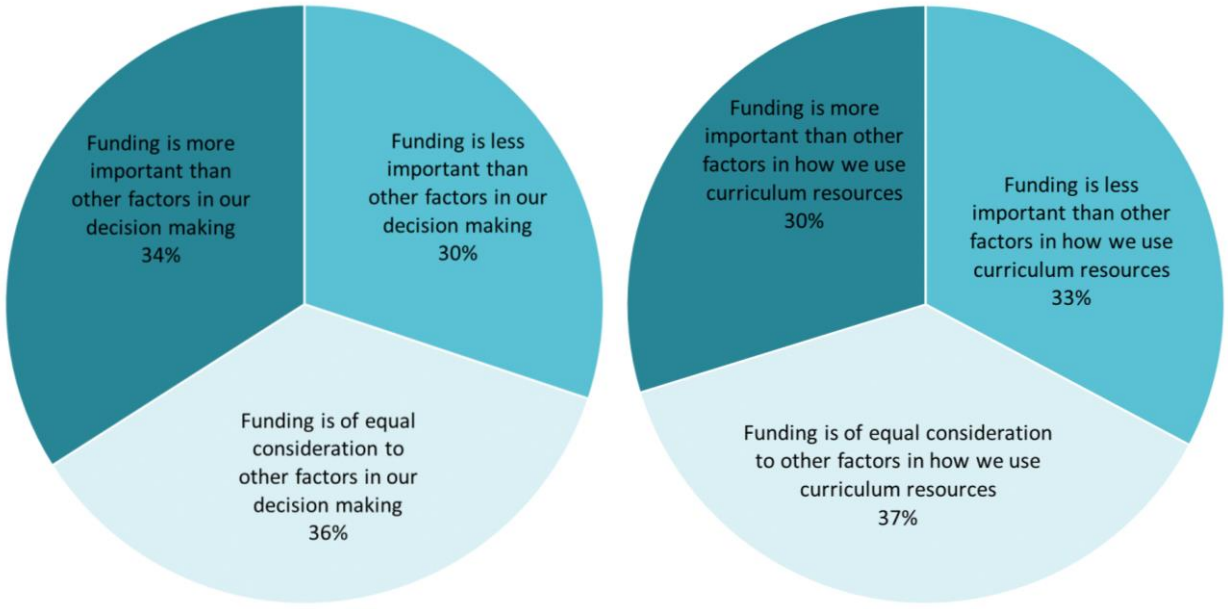


Figure 2: Importance of funding in schools' curriculum resource decision making

The general finding above – that in approximately two-thirds of schools, funding is of equal or less importance than other factors in their decision making around choice and use of curriculum resources – mirrors our finding that a similar percentage of schools stated they would not make any different decisions about their choice and use of curriculum resources even in the absence of any funding constraints. The

following two vignettes illustrate the rationales given by Mathematics Subject Leaders for why they would maintain their current approaches:

"We've had such good feedback, I wouldn't see any reason to change it at the moment."

The DfE-approved textbook-scheme works well for teachers and pupils

Schools using DfE-approved textbook-schemes talked about their satisfaction with their current approach and the outcomes for pupils, "I just think what we've got works". One reported that their school was "in quite a deprived area" and that because the textbook-scheme is working well for the teachers and pupils and, as they currently had the budget to continue to resource it, they saw no reason to make changes.

Our professional development investment has paid off

One school that had made the decision to use the NCETM resources for teaching mathematics[3] talked about their satisfaction with their current approach because of the professional development staff had gained as this is embedded in the materials. This resulted in a desire not to make changes such as adopting a scheme, textbook-based or otherwise, even if there were no financial constraints: they described the NCETM resources for teaching mathematics as "working really well for us. We've worked really hard on making sure that we as professionals have a deep understanding. But you can see the difference it's making to teachers, everyone seems a lot more confident in teaching maths".

"Everyone seems a lot more confident in teaching maths."

Where schools did say they would make different decisions, many responses talked about being able to extend their use of the schemes they were currently using (as opposed to buying in new schemes or other curriculum resources). In many cases, extension involved buying into broader elements of a scheme such as teacher guides, assessment packages and online subscriptions. While only applying to a sub-section of the respondents, this is an important finding in relation to the constraints on funding use under the revised DfE subsidy-funding initiative.

[3] The National Centre for Excellence in the Teaching of Mathematics (NCETM) are funded by the DfE. They provide full curriculum maps and a range of free to use professional development materials, lesson materials, and video lessons, including those addressing the ongoing effects of the pandemic. They can be accessed here: https://www.ncetm.org.uk/in-the-classroom/resources-for-teaching-maths-in-primary-and-secondary-schools/support-for-primary-teachers/ (Accessed 23rd March 2023)

4.2 Eligibility for and awareness of funding

56%

The percentage of schools who were unaware of the existence of the DfE textbook-scheme funding initiatives.

Data provided to us by the DfE show that at the time of completing our Main Survey, 49% of schools had been, or were, eligible for one or both funding initiatives, either through engaging with the NCETM Professional Development programme(s) or through being identified by the DfE for the subsidy-funding initiative. This aligns with the DfE aspiration that 8000 primary schools had access to "the south Asian 'mastery' approach to teaching maths … supported by the use of high-quality textbooks" (DfE, 2016, n.p., see also Pratt & Alderton, 2023). However, to benefit from any funding initiative, schools need to be aware of the existence of that initiative. We found that, despite the funding initiatives having been in existence for over six years, fewer than half of schools (44%) had heard of either or both initiatives. Further, of those schools in our sample who are or were eligible, 46% were unaware they were eligible. Schools with a higher level of pupils entitled to Free School Meals were more likely to have heard of the funding initiatives (51% of schools with a very high level of pupils entitled to Free School Meals had heard of the initiatives). This may be an artefact of the DfE shift in focus towards disadvantaged schools with the subsidy initiative as schools contacted directly about funding are more likely to have an awareness of the initiative.

Discussion with school experts within our Advisory Group suggests that schools are inundated with funding initiatives, and that this, in combination with the substantial disruption to schools because of the Covid-19 pandemic, may account for some of the mismatch seen here, with schools not remembering the various initiatives they would have been offered funding under across several years.

4.3 Participation in funding

Data from the DfE has a spikey profile, with the conversion rate from schools being eligible for funding to then participating in the initiatives (that is, buying into the DfE-approved textbook-schemes) varying year on year. Our data show that across all years of the funding initiatives, of the 49% of schools in our sample who are or have been eligible for funding, 33% report making use of the funding. This figure may be slightly higher than the true figure for all schools as a few schools may have misattributed the funding spent from another source to the DfE initiatives. 33% of eligible schools making use of the funding would represent 16% of all schools being both eligible for, and using, the DfE-approved textbook-scheme funding across England.

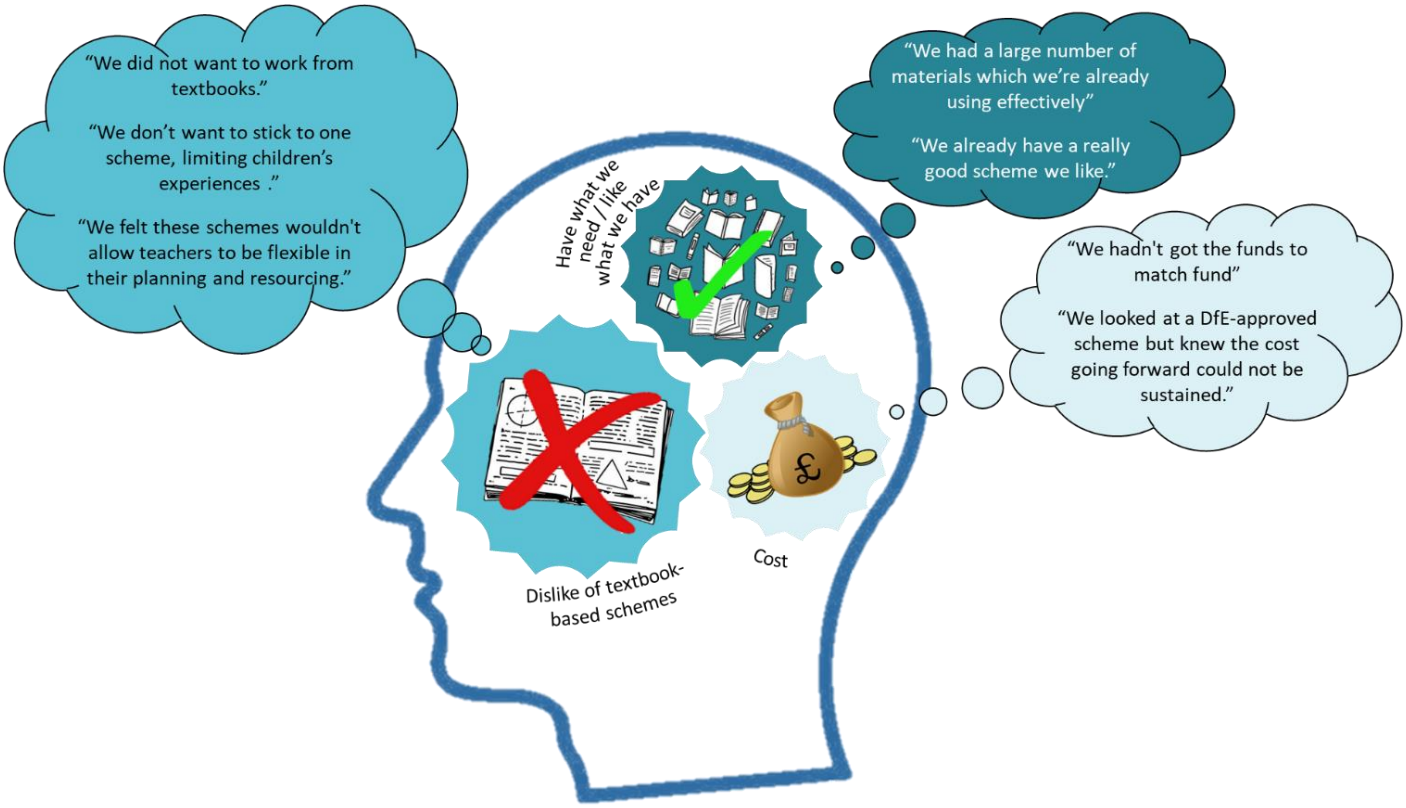


Figure 3: Schools' thinking when deciding not to participate in DfE textbook-scheme funding initiatives

Of those schools in our sample who participated in the funding initiatives, 82% used part or all of the funding to purchase textbooks,[4] 59% used part or all of the funding to purchase printed workbooks and 49% used part or all of the funding to purchase online subscriptions.

Where schools were eligible for funding but did not participate in the initiatives, three factors emerged as influential in this decision-making. Almost half of the reasons schools gave us for not participating in the funding initiatives referred to a dislike of textbooks themselves or textbook-schemes. Just over a quarter of reasons referred to being satisfied with and/or liking what they currently had, while just under a quarter cited the cost – including ongoing costs – of participating in the DfE initiatives (Figure 3).

4.4 Longevity of funding

With the DfE-approved textbook-scheme funding initiatives operating since 2016, we wanted to know whether the changes schools had made in adopting the initiatives were still in place. This is particularly key given that the funding only covered the initial outlay (and schools needed to match this) meaning that any school deciding to move to one of the DfE-approved textbook-schemes would have to cover ongoing costs if continuing to use the textbook-scheme in its entirety.

[4] The current subsidy-funding initiative requires schools to purchase full schemes so this figure may rise.

While our sample for this analysis was small as it only included those schools who had been eligible for, were aware they had been eligible for, and had made use of, the funding initiatives, the results are important when looking at the intended long-term changes of such policy/funding initiatives. Table 3 shows that fewer than half of schools in our sample who initially bought into one of the DfE-approved textbook-schemes have continued to use all components of the textbook-scheme, finding their own funding for consumables such as pupil workbooks and online subscriptions. While a further 24% are still using the DfE-approved textbook-schemes in some form, their decision not to fund the purchase of consumables means that the resource is no longer being used in its entirety in the originally expected manner. 37% of schools in our sample who had received DfE funding have now fully or largely stopped using the DfE-approved textbook-scheme they purchased with this funding.

37%

The percentage of schools who have abandoned the use of a DfE-approved textbook-scheme they received funding to implement.

Current use of DfE-approved textbook-scheme	Number of schools	% of those who received funding
We have continued to use the textbook-scheme and now fund consumables (e.g., pupil workbooks) ourselves	34	39
We have continued to use the textbook-scheme and the resources we have, but we no longer buy new consumables	21	24
We have largely or completely stopped using this resource	32	37
TOTAL	**87**	**100**

Table 3: Current use of DfE-approved textbook-schemes by schools who received funding

Reasons given by schools for abandoning a DfE funded textbook-scheme mirror reasons given by schools for not initially adopting a DfE funded textbook-scheme at all. Costs – particularly ongoing costs – were sometimes seen as prohibitive, particularly when free or much lower-cost alternatives of a high quality were found to be available. There were also concerns with the lack of ease with which the DfE-approved textbook-schemes could be adapted, with schools citing the need to adapt to cater for attainment levels, reading ability and variety of experience.

The financial tensions are demonstrated in the two vignettes below. While both schools had received DfE funding to purchase an approved textbook-scheme, and both had had positive experiences with the DfE-approved textbook-schemes, we see one school having to make decisions about future use on a financial basis and another able to continue funding consumables within the textbook-schemes (such as pupil workbooks) but with the Mathematics Subject Leader aware there are financial decisions to be had here behind the scenes.

"It's very, very expensive and we have no money. We can't afford it anymore."

Financial threats to future use of a DfE-approved textbook-scheme

One school that had received funding for a DfE-approved textbook-scheme, intended to continue to use the scheme. However, they were concerned about how they would fund its future use. They were in the second year of a three-year package and planned to review school budgets "to work out whether we can afford it, which is a shame because personally I think it's a good scheme and I would like to carry on with it".

Future use of DfE-approved textbook-scheme: financial & attainment incentives

Another school that also received funding for a DfE-approved textbook-scheme, were optimistic that the school would continue to prioritise funding the scheme because of the financial investment to date and the rising attainment in mathematics following several years of using the scheme; "My hope is that they've invested so heavily in prior years, that to pull that now would be counterproductive beyond just money".

"It is money well spent. For my school in particular the proof of that is the results."

4.5 Funding: awareness, uptake, and continuity

Sections 4.2 to 4.4 tell an important story. While the number of schools eligible for the DfE funding initiatives is broadly inline with the DfE aspiration that 8000 primary schools had access to "the south Asian 'mastery' approach to teaching maths … supported by the use of high-quality textbooks" (DfE, 2016, n.p.), many of these schools are unaware of being eligible for this funding to purchase DfE-approved textbook-schemes. Where they are eligible, only a third make use of this funding. Of these schools, more than a half, in a relatively short timeframe, have stopped using the DfE-approved textbook-schemes. This is illustrated in Figure 4, showing that despite the DfE aspiration that 8000 primary schools having access to a 'mastery' approach to teaching maths was all but met, on the ground this does not translate to anything like that aspirational figure now using these DfE-approved textbook-schemes in practice.

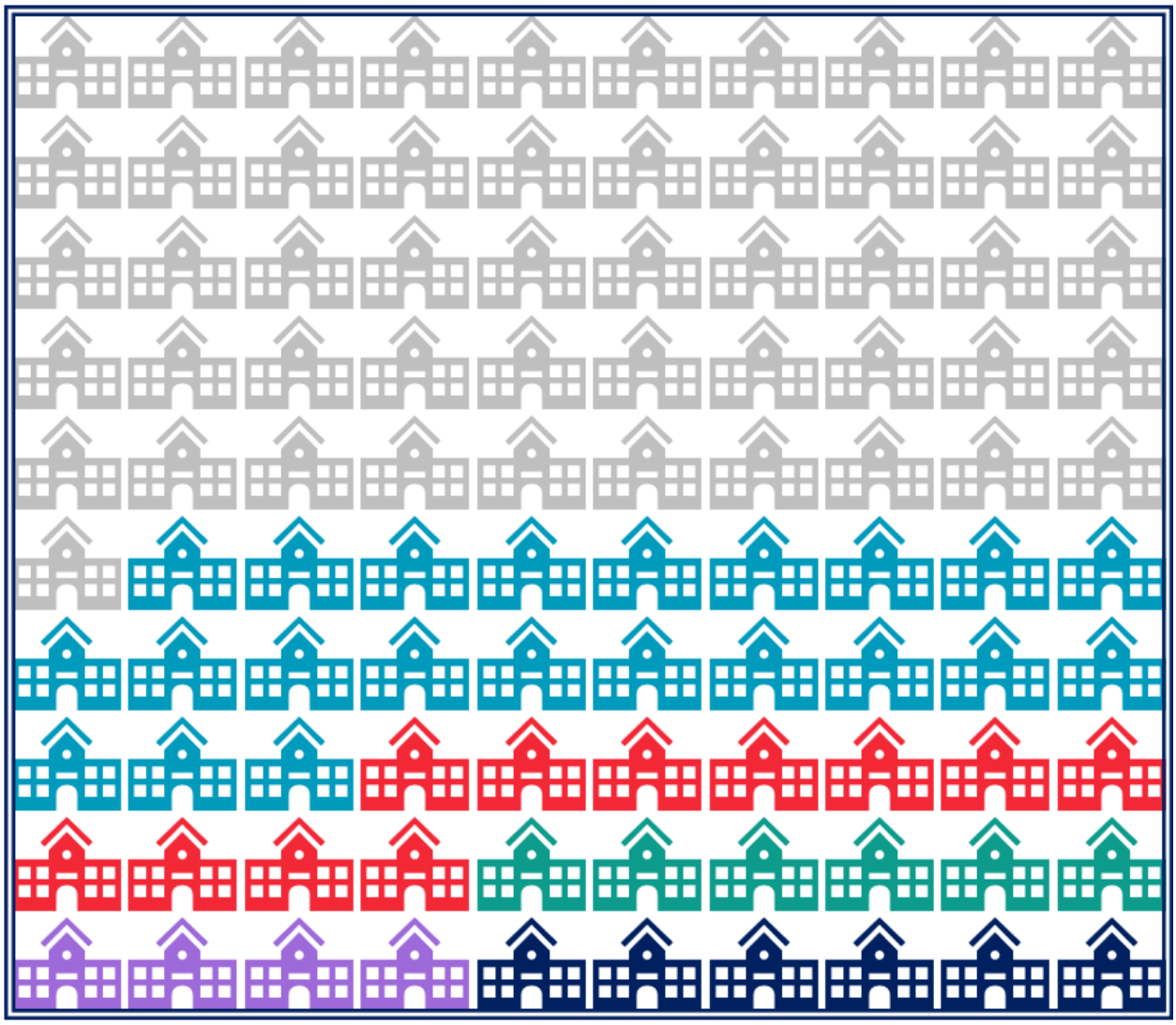


Figure 4: Patterns of awareness, uptake, and continuity in DfE funding initiatives

(Note that the schools who were not eligible for the DfE funding initiative(s) had not taken part in the NCETM Professional Development programme(s) and, latterly, were not identified by the DfE as disadvantaged. Currently (2022-23) the DfE are not releasing any funding under the textbook-funding initiatives and so these schools currently cannot become eligible for these initiatives.)

5 Key Findings: Curriculum Resource Choice and Use in Primary Mathematics

Mathematics curriculum resource choice and use covers three phases (Figure 5). Schools must make decisions at each phase; the following sub-sections address what we know about these choices.

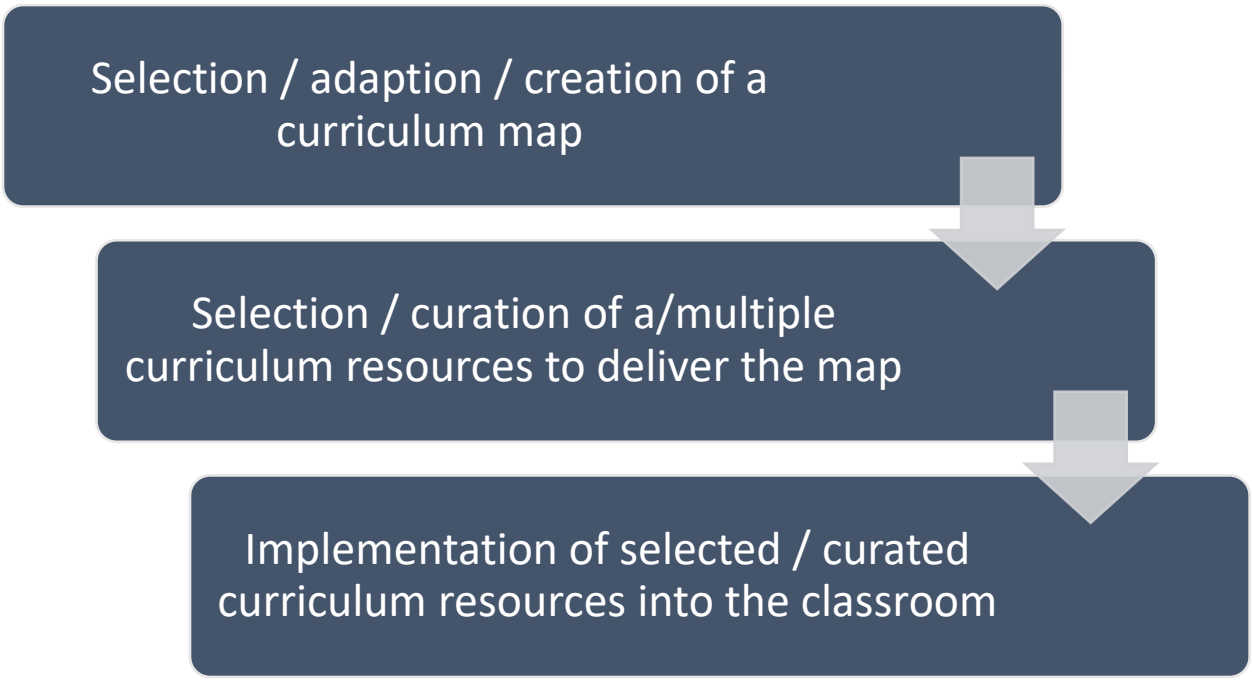


Figure 5: Three phases of mathematics curriculum resource choice and use

5.1 Curriculum map design

The National Curriculum for mathematics (DfE, 2103) provides a set of statutory requirements by year group, but it is then up to schools to further demarcate this, making decisions about which topics are taught when within the year and even whether some topics will be taught 'out of year'. A school's curriculum map for mathematics outlines these decisions. It refers to the plan they have or create, outlining which aspects of the mathematics curriculum are to be taught in which year and at which stage within the year. The curriculum map is essentially the underpinning structure of mathematics provision within a school (see example in Figure 6).

Maps may come directly from a scheme, may be adapted from one provided by a scheme, or may be developed from scratch. Some Local Authorities and Multi-Academy Trusts have centralised curriculum maps available to be used – or sometimes required to be used – by all schools in that Local Authority or Trust. Other schools select, adapt, or develop their own map based on the needs of their school.

Figure 6: Example partial curriculum map[5]

661 schools told us about the source of their mathematics curriculum map (Figure 7). The percentage of schools taking each approach is not even, with schools being statistically more likely to take a curriculum map from a scheme and then adapt this to the needs of their school, and far less likely to create their own curriculum map from scratch, either within the school or within the Trust [$\chi^2(2) = 186.230$, $p < 0.001$].

[5] Extracted from the NCETM Curriculum Prioritisation in Primary Mathematics materials (available at: https://www.ncetm.org.uk/classroom-resources/cp-curriculum-prioritisation-in-primary-maths/)

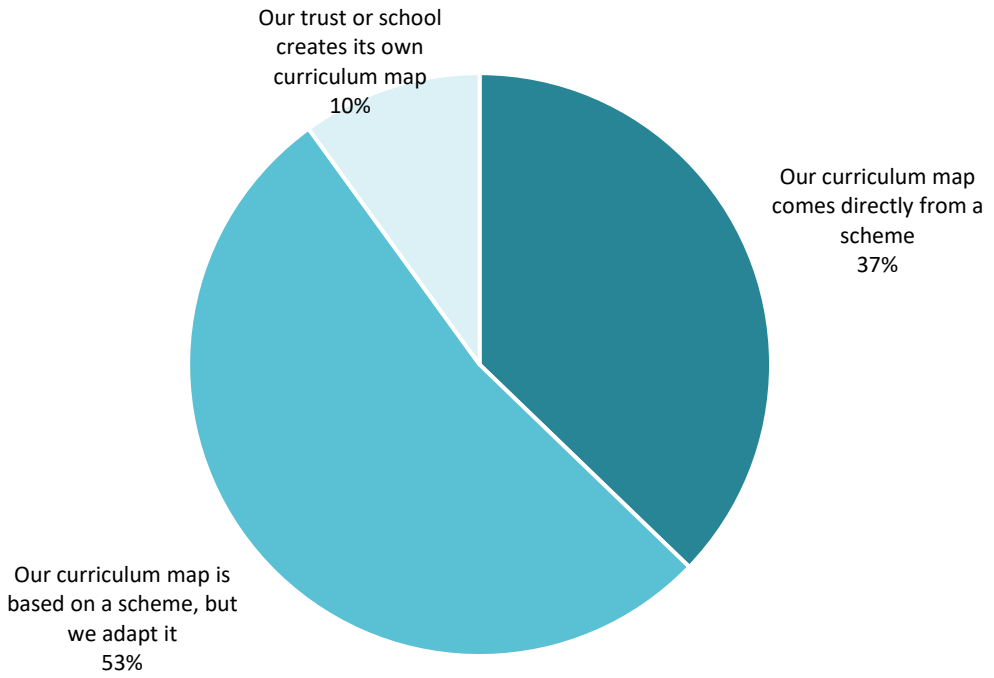


Figure 7: Schools' approaches to sourcing and/or designing their curriculum map

Schools were asked, through a free-text response, why they took the approach they did to sourcing, adapting, or creating their school's curriculum map. The key drivers are shown in Table 4. This shows us that different approaches to developing a school's mathematics curriculum map are driven by different desires or beliefs.

Schools who take their curriculum map from a scheme without adapting it are most likely to be driven by the need for consistency and the desire to implement a mastery approach to teaching and learning in mathematics:

> *"We are currently rated 'Inadequate' and want to ensure we have a Mastery based approach to the teaching of mathematics that is consistent across the school."*
>
> *[Medium-sized urban academy, East of England]*

Schools adapting a plan or developing their own were less likely to be, or not at all, driven by these same desires. Instead, these schools strongly asserted a drive to meet the needs of the pupils:

> *"As a school, we believe in developing a curriculum which is for our school. We use the National curriculum objectives, plan our long-term coverage and plan teaching sequences which match the needs of our children at the time."*
>
> *[Large urban LA maintained school, East of England]*

Of interest, those who used a curriculum map from a scheme without adaptation did not cite meeting pupils' needs as a reason for their decision-making. It is important to note that this does not mean that they did not consider pupils' needs, but that this reason was not a dominant driver in their decision-making about their curriculum map. While the percentage of schools citing reasons relating to teachers / the workforce was smaller across all three approaches, there are some interesting trends here. Schools who use (without adaptation) a curriculum map from a scheme cite this as being supportive of teacher subject knowledge, teacher confidence, and reducing teacher workload. Schools who adapt a curriculum map from a scheme or who create their own, express a greater concern for teacher autonomy, seeing the teacher as a professional or expert.

Reason for using this approach	**Curriculum map comes directly from a scheme** (% of respondents)	**Curriculum map is adapted from a scheme** (% of respondents)	**Trust or school creates its own curriculum map** (% of respondents)
To develop a mastery approach	26	12	5
To ensure consistency across classes/years	24	7	0
To ensure progression across classes/years	19	10	5
Use of a trusted or approved scheme	15	7	0
To ensure coverage of the curriculum	11	4	5
To reduce teacher workload	10	5	0
To support teacher subject knowledge in mathematics	10	5	3
Recommendation (e.g., by Maths Hub)	3	1	0
In response to the Covid-19 pandemic	2	10	9
To account for teacher autonomy and expertise	1	8	11
To cater for mixed-age teaching	0	5	8
To develop a high-quality curriculum map	0	0	8
To meet pupils' needs	0	51	58
To mitigate perceived limitations in the commercial scheme	0	11	0

Table 4: Reasons given for developing a curriculum map in a particular way

5.2 Curriculum resources: Access and use

Once a school has established its curriculum map (see section 5.1), it then needs to decide which curriculum resources to use. There are many decisions to be made here. As a first level of decision-making, schools may decide to follow a scheme (usually the one their curriculum map comes, or is adapted, from), using the curriculum resources (which may include textbooks, workbooks, worksheets, online apps/games, etc.) provided by that scheme. Even within this decision there are different approaches: some schools may use their selected scheme exclusively, while others may take resources from their selected scheme but adapt or supplement these (with other curriculum resources). Other schools will make a different decision, deciding not to base their curriculum resource choice on any one scheme, but

instead to curate appropriate curriculum resources from across a range of providers or, indeed, to develop their own from scratch. In such cases, this curation may happen at a school, year, or teacher level, with curation at a teacher level providing individual teachers with the autonomy to curate curriculum resources from multiple places, based on their judgement of their pupil needs.

These different choices illustrate how England sits apart from many jurisdictions where schools are required to follow a government dictated scheme and where schools and individual teachers may have limited choice about procuring additional curriculum resources. Previous theoretical work in secondary mathematics has suggested these choices – published schemes or curation – to both be suboptimal (Foster et al., 2021). As such, the findings here are fundamental, as they give us a deep insight into the shape of the current landscape in primary mathematics education and the extent to which the underpinnings of the DfE initiatives align with this. Misalignment here may help make sense in part of the uptake and continuation patterns in the use of DfE initiatives illustrated in Figure 4.

Our data show that very few schools use a mathematics scheme exclusively, without adaptation and without supplementation with other curriculum resources. Most schools either use a scheme as their central spine but then adapt or supplement this, or they have no central spine, instead curating from across a variety of places (Table 5).

3%

The percentage of schools who use one scheme – without supplementation – for the planning and delivery of mathematics across the school.

Approach	Number	%
We use curriculum resources from various places	307	46
We use one scheme exclusively	19	3
We mainly use one scheme but supplement it as required	338	51
TOTAL	**664**	**100**

Table 5: Percentage of schools taking different approaches to resource their curriculum map

The findings in Table 5 report the approach taken by schools overall. The small number of schools who told us that they use one scheme exclusively, are telling us that they (and their class teachers) take this approach in every mathematics lesson in every year group across the academic year.

In our Subsidiary Survey, we asked class teachers which of the above three approaches they had taken in the last week (Table 6). It may appear that these findings contradict the Main Survey, given the higher number of class teachers reporting the exclusive use of one scheme. However, what they tell us is that practices vary week on week; our Main Survey tells us that is very unlikely a school will maintain the sole and un-supplemented use of one scheme across the school and year, while our Subsidiary Survey gives us the 'on-the-ground' picture, whereby class teachers may use one scheme exclusively in one week, but in another, may supplement this or use a different curriculum resource altogether. Further, it may be the case that class teachers "in theory" supplement their curriculum resources (and this is the position of the school), yet rarely find they have the time to do this.

It is worth noting that in the week in which class teachers completed the Subsidiary Survey, five of the six year groups were likely to have been covering the mathematical topics of fractions, decimals, percentages and ration, topics where non-specialist primary teachers are known to have weaker subject knowledge and hence where it may be more likely that they elected to follow a scheme without deviation.

Approach	%
I used curriculum resources from various places	29
I used one scheme exclusively	21
I mainly used one scheme but supplemented it as required	50
TOTAL	**100**

Table 6: Percentage of class teachers taking different approaches to resource the curriculum map

We also asked class teachers whether they felt mandated to use a particular curriculum resource or set of curriculum resources as specified by the school (or Trust). 8% of class teachers told us this was the case and that they did not feel at liberty to use their own curriculum resources. What this also tells us is that 92% of class teachers do feel free to either supplement a school central spine or to use curriculum resources from a variety of places, again illustrating, as discussed on p.37, just how unique primary mathematics teaching is in England when compared with other – particularly high performing – jurisdictions.

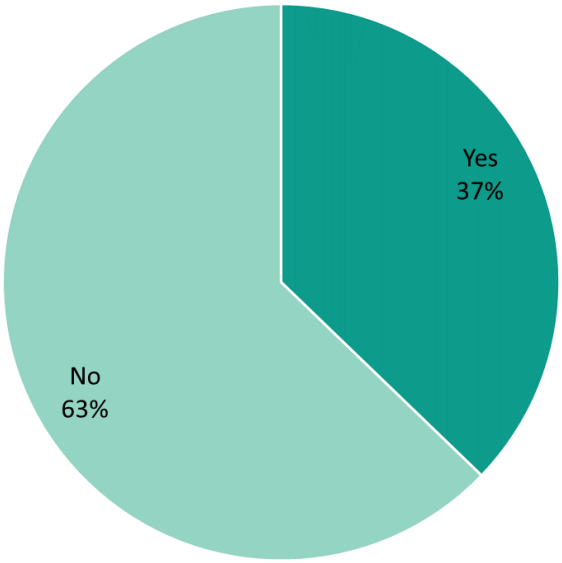


Figure 8: Percentage of class teachers spending their money on curriculum resources in the survey week

It is well known that teachers supplement resources used in the classroom – perhaps particularly so in the primary classroom – often bringing in items scavenged from their homes and gardens or dipping into their own pockets to purchase various resources from books for the reading corner and art materials, to a range of mathematics curriculum resources. We asked class teachers if they had spent their own money on any mathematics curriculum resources in the last week; in many cases this would have taken the form of paying a one-off cost for access or maintaining a personal subscription to an online teacher resource bank, often those providing curriculum resources developed by teachers for teachers (Figure 8). It is not surprising, but should be a cause for concern, given the current cost of living and teacher recruitment crises, that over a third of class teachers told us they had spent their own money on mathematics curriculum resources in the last week.

"It really does vary but I think everyone uses it as a starting point"

Flexibility and teacher autonomy in the use of a scheme

One school adopted the use of an online-scheme to support teacher confidence and subject knowledge, to ensure a focus on conceptual understanding and to ensure that models and images had a high priority. However, whilst used as a starting point across all year groups and approximately half the time overall, there are differences in the extent that the scheme is used: "there's a certain amount of flexibility and freedom and some year groups use it a lot, some year groups don't use it as much". The Mathematics Subject Lead is happy with this variability: "I wouldn't want them to just take it completely without thinking about the content at all and just presenting it anyway" so they are happy that teachers make their own decisions about when and how to draw on the scheme. Supplementary curriculum resources are drawn from a range of places and are often teacher created.

As the number of schools reporting the use of one exclusive scheme at all times represents a small percentage of the respondents, the subsequent analysis combines those schools who exclusively use a scheme with those who use a scheme but adapt or add to this. In doing this, we see that the percentage of schools taking each approach (with a scheme as a central spine or not) is fairly equal and not significantly different from an even split [$\chi^2(1) = 3.765$, $p = 0.052$] (Figure 9).

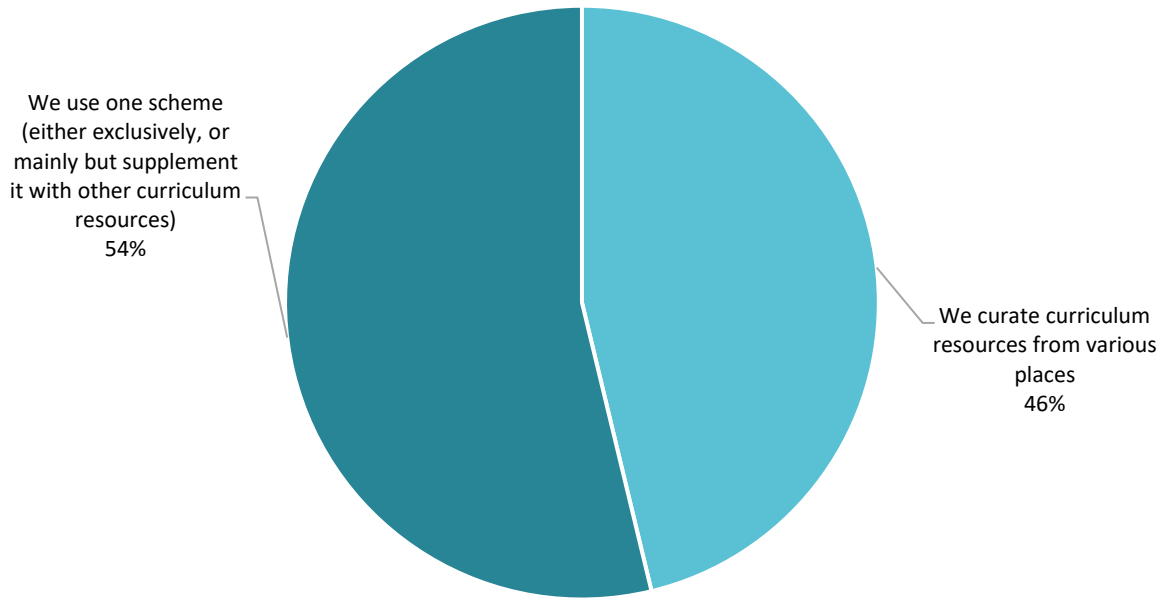


Figure 9: Percentage of schools structuring their provision around a central spine

5.2.1 Having a central spine resource

Just over half of schools, 54%, have a scheme which acts as a central spine, supplemented in 94% of these schools with other curriculum resources. We asked these schools with a central spine, through a free-text response, why they had elected to have a central spine (Figure 10).

Figure 10: Reasons given by schools for having a central spine

The most common word used, found in 34% of the responses, was "consistency". An exploration of the full context of the responses showed that this could mean different, but related ideas, involving consistency for all involved: teachers, pupils, and parents/carers engaged in home learning. Consistency also meant both being taught the same thing (for example within year-groups) and being taught in the same way (such as in the selection of representations):

> *"Our Academy is currently rated inadequate, and we wanted to ensure there was a consistent approach to the teaching of mathematics using Mastery."*
>
> *[Medium-sized urban academy, East of England]*

> *"To ensure consistency across the school and at home during lockdown."*
>
> *[Very small rural LA maintained school, Yorkshire and the Humber]*

> *We needed consistency of approach: in maths language, use of visual resources, manipulatives, and methods … Children will be exposed to the same models and images throughout school, building on their understanding … the deprived context of our school means the routines of a programme helps the learners more.*
>
> *[Small urban LA maintained school, North-West England]*

Many schools who talked of consistency, also talked of progression (12% of all respondents) and to a lesser extent, curriculum coverage (6%). Consistency, progression and curriculum-coverage are linked, all aiming to provide efficient, coherent coverage of the statutory requirements. In several schools, this was

directly related to the school implementing a mastery approach (12%). While less often referred to, meeting statutory requirements is also seen in the schools who cited a need or desire to improve standards (4%) sometimes referring to their current (usually inadequate) Ofsted rating.

"If you're shown something in a very different way one year to the next, the pupils might not so easily make the links."

Seeking progression through consistency for pupils and teachers

One school elected to use a DfE-approved textbook-scheme as its central spine because of the opportunities it affords for consistency and progression across the school. They liked the way that consistency in methods and representations enabled pupils to make links to prior understanding as they progressed from year to year. It also supports teachers to revisit, understand, and build on the content and methods from previous years, and to revisit key ideas with pupils as needed.

Beyond issues of consistency, practical issues were also frequently cited reasons for a school deciding to have a central spine. Schools talked about the benefits of an online offering (6%) as well as the potential to deviate from or adapt the scheme (4%). They valued a scheme thought of as "high-quality" (4%), with other schools mentioning this in relation to the selected scheme being recommended by others (7% - this ranged from Maths Hubs, colleagues bringing experiences from other schools to discussion on social media). Additionally, 7% of schools cited cost-related issues, that is that it was either available free/cheaply, or that the school had received funding to support the purchase. A further practical consideration was in relation to teachers: schools elected to have a central spine as this supported CPD, subject-knowledge and teacher confidence (6%) and reduced workload (5%). While the numbers are very small, it is interesting to note that more schools cited a scheme as being DfE-approved as a more salient factor than the number of schools who cited receiving funding as being a factor in their decision making. This may suggest that it is the approval (which we also see in the numbers taking recommendations from various sources) which is potentially more important than receiving funding.

2%

The percentage of class teachers who were involved in selecting a school's scheme where a school followed a scheme as a central-spine.

We also looked at who, within the schools, made the decision about which scheme to use. We hypothesised that the nature and control of the school may impact on decision-making (both the decisions made and who makes them), particularly as the number of schools that are part of a trust (e.g., a Multi-Academy Trust MAT) increases (Plaister, 2022). 33% of schools responding to our Main Survey were academies which is not statistically different from the number of primary schools which were academies at the time of the Main Survey. Just 11% of these schools (i.e., of the 33% which were academies), told us that the scheme they had as a central spine was selected by the Trust. Across all schools with a central spine, it was most common that the Head/SLT and the Mathematics Subject Leader collaboratively made this decision (46% of schools with a central spine) while in a further 29% of schools, this decision was made

solely by the Mathematics Subject Lead. Of note, in only 2% of schools with a central spine were non-subject lead class teachers – those most commonly using the selected scheme – involved, individually, or even in collaboration with the Mathematics Subject Leader, in deciding the scheme to use.

5.2.2 Having a non-supplemented scheme

1%

The percentage of primary schools using a DfE-approved textbook - scheme without supplementation.

While we noted that the percentage of schools taking one scheme and using this as the sole provision in primary mathematics is incredibly small (particularly when considering that this is the DfE's preferred approach) it is important to pause and to look at what we know about these schools, their decision making, and the nature of teaching and learning mathematics in these schools.

The 3% of schools using one scheme exclusively, without supplementation, represents just 19 schools. The majority of these schools adopted this between 2016 and 2021 (84%). All other schools had been using their adopted scheme prior to 2000. None of these schools adopted their selected scheme between 2000 and 2016. Of the 19 schools with a non-supplemented scheme, just eight schools have one of the DfE-approved textbook-schemes as their chosen scheme. This means that only 1% of schools are using a DfE-approved textbook-scheme in a way that most closely resembles that of jurisdictions from which our textbook policy was borrowed. Of these eight, all have purchased the schemes' textbooks, all have purchased access (print or online) to the teachers' guides, and seven out of eight make use of the printed pupil workbooks. Fewer than half use the assessment materials.

While the numbers are too small to make any solid statements, we note that across the 3% of schools taking one non-supplemented scheme, demographically, there appear to be no differences between whether schools are under Local Authority control or are Academies or Free Schools. Schools taking this approach are, on average, generally larger, with a mean number on roll of 337 pupils, compared with 289 across all schools catering for the primary ages in England. They are also more often found in urban locations (89% of these schools are in urban locations). They generally have a higher percentage of pupils eligible for Free School Meals at 33%, compared with 21% across all schools catering for the primary ages in England. Of interest, the distribution of these schools across England is inconsistent, with 37% of these schools located in the Northwest of England. This skewness towards the Northwest does not appear to be the influence of a particular Maths Hub, despite "recommendation" being the key driver for schools opting for a single non-supplemented scheme.

In relation to how these central schemes were used, it is perhaps surprising, given these schools have made the decision to base all teaching and learning on one scheme, that these schools were more likely than across all schools responding to the Main Survey to find the need to adapt the curriculum resource (that is to make internal changes to how the curriculum resource was used, rather than add to them through supplementary curriculum resources). As with the full sample (considered in section 5.4.3), the main reason for adapting the curriculum resource was to adjust to pupils' attainment levels. Adaptations needed for this reason sit at odds with the design of such schemes, particularly the DfE-approved textbook-schemes, which are written to meet the curriculum and mathematical needs of pupils at

particular ages. This may suggest that the aim of keeping the class generally together – an underpinning tenet of the mastery approach – is not always achievable in practice, particularly given the large attainment gaps discussed previously. In our interviews with Mathematics Subject Leads, we did sometimes see a commitment to using the scheme exactly as it came "out of the wrapping" but across our broader population, even schools that wanted to use the schemes as written found the need to make adaptations.

"We talked about what is intelligent practice and why is this intelligent practice and why is this not."

Fidelity to a DfE-approved textbook-scheme

One school told us that fidelity to the scheme was a really important aspect of their approach to teaching mathematics and this meant that no other curriculum resources were used. "We did something on intelligent practice and we got a few other things out to have a look at and we talked about what is intelligent practice and why is this intelligent practice and why is this not intelligent practice? So yeah, we do maintain that fidelity".

Where pupils' needs necessitate adaptations important principles applied: "It might be only appropriate for a pupil rather than working with say, 2987 and something, to work with, say 2000 and 3000, because you're making the link that two and three makes five, 20 and 30 makes 50. So we try and maintain the magnitude of the numbers. For greater depth we tend to go back to the original task and try and pull something more out of that".

5.2.3 Not having a central spine: curating curriculum resources from multiple places

As our findings in Section 5.2 show, almost half of schools (46%) do not have a scheme as a central spine (whether supplemented or not) and instead curate curriculum resources from multiple places. Except for school size (discussed in Section 6.1), there were no demographic characteristics associated with schools taking such a curated approach. The extent to which schools took a curated approach was a surprising finding to us – and to those we have discussed this with – as while we were aware that some teachers individually rejected the idea of schemes, we were not expecting to find this to be a whole school approach / ideology, at least not so extensively across schools.

"It's not the cost. I mean, of course money's tight everywhere. But if we felt that a scheme was the right thing to do, we would buy it."

Deciding not to use a scheme

In one school the decision not to use a scheme was based on a view that using such a scheme deskills teachers. "I've observed people [using a scheme] and they're like 'We've got all the PowerPoints and we don't have to plan it. It's all in this book'". With a stable staff team who shared a vision for mathematics the school developed their own curriculum map; teachers use the established calculation policy, and with an emphasis on the use of models and images, curate curriculum resources from a range of places. This approach gives the flexibility to adapt to meet pupils' needs that the Mathematics Subject Leader felt would be more challenging within the structure of a scheme. Reflection on the appropriateness of progression was always ongoing "We're always looking at things and thinking about how to move things forward".

Free-text responses to our Main Survey allowed us to understand the rationale behind schools' decisions to curate, rather than to base their provision on a central spine. Many of these have been covered in Figure 3 in Section 4.3 (Participation in funding) as the rationale for deciding not to participate in the DfE funding initiatives overlap substantially with the rationale for opting to curate curriculum resources from various places. Beyond the cost implications of buying into and maintaining a scheme, rationale could generally be categorised as: responding to the unique pupils, responding to the unique teacher, and the avoidance of prescription (Figure 11).

The unique pupil

"We feel as though it works for our children, rather than following a ready-made scheme." [Medium-sized urban LA maintained school, North-West England]

"Our approach allows us to respond to the needs of our students and draw on many high-quality resources, rather than rely on one scheme." [Small urban LA maintained school, West-Midlands]

"One size does not fit all!" [Small urban academy East of England]

The unique teacher

"Different teachers favour different schemes" [Very small rural LA maintained school, North-West England]

"This approach means that, as teachers, we can use different maths platforms, as some have some fab resources. So we're not restricted!" [Large urban academy, Yorkshire and the Humber]

"It gives more experienced teachers the scope to use their creativity and skills." [Very small rural LA maintained school, East of England]

Rejecting prescription

"We don't want the curriculum to be too dry and prescriptive so bring it to life with a variety of resources." [Small urban Free School, North-West England]

"We believe that we know our children's needs best, rather than a dry scheme. We want to be teaching, rather than reading from a script." [Medium-sized urban LA maintained school, South-East England]

Figure 11: Rationale for rejecting a scheme as a central spine

To decide to curate curriculum resources from a variety of places rather than to be led (to any extent) by a scheme was clearly an important component of a schools' – and hence their leadership team's – thinking about the teaching and learning of primary mathematics. This came across strongly in the free-text comments in the Main Survey, such as in the example below which suggests a belief that some schemes may be flawed as the structure does not match with the school's approach to teaching:

> *"As a school we believe that it is extremely important to develop and build on the expertise of our teachers in school. We use a range of resources but pick and choose what we want to use. We have not and will not buy into a scheme completely. We believe it is important for teachers to be aware of assessment criteria and plan carefully how to meet those. When looking at published schemes, I have been shocked at how much planning is simply 'handed over' to the scheme. For example, when schools first began to take on [online scheme] I was shocked how teachers didn't understand that this would affect their whole assessment system.* ***Also, we believe at our school in teaching a spiral curriculum where all areas are visited each term. We never felt comfortable teaching long blocks of learning.*** *We believe the good attainment of our children has supported this decision."*
>
> *[Large urban LA maintained school, South-East England]*

5.3 The number of curriculum resources used in primary schools in England

107

The number of mathematics curriculum resources primary schools could have access to.

It is the sheer array of mathematics curriculum resources, from schemes to teacher populated banks of curriculum resources for teachers to 'dip into', which makes England stand out from many other jurisdictions. From our Main Survey, we found that primary schools in England have access to 107 different mathematics curriculum resources (some of which may incur a cost). We are aware that since the Main Survey was conducted, at least two new providers have come to the market. There are also likely to be lesser used curriculum resources not picked up by our Main Survey instrument. Of course, not all schools are aware of or have access to all 107, but this illustrates the range and diversity of curriculum resources available and may begin to account for some of the issues faced by schools in selecting, adapting, supplementing, or curating their curriculum resources. This has implications for policy directives attempting to push the use of one scheme / textbook, as this sits very much at odds with current practices.

The 107 mathematics curriculum resources overlap in terms of features. These features were coded across all resources (see Annex 2: Curriculum Resources Currently Used) allowing us to describe – and where applicable identify common features of – particular curriculum resources. The ten mathematics curriculum resources most cited by schools, and each found in or used in over 30% of schools, demonstrate the range of curriculum resources being used in primary school mathematics (Table 7). It is important to note that by citing a resource, a school is simply telling us that that resource features somewhere in their mathematics curriculum resourcing. These data do not tell us the extent to which any mathematics curriculum resource is used by a school, and we make no judgement about the quality of any resource. While some resource providers and publishers make a range of claims as to the research basis of their curriculum resources, and the DfE-approved textbooks-schemes undergo a selection process, there exists no formal definition or measure of quality in relation to the different curriculum resources used by schools and teachers and individuals will make different judgements, with different rationale, as to the quality of any resource.

It is worth noting that 80 of the curriculum resources used in primary school mathematics are each found in fewer than 10% of schools, with 52 of these curriculum resources (mainly being online resources targeting a range of content areas) each being found in fewer than 1% of schools. This suggests huge diversity in the curriculum resources different schools (and hence pupils) have access to.

#	Resource		Online, Print or Hybrid[6]	Textbook based	Type	Content	Has printed workbooks	Free / Pay to access	No. of schools with resource	% of schools with resource
1	*White Rose*	White Rose Maths	Hybrid (mainly online)	Non-textbook	Curriculum mapped scheme	Full curriculum coverage	Includes workbooks	Free with pay to access options	**593**	**89**
2	*NCETM resources for teaching mathematics*	NCETM National Centre for Excellence in the Teaching of Mathematics	Online	Non-textbook	Curriculum mapped scheme	Full curriculum coverage	Without workbooks	Free	**526**	**79**
3	*Nrich*	nrich enriching mathematics	Online	Non-textbook	Resource bank	Problem-solving and reasoning focus	Without workbooks	Free	**477**	**72**
4	*Times Tables Rock Stars*	TIMES TABLES ROCK STARS	Online	Non-textbook	Online resource (App/game/CAI /video/etc.)	Multiplication and division recall focus	Without workbooks	Pay to access	**443**	**67**
5	*Twinkl*	twinkl	Online	Non-textbook	Resource bank	Full curriculum coverage	Without workbooks	Pay to access	**404**	**61**
6	*Classroom Secrets*	Classroom secrets	Online	Non-textbook	Resource bank	Full curriculum coverage	Without workbooks	Pay to access	**278**	**42**
7	*BBC Bitesize*	BBC Bitesize	Online	Non-textbook	Resource bank	Full curriculum coverage	Without workbooks	Free	**247**	**37**

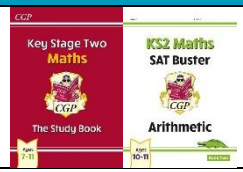
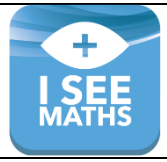
#	Resource		Online, Print or Hybrid[6]	Textbook based	Type	Content	Has printed workbooks	Free / Pay to access	No. of schools with resource	% of schools with resource
8	*CGP Maths (Schofield & Sims)*		Paper-based	Textbook-based[7]	Resource bank	Mental maths and intervention focus	Includes workbooks	Pay to access	**233**	**35**
9	*NumBots*		Online	Non-textbook	Online resource (App/game/CAI /video/etc.)	Recall and fluency in mental addition and subtraction	Without workbooks	Pay to access	**222**	**33**
10	*I See Maths - Gareth Metcalfe*		Online	Non-textbook	Resource bank	Problem-solving and reasoning focus	Without workbooks	Pay to access	**216**	**33**

Table 7: Ten most commonly found curriculum resources in primary mathematics

[6] There are complexities in classifying curriculum resources as online, print-based, or hybrid. Some resources have developed hybrid models (for example in response to the pandemic), while all resources may be used in unintended ways (online resources printed into booklets or paper-based resources scanned for online use).

[7] While not a textbook scheme in the traditional sense, this has been classified as textbook-based as the resources include printed textbooks (e.g., The KS2 Maths Study Book - Ages 7-11) with information input and questions intended for pupils to complete in an exercise book or on paper (i.e., not in the printed book). This illustrates the complexity of classifying the wide-variety of curriculum resources used in primary mathematics.

Although schools (and teachers) have access to such a vast range of curriculum resources overall, we found that schools make use of between one and 26 different curriculum resources somewhere in their mathematics planning, teaching, learning and assessment activities (Figure 12). Most commonly, as seen in over half of schools, schools have access to between five and ten curriculum resources, with the modal number of curriculum resources schools have access to being ten.

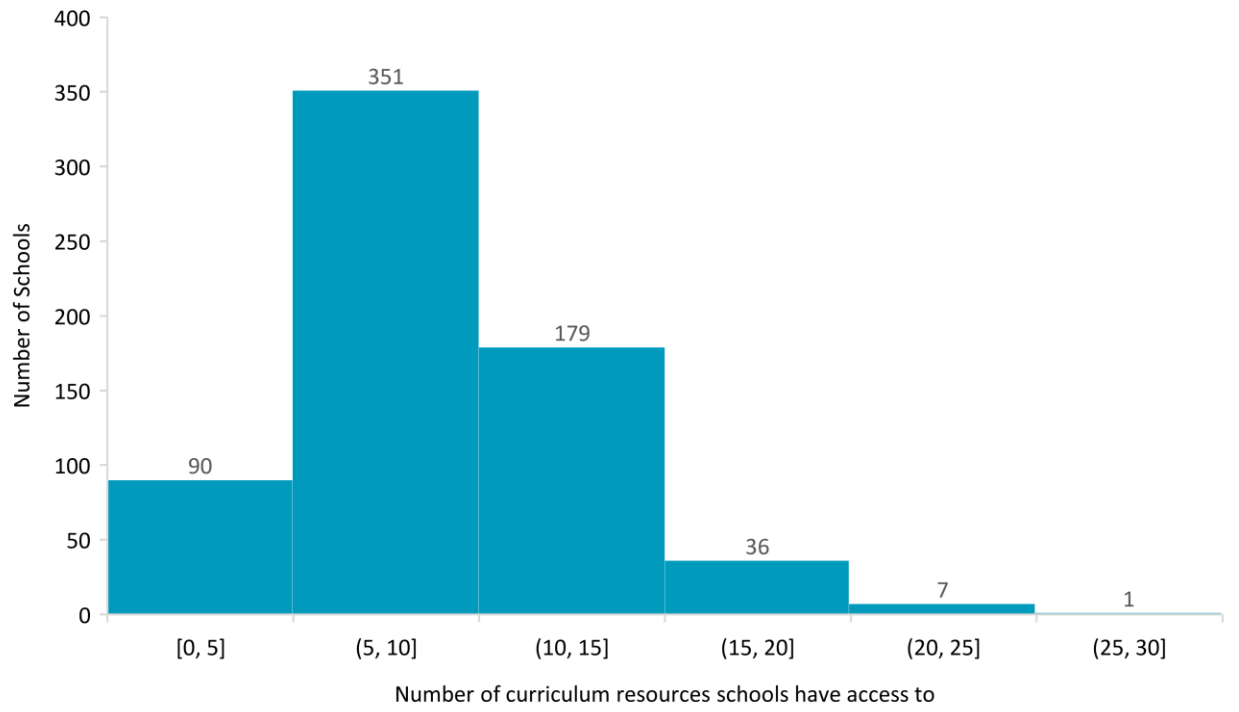


Figure 12: Number of mathematics curriculum resources schools have access to[8]

The two DfE-approved textbook-schemes are found in 22% and 10% of schools, being the 13th and 28th most frequently cited curriculum resources. Schools which have access to one, or both, of these DfE-approved textbook-schemes make use of the same range of curriculum resources as all other schools, making use of between one and 26 different curriculum resources somewhere in their mathematics planning, teaching, learning and assessment activities, with the modal number of curriculum resources these schools have access to being nine.

5.3.1 Where different curriculum resources are used

It is important to note that while schools access a vast range of mathematics curriculum resources, these are not all used to support all areas of teaching and learning activity in primary mathematics. Indeed, some curriculum resources are specifically designed for particular activities such as retrieval practice activities via an app set for homework.

[8] Note that on the horizontal axis (x-axis) of a histogram, a square bracket indicates an inclusive bound and a rounded bracket indicates an exclusive bound.

18% of schools have specific curriculum resources they use for planning only. Of these schools, 83% have one specific resource which they use only for planning and not for teaching/delivery. Across all schools, 26 different resources are used for the purpose of planning only. However, two curriculum resources, both providing free access to a curriculum map and teacher subject and pedagogic content knowledge support, dominate those used for the purpose of planning only. Where schools do have a specific curriculum resource used for planning only, they then resource this planning through curating other mathematics curriculum resources for the purpose of teaching, learning and assessment.

Generally, where schools have chosen to use a particular curriculum resource for planning only, this acted as a framework, allowing the individual teachers then to make decisions about how they taught. In many cases, curriculum resources used just for planning were used to support pedagogic content knowledge, helping teachers to identify small progression steps (see, for example, Shaw, Rushton and Majewska, 2022), potential misconceptions, appropriate representations, and effective questioning:

> *"The [planning] resources help teaching staff with their pedagogical approach to teaching maths whilst also providing further subject knowledge guidance for smaller stepped progression points."*
>
> *[Large urban LA maintained school, London]*

> *"[They] support staff in planning effective lessons, identifying misconceptions, knowing what questions to ask, delivering small steps."*
>
> *[Small urban academy, West-Midlands]*

> *"The representations [in the selected planning resource] are useful to support conceptual understanding. Teachers learn from using this resource. e.g., depth of learning is provided by examples of varied practice including procedural variation and the use of dòng nǎo jīn[9]."*
>
> *[Large urban LA maintained school, Yorkshire and the Humber]*

A more common occurrence of specific curriculum resources being used for a particular aspect of primary mathematics is in the setting of homework activities. Just over a third of schools (36%) have a curriculum resource or resources which they use just for homework. Two-thirds of these schools (67%) rely solely on one curriculum resource for setting homework across the school, while another quarter (25%) have two specific curriculum resources for this purpose.

A range of curriculum resources are used only for setting work to be completed at home, with 39 different resources used for this purpose. The five most common curriculum resources used for home working are all online (or hybrid but online for the purpose of homework) non-textbook-based resources. Three of these five are Apps taking the form of games or Computer Aided Instruction (CAI) / individualised learning. They are either free to access or attract a school subscription charge. While the majority of curriculum

[9] *dòng nǎo jīn has the Chinese characters 动脑筋. It translates as "to use one's brain" and has been imported into mastery practices in mathematics. It usually involves starting the lesson with a problem to be solved which the pupils do not yet have the mathematical knowledge and/or skills to solve. They must work out what they need to know and are then taught those components so they can solve the problem.*

resources purport to cover the full primary mathematics curriculum, it is of note that two of the most common top-five resources used for the purpose of homework focus solely on developing fluency in specific areas, namely multiplication facts and addition and subtraction facts respectively.

A core reason for a school to select a particular curriculum resource for use for homework related to the ease of use of the curriculum resources, both in terms of online access and in understanding what was required. Importantly, this understanding was often related to the parent/carer who may be supporting the pupil(s) at home, rather than to the pupil themselves. Of note, there is an interesting dichotomy in terms of how schools approach the expectation for work to be completed online at home. While some schools mentioned setting online material to be completed at home as they did not have the hardware (such as enough individual tablets) for such work to be completed in class, others noted that online access may be difficult for their pupils and so they purposely set paper-based activities. In relation to this, some of the App providers appear to have – perhaps as a result of media coverage during the Covid-19 pandemic – identified online access as a potential barrier and provide paper-based alternatives to predominantly online content, allowing teachers to provide pupils with photocopied workbook versions of Apps.

Some schools selected home learning platforms based on the ability to provide (either through a conscious decision or through the CAI provided by the programme) individualised instruction; this is particularly so where the desire was to build pupils' fluency in areas such as learning multiplication tables. Many of these programmes also provide an output to the teacher, effectively creating a class record of engagement and attainment with the App: "Tables and charts [produced in this App] enable teachers to keep track of progress and usage at a class and individual level". This is seen by schools as supportive of progression as well as reducing teacher workload through eliminating the need to take in, mark, and return multiple worksheets.

A feature of note of many of the curriculum resources selected for use at home is that they align closely with the schools' curriculum maps, allowing for consistency (for instance in approaches and terminology), directed practice where needed (for example where a pupil is identified as needing further consolidation in a particular area), and ensuring progression rather than repetition where appropriate. It is worth noting that the producers of these programmes used at school appear to be well-aware of this need for consistency and are aware of their place within the market; for example, some common mathematics curriculum resources used at home state as a key benefit on their websites that they provide "curriculum-aligned lessons that connect with school work", with content "fully aligned to the National Curriculum".

5.3.2 Stability in schools' decision making about curriculum resource choice

At the time of completing the Main Survey (November 2021 to January 2022) just 8% of schools told us that they anticipated making any changes to their resource selection in the coming academic year. Where schools did indicate that they were likely to change their curriculum resource selection in some way, the key reasons for this were to either add a new curriculum resource or to add to an existing curriculum resource, for example through purchasing different components of a scheme or online access. We did see in our Mathematics Subject Leader interviews that perceptions here may have later changed as schools looked to address identified gaps in learning arising from the pandemic. It will be important for further research to be conducted to establish average rates of curriculum resource turnaround in schools, something which will also feed into a better understanding of the underpinning continuation – or not – in the use of the DfE-approved textbook-schemes (Figure 4).

"Some of them are so far apart that trying to close the gap is almost an impossible task."

Small steps now need to be tiny steps

In one school that had previously used an online-scheme prior to the Covid-19 pandemic, the variability with which pupils had been able to engage in learning during periods of lockdown meant that the scheme no longer provided what was needed. The scheme's lessons and problems were now too hard: "we've lost all this time, we've lost all of the variation, we've lost all that teacher talk". Furthermore, young pupils' language proficiency had also declined. Whilst the school had previously used the online-scheme to support pupils' small steps in learning they now need to focus on "tiny steps"; they are continuing to use the curriculum map from the online-scheme with teachers curating curriculum resources from various places.

5.4 Curriculum resources: Their use in the classroom

In the section above we have examined how primary schools make decisions about what mathematics to teach and when (section 5.1) and the range of curriculum resources they have available to select from and decisions made here (section 5.2). We now turn to what schools do with these curriculum resources, once they have decided which ones they are going to use. Do they use them as envisaged by the publishers/producers? Does usage look like the model seen in high performing jurisdictions? To what extent do schools supplement or adapt curriculum resources, and what are their reasons for doing this?

5.4.1 How schools use resources

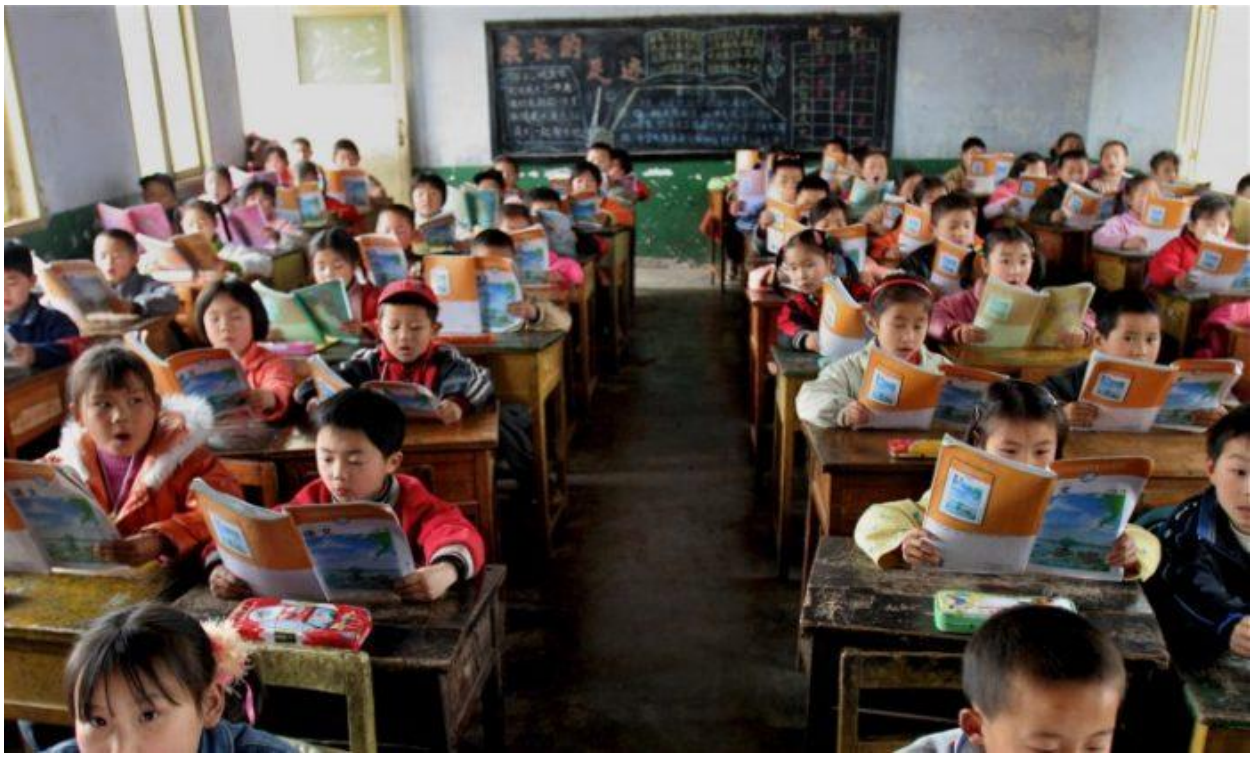


Figure 13: Common media portrayal of primary mathematics teaching in China (extracted from Clegg, 2017)

The DfE funding initiatives sit within the wider mastery reform in mathematics education introduced in 2014. This reform sought to introduce a new pedagogic approach to teaching mathematics in England embedded in identifying the features of mathematics teaching in high performing jurisdictions. While media images have focussed on strong aspects of contrast – showing rows of pupils working independently in large classes in China, for example (Blausten, et al., 2020) – mastery requires substantial departures from previous practices, particularly those embedded during the earlier National Numeracy Strategy which "explicitly eschewed the use of textbooks in classroom" (Blausten, et al., 2020, p.37) (Figure 13). If the 'ideal' image is for each pupil to be working with/from a textbook (and associated pupil workbooks found in both DfE-approved textbook-schemes) how does reality on the ground compare?

5.4.1.1 Approaches during teaching inputs

We asked schools how they share material from their selected curriculum resource(s) with pupils during teaching inputs in mathematics. Across the population, almost all schools (98%) use some form of interactive screen/projection to share material with the class during whole class inputs. Conversely, less than 20% of schools use individual pupil laptops or tablets to share material. This fits closely with findings from the latest iteration of TIMSS (Mullis et al., 2020) which found that although 32% of pupils in England at 4th Grade (9-10 years old) have access to computer equipment, this is usually shared across classes or the school (such as a shared-use iPad trolley) and would not be available for all mathematics lessons. TIMSS also found that over three-quarters of primary teachers in England reported mathematics teaching was "somewhat affected" by resource shortages; this appears to be reflected in our Main Survey findings; only a fifth of schools were able to give pupils direct access to textbooks – individually or shared – but 70% provided information via photocopied sheets, sometimes photocopies of pages from textbooks (Figure 14). This may, at surface level, seem like false economy as photocopying charges mount up, but the original outlay for textbooks is likely to be thought of as prohibitive to many schools.

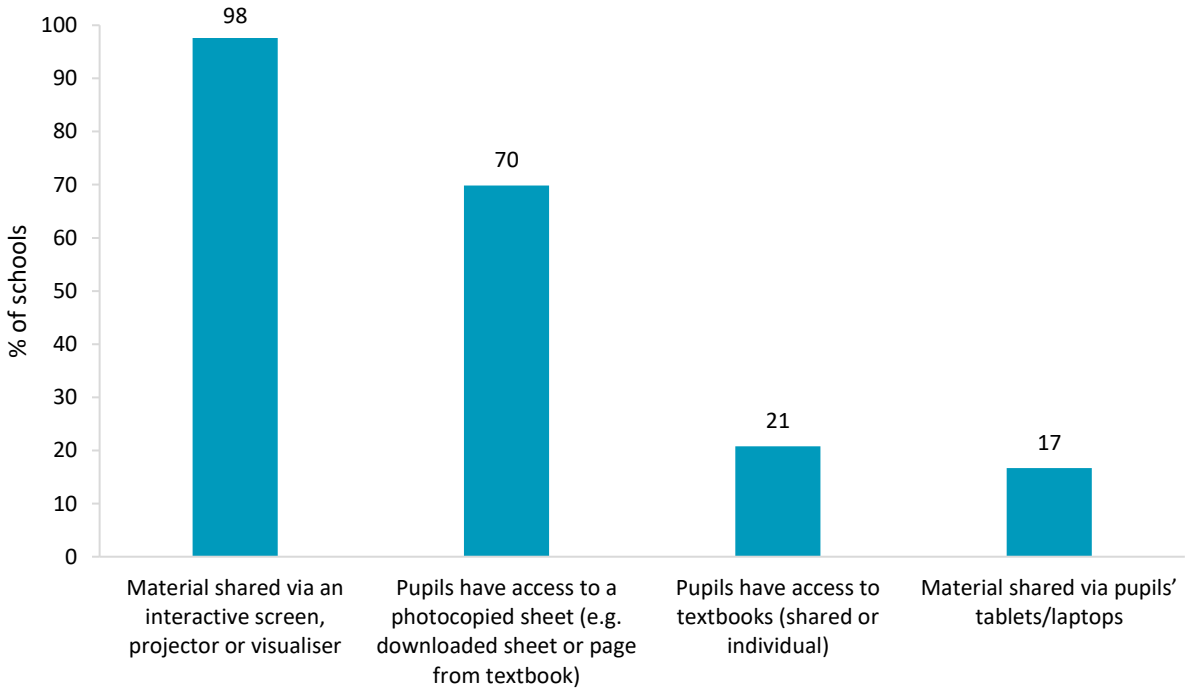


Figure 14: Approaches used by schools to share material during teaching inputs

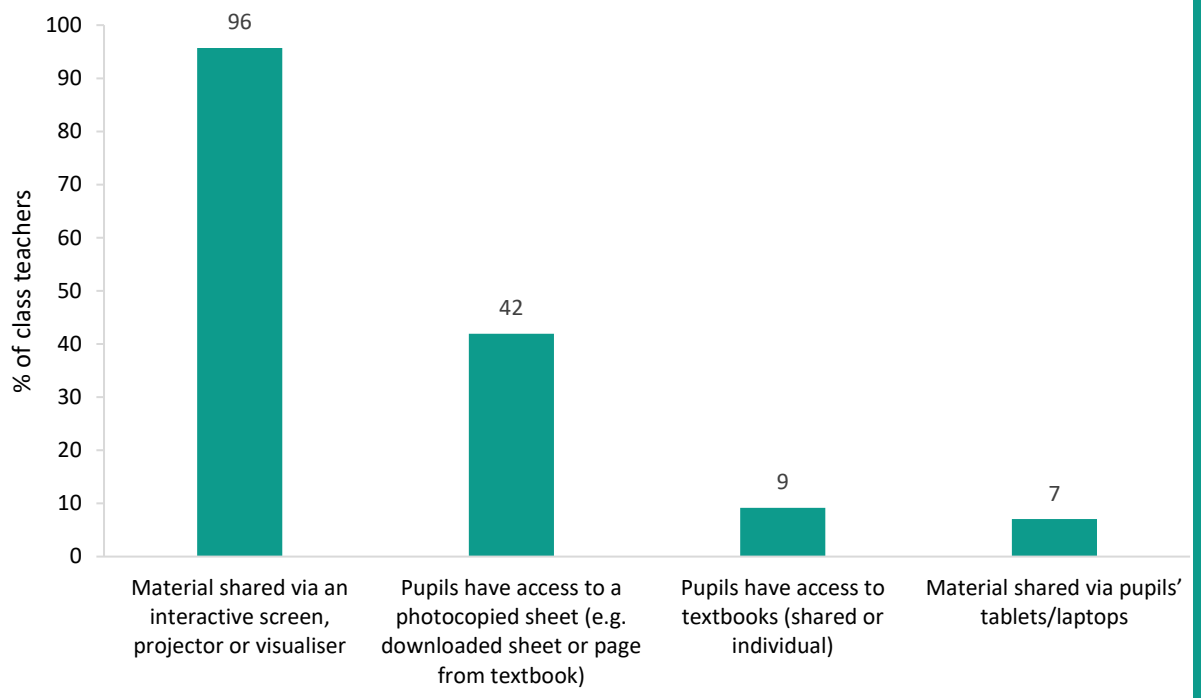


Figure 15: Approaches used by class teachers to share material during teaching inputs

Within our Subsidiary Survey, we asked class teachers the same question regarding the different ways in which they shared material from their selected curriculum resource(s) with the class but asked them to focus on their last mathematics lesson (Figure 15). As with the Main Survey, class teachers could select multiple options in cases where they had used two or more tools.

The graphs above show that the picture emerging from class teachers is almost identical to that reported across schools. The most common approach is to share material via some type of screen, while it is very uncommon for pupils to follow material in a textbook while the class teacher is teaching. Fewer class teachers told us that they had used photocopied sheets to give pupils access to teaching content; without being able to see into these classes it is not possible to say why, although is likely to represent the 'snapshot' nature of the Subsidiary Survey data.

9%

The percentage of class teachers who told us their pupils had access to physical textbooks during teaching inputs.

While the above represents the picture across all schools, we were interested to see whether decisions related to curriculum map resourcing and choice of curriculum resources were associated with how materials were shared with pupils. We found that schools who curate curriculum resources from various places – without a central spine – were slightly more likely to use photocopied sheets, while schools with a scheme as a central spine were slightly more likely to provide pupils with access to textbooks to access lesson material (Table 8).

Approach to resourcing the curriculum map	Material shared via an interactive screen	Material shared via pupils' tablets/laptops	Pupils have access to textbooks	Pupils have access to a photocopied sheet
We use curriculum resources from various places	99	19	16	77
We use resources exclusively or mainly from one scheme	97	15	25	64

Table 8: Material sharing methods (%) used by schools taking each resourcing approach (multiple choice)

Being aware from TIMSS data (Mullis et al., 2020) that limited resources have some impact on pedagogic approaches, we wanted to understand further what was happening in schools who had selected a scheme as a central spine (whether supplemented or not) and whether this being textbook-based or not was associated with what happened in the classroom. Here we did find significant differences in approaches. As would be expected given the access to textbooks that a textbook-based scheme brings, where a school's central spine is textbook-based, they are less likely to photocopy sheets and more likely to share materials with pupils by providing pupils with copies of a textbook than in schools where the central spine is non-textbook based [$\chi^2(1) = 75.895$, $p < 0.001$] (Figure 16).

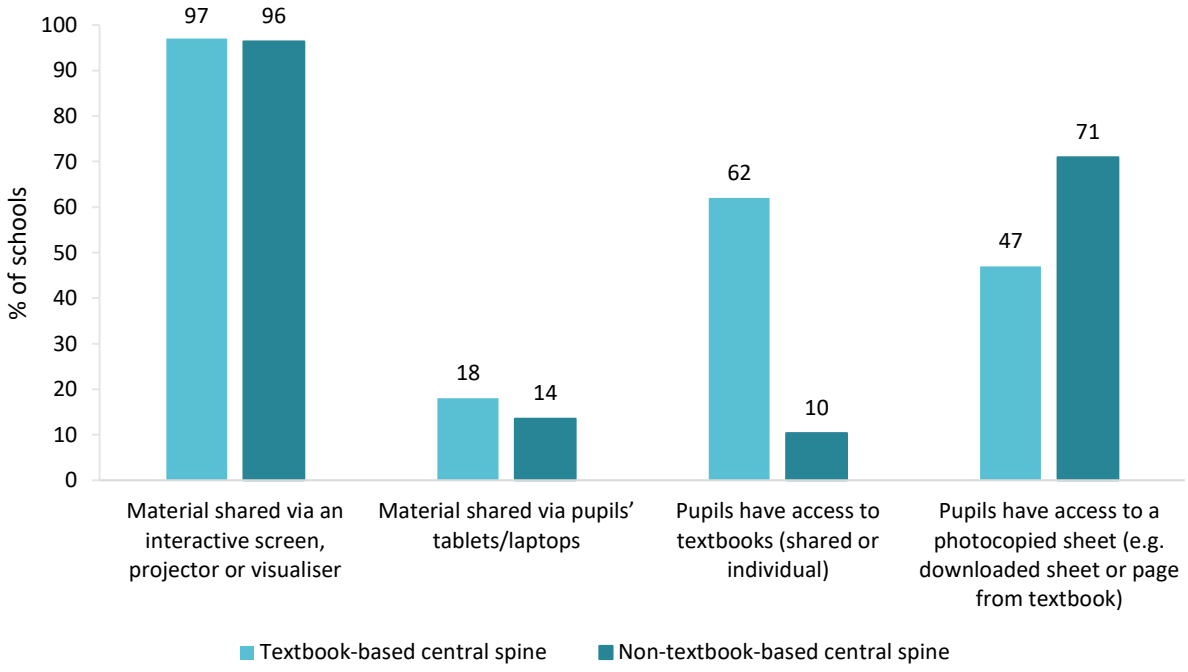


Figure 16: Approaches to sharing materials based on format of central spine

While the differences illustrated above are not surprising, what is perhaps surprising here is that only 62% of schools with a textbook-scheme give pupils access to the textbooks during teaching inputs. Over a third of schools with a textbook-scheme are therefore not using the textbooks within this scheme during teaching inputs. This may reflect a range of issues, not least school financing and pedagogic preferences.

Returning to the full school population, it is worth looking at the association between the DfE funding initiatives and the extent to which models of material sharing in class reflect the government's desired model. Re-running the analysis above, but this time contrasting those schools in the sample who have made use of (at some point) the DfE funding initiatives with those schools in the sample who have never made use of this funding (either through ineligibility or an active decision not to participate) shows little difference in the use of technology or photocopied sheets, but a highly significant difference in pupil access to textbooks (Table 8). Schools using either of the DfE funding initiatives are significantly more likely to provide pupils with textbooks during the teaching input [$\chi^2(1) = 22.168$, $p < 0.001$]. However, as Table 9 shows in contrast with Figure 16, schools who have made use of DfE funding *at some point* are still less likely that schools with a current textbook-based central spine, to give pupils access to textbooks (42% as opposed to 62%). It is likely that this reflects shifts in approaches as those schools which have had DfE funding in the past may no longer be using the DfE-approved textbook-scheme (as seen in Figure 4, p.32). This may suggest that pedagogic changes brought about by using a DfE-approved textbook-scheme may not be maintained if the scheme is discontinued by the school.

While we would expect schools who have received funding to purchase a textbook-scheme to be using textbooks more often in lessons, there are two points of note:

1. As above, these percentages are not high; fewer than half of schools who have or have had funds to purchase a DfE-approved textbook-scheme give pupils access to textbooks in lessons.
2. Despite the lower-than-expected percentage discussed above, the difference in percentage access to textbooks does suggest that this funding approach works to push a pedagogic agenda.

Funding status	Material shared via an interactive screen	Material shared via pupils' tablets/laptops	Pupils have access to textbooks	Pupils have access to a photocopied sheet
Schools who have not made use of either DfE funding initiative	99	15	6	68
Schools who have made use of either DfE funding initiative	99	13	42	70

Table 9: Material sharing methods (%) used by schools with or without DfE funding (multiple choice)

5.4.1.2 Approaches during pupil independent tasks

While section 5.4.1.1 explored how materials were shared during teaching inputs, we were also interested in how pupils recorded their mathematics and how curriculum resourcing decisions are associated with this. Pupil recording in mathematics can take different forms to other subject areas and has undergone different fashions and trends over many decades. It may include, but not be limited to:

- Working in exercise books or journals
- Working on photocopied sheets / part-sheets (which may be stuck in exercise books/journals)
- Working in published pupil workbooks
- Working on paper (plain, squared or lined)
- Working on mini whiteboards (which may be photographed as evidence)
- Working on tablets/laptops/PCs

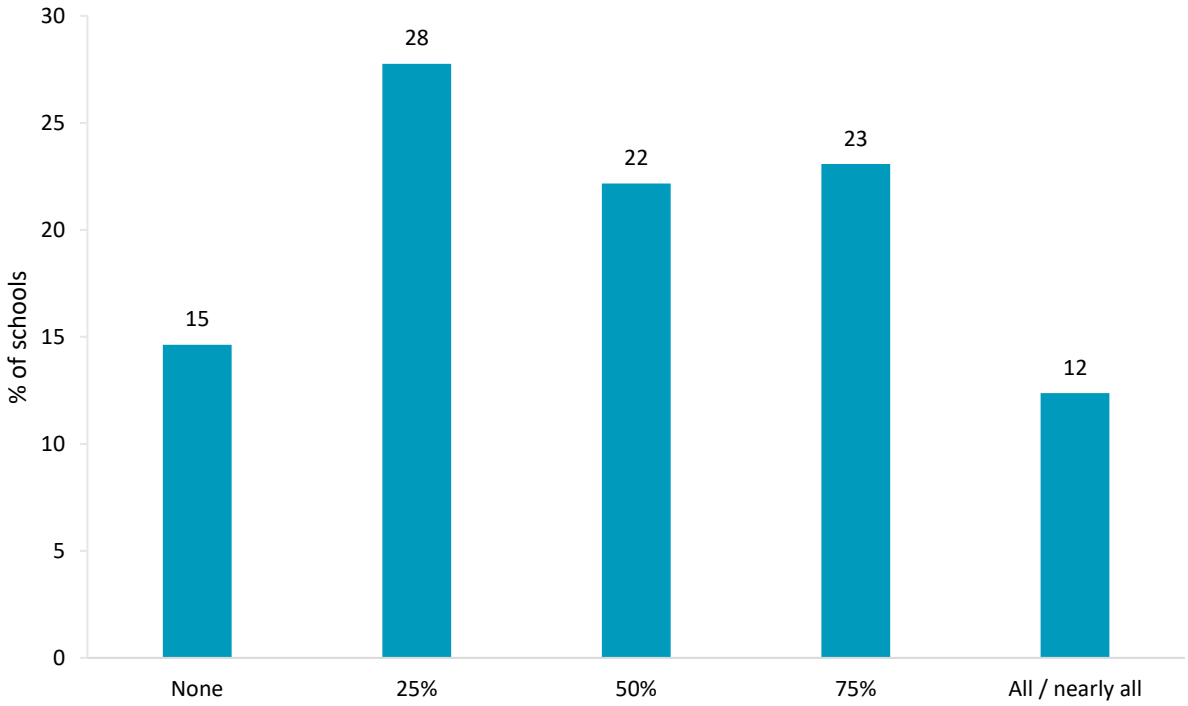


Figure 17: Percentage of pupils' recording in/on purchased or downloaded workbooks or worksheets

We looked at where schools were using downloaded (and photocopied) worksheets and write-in pupil workbooks. Firstly, we established the extent to which these were used across the school population by asking schools what percentage of pupil recording generally consisted of either/both of these approaches. Our results showed that most schools made some use of downloadable sheets or pupil booklets, but the extent to which these were used varied across schools (Figure 17).

To understand the picture from a different angle, we asked class teachers in the Subsidiary Survey about the different ways in which pupils in their classes had recorded written work (where work was recorded) in the last week. Some class teachers would have used more than one approach and so class teachers were able to select as many as applied.

These results (Figure 18) show us that multiple approaches to pupil recording are taking place in primary mathematics classrooms. Over half (57%) of class teachers used some form of purchased or downloaded workbook or worksheet which fits with the Main Survey school level data that also identified strong use of such approaches.

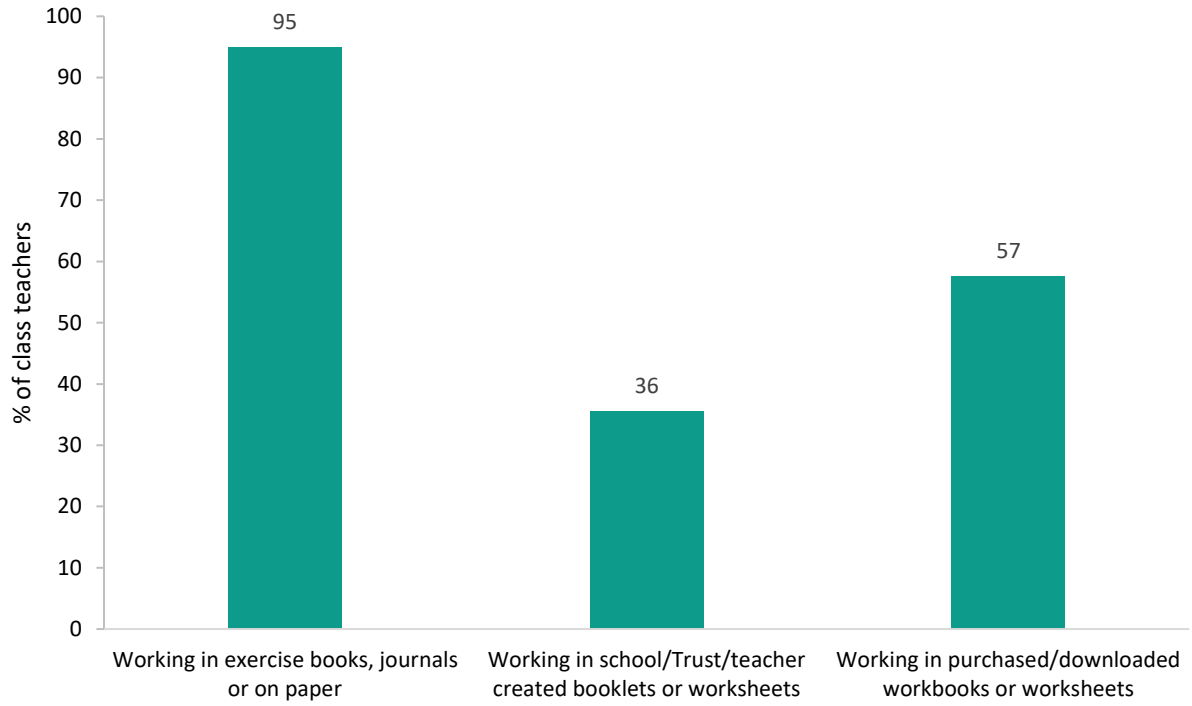


Figure 18: Percentage of class teachers using each pupil recording approach in the last week

The class teacher data also add an interesting element to the picture as they show that over a third of class teachers (36%) used some form of self-created workbook or worksheet during the Subsidiary Survey week. Unpacking these data further shows that 5% of class teachers were using workbooks or worksheets created at a school or Trust level, while 31% of class teachers were using workbooks or worksheets they had created themselves. This suggests that a substantial amount of time is being used by class teachers each week not only curating, but creating, curriculum resource content.

As above, we were then interested to understand further what was happening in schools who had selected a scheme as a central spine (whether supplemented or not) and whether this being a textbook-scheme or not was associated with what happened in the classroom in terms of pupil recording. Schools who do not have a central spine – who use a variety of curriculum resources to resource their curriculum map – report a smaller percentage of pupil recording taking place on/in downloaded worksheets or purchased workbooks, while schools with a central spine (whether supplemented or not) report a higher percentage of pupil recording taking place on/in downloaded worksheets or purchased workbooks (Table 10).

Approach to resourcing the curriculum map	None	25%	50%	75%	All / nearly all
We use curriculum resources from various places	21	33	25	16	5
We use resources exclusively or mainly from one scheme	10	23	20	29	19

Table 10: Pupils' recording in purchased/downloaded workbooks/worksheets by resourcing approach (%)

Following this, we then wanted to understand, as above for the teaching input, what was happening in schools who had selected a scheme as a central spine (whether supplemented or not) and whether this being a textbook-scheme or not was associated with what happened in the classroom in relation to pupil recording.

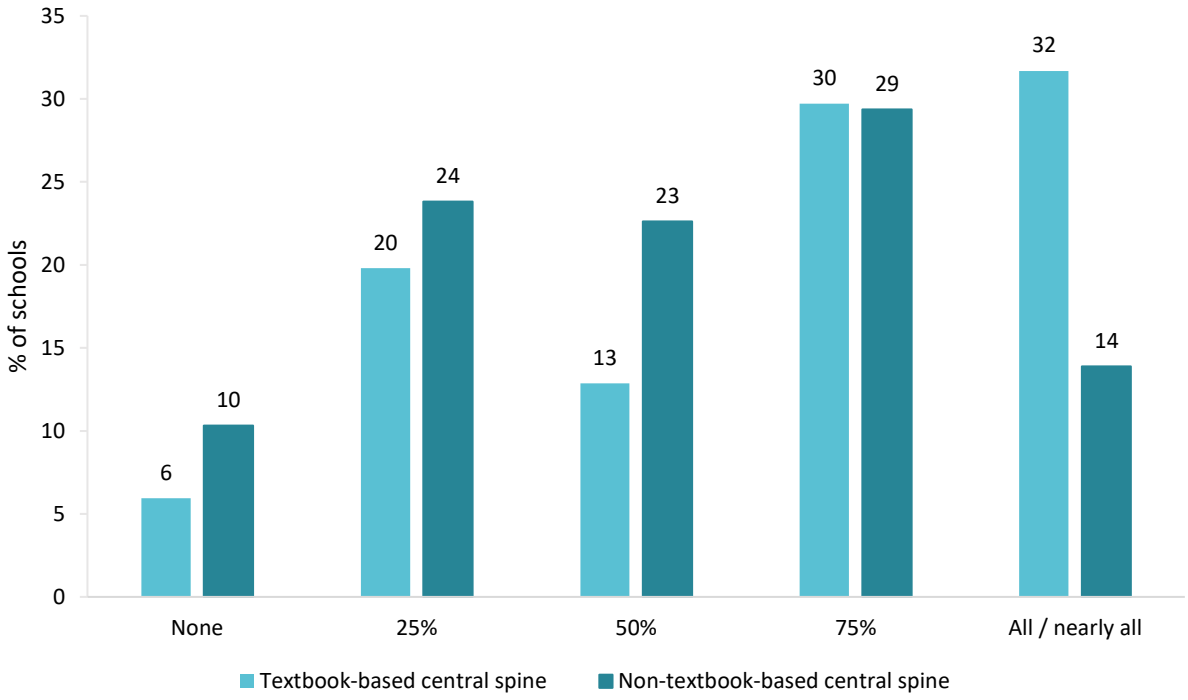


Figure 19: Percentage of pupil recording on worksheets/workbooks based on central spine type

There were generally no differences found in the percentage of pupil work undertaken in/on worksheets/books between schools having a textbook-scheme or non-textbook based scheme as a central spine except when looking at the percentage of schools where all, or nearly all, recording is completed on purchased or downloaded workbooks or worksheets. Here, schools who have a textbook-scheme are far more likely to have pupils record in this way than schools with a non-textbook-scheme [$\chi^2(1) = 11.961$, $p = 0.001$] (Figure 19). This is likely to be reflective of the fact that all eight textbook- schemes used by schools also have available write-in pupil workbooks as part of the purchasable package. Conversely, of the 11 non-textbook-schemes used by schools, only one comes with pupil workbooks and these are sold within a hybrid scheme as an add-on, rather than being part of the scheme package.

5.4.2 Adaptive teaching[10]

An important shift in pedagogy inherent in the mastery approach is the move from the belief that pupils have inherent levels of mathematical ability to a belief that, with appropriate teaching, all pupils can achieve mathematically. This requires a shift from approaches which match the content to the pupils'

[10] While we use the term 'adaptive teaching' to title this section, we also use the term 'differentiation' within our writing as differentiation was the term used when the Main Survey was administered and is familiar to teachers.

'ability' (such as differentiation through tasks and ability grouping) to a uniform approach with high standards for all and an expectation that, on the whole, pupils will progress trough the curriculum at the same pace. We therefore wanted to explore whether this shift was being seen in schools and whether decisions around the types of curriculum resources used had an impact on pedagogic decisions around differentiation and adaptive teaching. We would expect that schools using a mastery-underpinned scheme – and certainly one of the DfE-approved textbooks, would be more likely to engage in practices where classes were kept together as this is the expectation of the pedagogic approach these textbooks draw on.

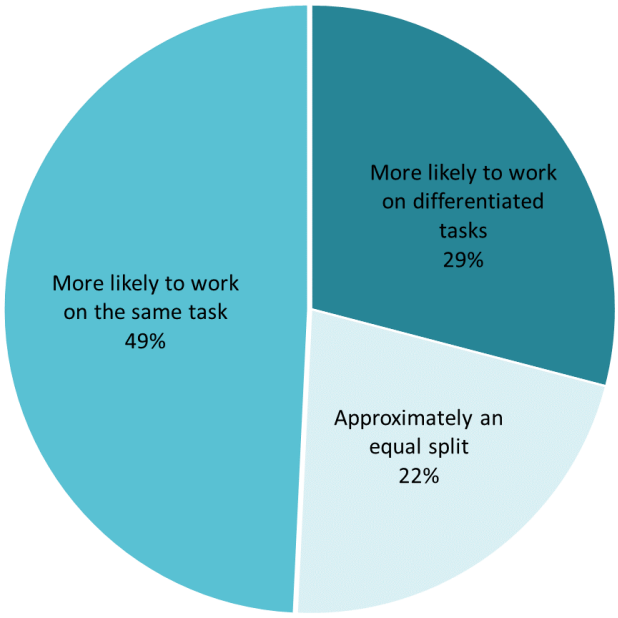


Figure 20: Extent of task-differentiation across schools

We found that in half of schools, pupils were more likely to be working on the same tasks in lessons (that is, something resembling a pedagogy associated with a mastery approach). In the other schools, there was a split between schools where pupils were more likely to work on differentiated tasks and schools where pupils experienced an equal split between working on differentiated tasks and working on the same task as their peers (Figure 20).

Differentiated / adaptive teaching – or rather its opposite, keeping the class together – is anecdotally discussed as a barrier in implementing a mastery approach in mathematics. Differentiated teaching – through attainment grouping, differently levelled tasks, or differently levelled expectations – have been common approaches in primary mathematics teaching in England for decades (Marks, 2016).

Through our Subsidiary Survey we wanted to ascertain the extent to which the general picture (Figure 20) represented what class teachers were doing on the ground. We asked class teachers to tell us how they had planned tasks for their last mathematics lesson in the Survey week (Figure 21). These data

suggest that just over a third continue to provide differently levelled tasks for pupils in their classes. It may also be read that two-thirds are following a mastery model with pupils generally working on the same task(s); however, of those who told us their pupils generally worked on the same task(s), 75% had differentiated outcomes, expecting some pupils to complete more or fewer questions.

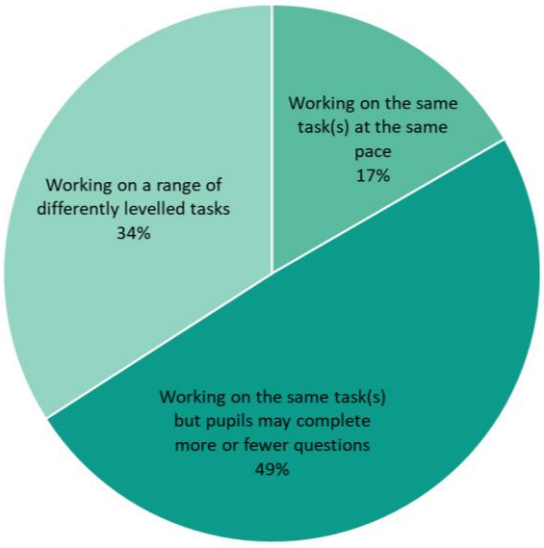


Figure 21: Approaches to adaptive teaching used by class teachers

It is difficult to comment on this in terms of a mastery model – as underpins the DfE-approved textbook-schemes – or in terms of the National Curriculum expectation that some pupils will demonstrate "Greater Depth", without knowing what questions (both quantity and type) were being directed at which pupils and for what reasons. These data suggest that a deeper exploration of adaptive teaching as understood, used, and as possible, is warranted.

Returning to the school-level, we were interested to understand further what was happening in schools who had selected a scheme as a central spine (whether supplemented or not) and whether this being textbook-based or not was associated with what happened in the classroom in terms of whether pupils generally worked on the same task or on differentiated tasks. As Table 11 shows, having a central spine or not has some association with the pedagogic approach taken in the classroom.

Approach to resourcing the curriculum map	More likely to work on differentiated tasks	Approximately an equal split	More likely to work on the same task
We use curriculum resources from various places	37	24	39
We use resources exclusively or mainly from one scheme	22	20	58

Table 11: Approaches to task differentiation by resourcing approach (%)

Schools using a central spine (supplemented or not) are statistically more likely to have pupils working on the same task than schools who do not use a central spine [$\chi^2(1) = 11.220$, $p = 0.001$]. This effect is stronger in schools where the central spine in textbook-based (Figure 22).

Schools not using a central spine are statistically more likely to have pupils working on differentiated tasks than schools with a central spine (supplemented or not) [$\chi^2(1) = 11.807$, $p = 0.001$]. Together, these results show us that the decision to have, or not to have, a central spine is associated with the degree to which schools engage in differentiated teaching practices, or whether they elect to keep the class working together on the same task (an underpinning concept in a mastery pedagogy). While the rationale for these practices is beyond the scope of our study, possible explanations may include:

- Schools with a central-spine aspiring to use this with fidelity – particularly in the case of mastery underpinned central spines – which would involve all pupils working on the same task.
- Schools who curate curriculum resources from various places making this decision with the intention of providing differentiated tasks from the outset; this may be in response to factors such as mixed-age teaching.

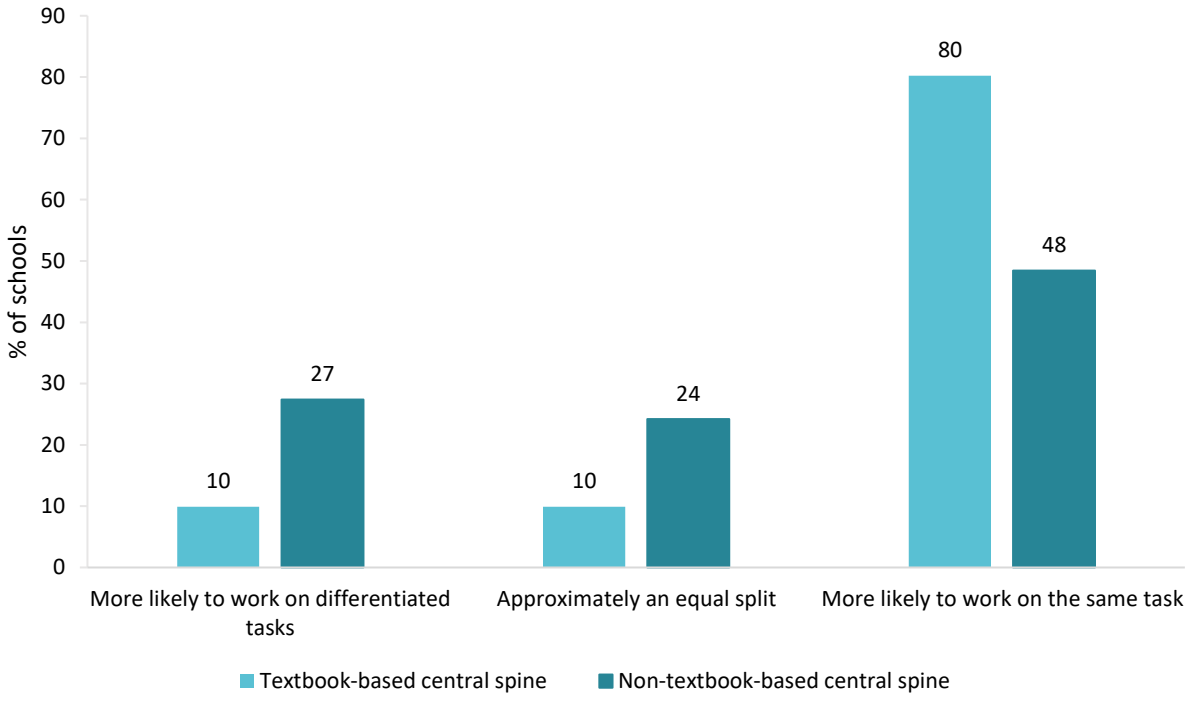


Figure 22: Approaches to differentiation based on format of central spine

5.4.2.1 The association between funding and differentiated or adaptive teaching

As noted above, the shift from differentiated tasks to keeping the class together (pupils being most likely to work on the same task) is a core component of the mastery agenda which the provision of DfE-approved textbook-scheme funding is designed to support. It is interesting, therefore, to look at the association between funding eligibility and uptake on pedagogic decisions around adaptive teaching.

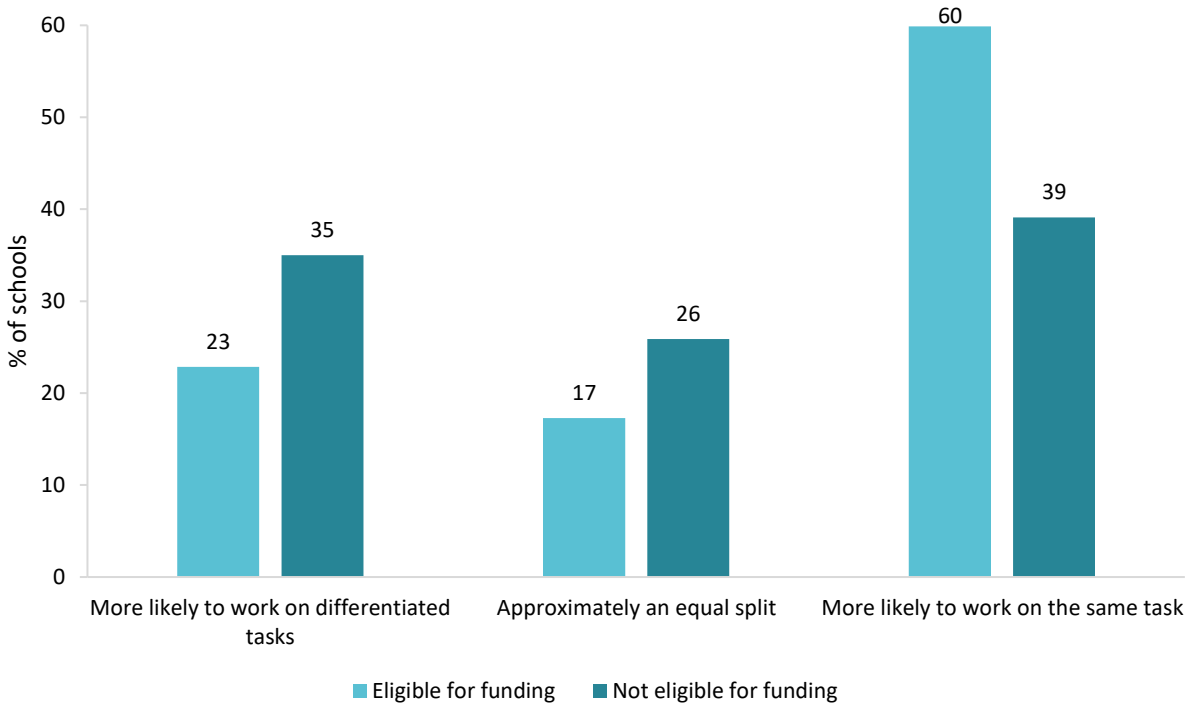


Figure 23: Approaches to differentiation based on whether a school has ever been eligible for DfE funding

Schools which have ever been eligible (whether used or not) for the DfE funding initiatives (based on the DfE data – so this includes schools who were unaware they were ever eligible) are significantly more likely to have pupils working on the same tasks than schools who have never been eligible for funding [$\chi^2(1) = 14.484$, $p < 0.001$]. Schools who have never been eligible for funding are significantly more likely to have pupils working on differentiated tasks than schools who have ever been eligible for funding [$\chi^2(1) = 8.462$, $p = 0.004$] (Figure 23).

It is important to note that these statistical differences are between schools who have been eligible for funding (that is, they met the criteria for eligibility, whether they were aware of this or not) and those who have never been eligible, rather than whether they have *used* the funding. If we look at the sub-group of 199 schools who told us they had been eligible for one or both DfE-funding initiatives and told us whether or not they had made use of this funding, we still find that schools who used the funding were more likely – by percentage points – to have all pupils working on the same task than schools who did not make use of the funding they were eligible for (Figure 24). However, and this must be reported with caution due to the smaller number of schools in this sub-group, this difference is not statistically significant [$\chi^2(1) = 1.740$, $p = 0.187$]. Looking across our evidence in this section, we might conclude that it is the impact of professional development engagement (which was a requirement of being eligible for DfE-approved textbook-funding), rather than any specific curriculum resource per se, that exerts a stronger, or at least longer-lived, influence on classroom pedagogic practices. As we saw earlier with a drop-off in particular practices where schools had moved away from DfE-approved textbook schemes, the curriculum resource in and of itself may not be the best vehicle to bring about sustained pedagogic change.

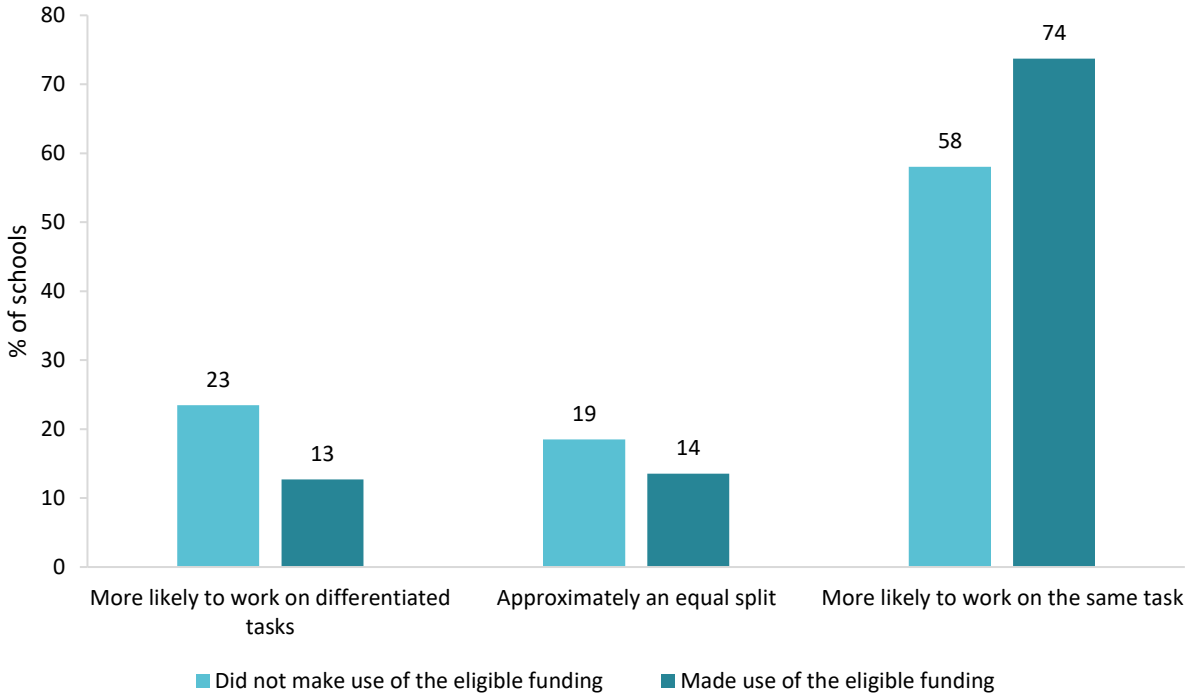


Figure 24: Approaches to differentiation based on whether a school made use of DfE textbook funding

5.4.3 Adaptation and supplementation of curriculum resources

In line with the mastery agenda, DfE-approved textbook-schemes are designed to foster deep conceptual and procedural knowledge through carefully designed, sequenced, lessons utilising ideas such as variation theory to maximise learning. Given this, pupils' activities within these schemes are designed to be used with fidelity (however presented by the teacher), that is, as prescribed by the authors and publishers. The purpose, stated by publishers, is that providing curriculum resources with such coherence already embedded frees up the teacher – usually a non-specialist – to think deeply about lesson planning, focussing on their subject and pedagogic knowledge, considering the incremental steps in the learning, possible misconceptions, appropriate representations to use and to plan careful questioning. This shift in focus does not sit easy with many teachers. A binary between fully scripted lessons and teacher autonomy arises in discussions about the use of curriculum resources such as the DfE-approved textbook-schemes. Anecdotally, and as often seen in social media discussions, Primary teachers typically view themselves as creative professionals, seeking to serve their pupils, and there is a fear that rigidly following a scheme works against this identity.

The literature tells us that, overwhelmingly, teachers make changes to curriculum resources, whether through supplementation or adaptation (Marple et al., 2017). They engage in a process Polikoff & Dean (2019, p.52) refer to as "some assembly required". In some cases, curriculum resources are taken and adapted by the teacher, for example changing or removing questions, altering the language, changing non-mathematical elements (font, images) or changing the proposed method. At other times, supplementation occurs, whereby, in a "premeditative, additive" move, teachers use additional curriculum resources to make changes to the officially adopted curriculum resources (Aguilar, Silver and

Polikoff, 2022, p.1). Often, both occur simultaneously. Here we look at when, why, and how schools adapt their selected curriculum resources.

5.4.3.1 How often do schools adapt curriculum resources?

In line with the literature, we found that just 1% of schools rarely or never make adaptations to or supplement their curriculum resources. 70% of schools told us that they make such changes on a more than occasional basis (Figure 25).

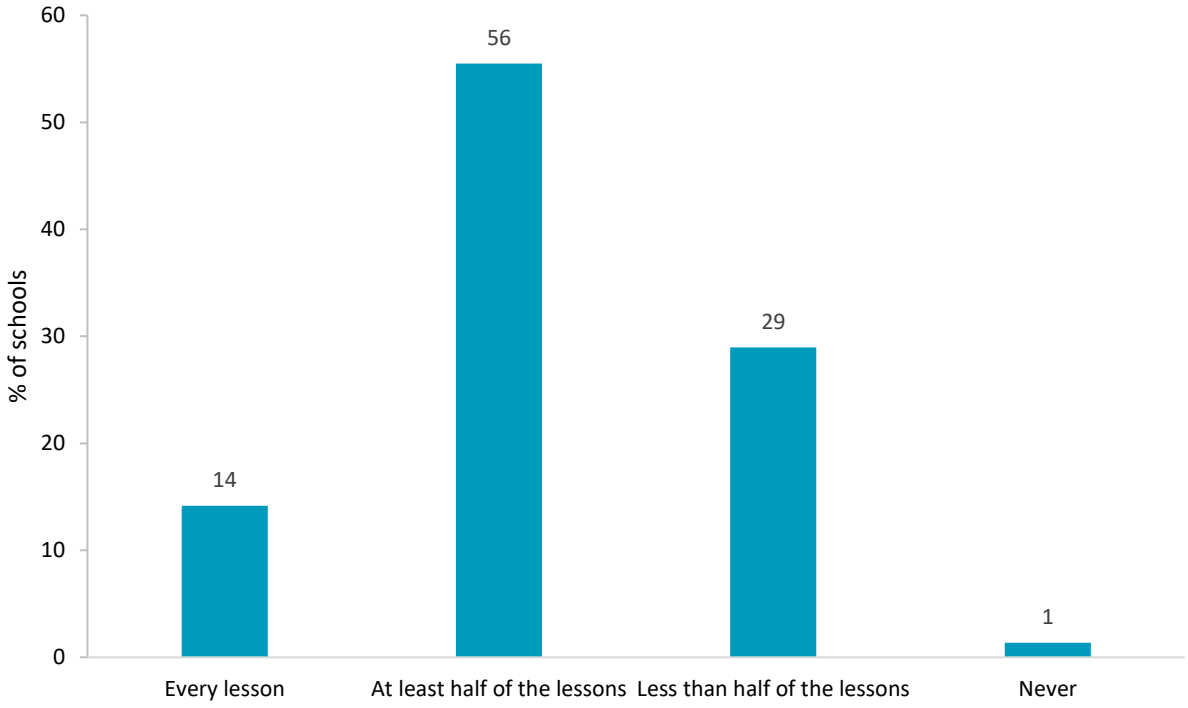


Figure 25: Frequency with which schools adapt curriculum resources

A grievance often heard from class teachers is the inordinate amount of time they spend adapting curriculum resources to suit their classes. Our Main Survey data at a school level do not dispute this. We were however interested to know the extent to which what class teachers were experiencing matched what schools felt to be the case. In our Subsidiary Survey we asked class teachers how often, in the last week, they had needed to adapt the curriculum resources they were using.

There are some differences in the picture presented by class teachers (Figure 26) and the school picture although this data, again, confirm that class teachers are adapting curriculum resources on a very regular basis. The slightly higher percentage of class teachers saying they never adapted curriculum resources in the week of the Subsidiary Survey is to be expected. Over a longer period, as represented in the school level Main Survey, we would expect to see fewer occurrences of schools not adapting at all, and, as noted earlier, in this particular week many class teachers would have been covering the

mathematical topic areas of fraction, decimals, percentages and ratio and may not have felt they had the necessary subject knowledge to adapt the curriculum resources they were using.

36% of class teachers told us that in the week of the survey, they had had to adapt curriculum resources in every lesson. 33% told us that in the week of the survey they had produced their own materials from scratch. We argue that this gives a truer picture of experiences on the ground, not just because it is reported by class teachers, but because in this case the Main Survey is reporting practices over the year; it would be expected therefore to find the "always" figure to be lower as there are likely to be at least some lessons or activities which class teachers do not adapt. Data from our Main Survey and our Subsidiary Survey align when looking at how frequently schools and class teachers reported a need to adapt curriculum resources for at least half, and in some cases every, lesson.

36%

The percentage of class teachers who told us they needed to adapt their curriculum resources for every lesson in the Subsidiary Survey week.

70% of schools reported this to be the case generally, while 65% of class teachers reported this experience in the week of the survey. This is an alarming finding as it potentially carries important implications for teacher workload. We look in Section 5.4.3.2 at the reasons why schools and class teachers adapt curriculum resources, but we flag this as a necessary consideration for all stakeholders.

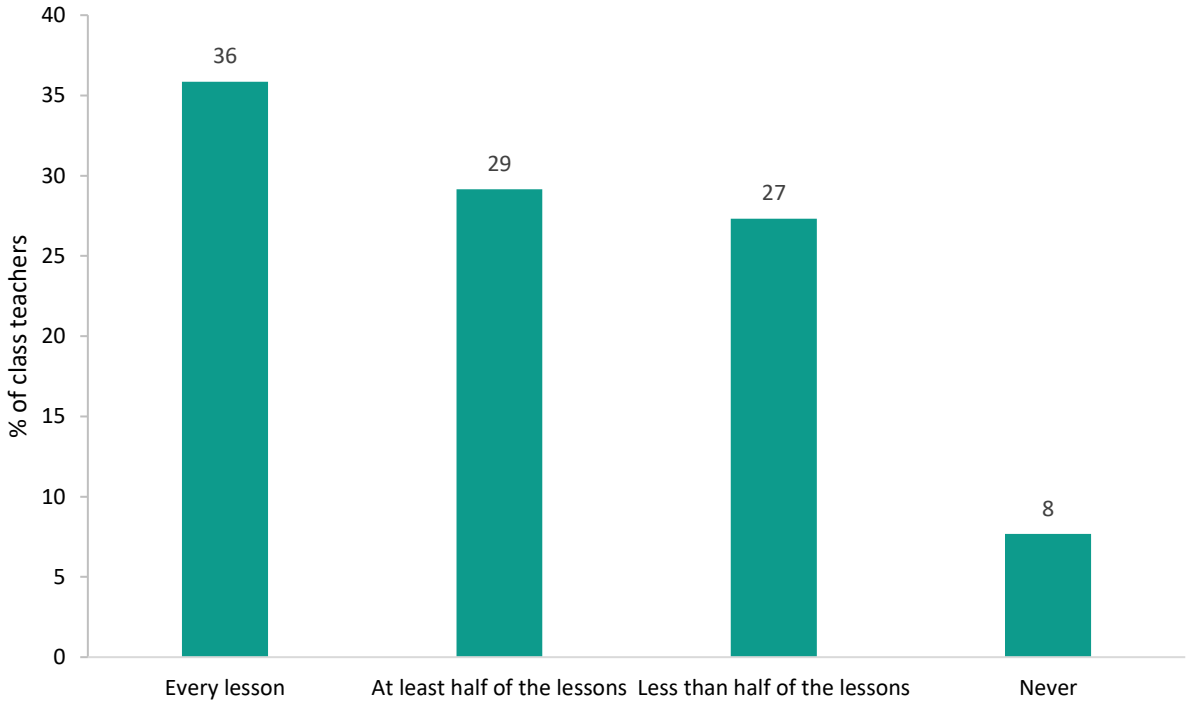


Figure 26: Frequency with which class teachers adapt curriculum resources

Again, returning to the school level, we were interested to understand what was happening in schools who had selected a scheme as a central spine (supplemented or not) and whether this being a textbook-scheme was associated with how frequently schools felt the need to adapt curriculum resources. Schools who do not have a central spine – who use a variety of curriculum resources – were significantly more likely to adapt curriculum resources than schools who did have a central spine [$\chi^2(4) = 15.923$, $p = 0.003$]. Schools with a central spine (whether supplemented or not), were significantly more likely to adapt resources in less than half of lessons [$\chi^2(4) = 13.788$, $p = 0.008$] (Table 12).

Approach to resourcing the curriculum map	Every lesson	At least half of the lessons	Less than half of the lessons	Never
We use curriculum resources from various places	15	64	20	0
We use resources exclusively or mainly from one scheme	13	48	37	2

Table 12: Frequency of adaptation of curriculum resources by resourcing approach (%)

In relation to the nature of the scheme as a central spine, schools with a textbook-scheme are less likely to adapt curriculum resources, while schools who do not have a textbook-based central scheme are more likely to find they need to adapt curriculum resources (Figure 27). These findings are statistically significant [$\chi^2(1) = 12.940$, $p < 0.001$].

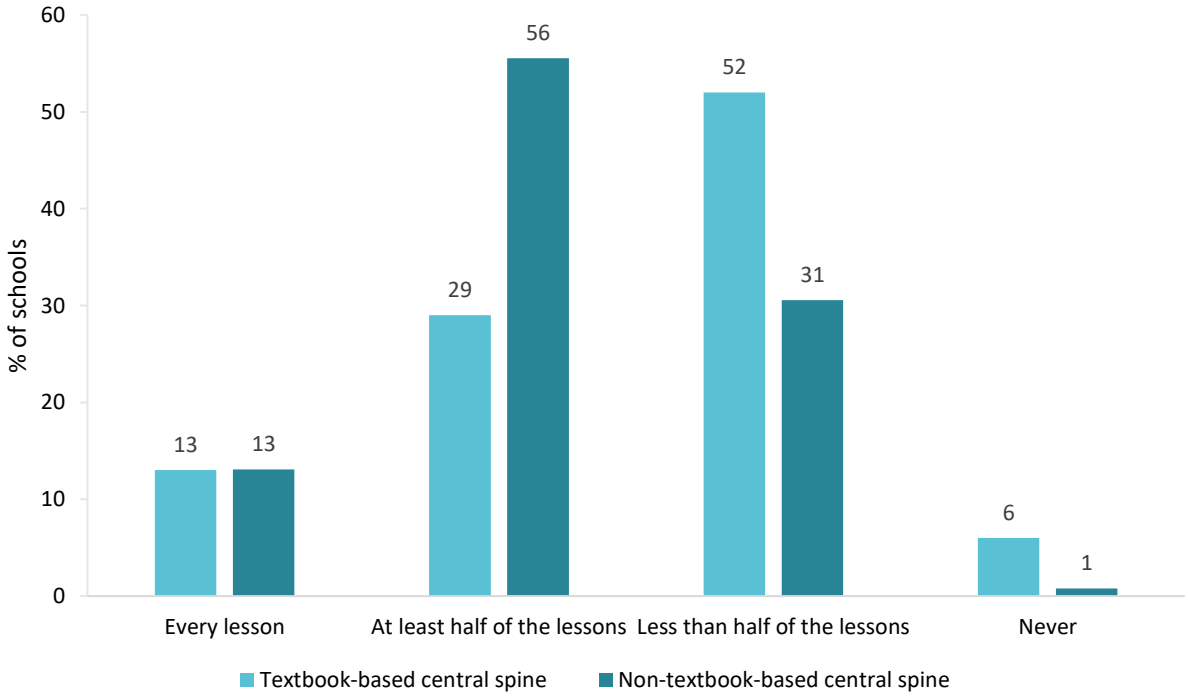


Figure 27: Frequency of adaptation based on format of central spine

5.4.3.2 *Reasons for adapting curriculum resources*

Silver's (2022) recent systematic review of curriculum supplementation illustrated the major motivations behind teachers' adaptations to, and supplementation of, curriculum resource, with these including aligning materials to students' needs, aligning to curriculum requirements and to adjust the difficulty level.

92%

The percentage of schools who told us they find they need to adapt curriculum resources to better match the pupils' attainment levels.

Within our Main Survey we asked schools about the reasons they may need to adapt (possibly through supplementation) the curriculum resources they used. These factors were taken from the literature and discussion with our Expert Teacher Panel. Schools were able to give free-text responses to indicate any salient factors not included in our list; only 12 schools provided further reasons, of which nine were related to the Covid-19 pandemic, something which we have considered separately in Annex 1: The Covid-19 pandemic. We were therefore satisfied, particularly given the input of our Expert Teacher Panel, that we were capturing the most important rationale for adaptation and the extent to which these were important (Figure 28).

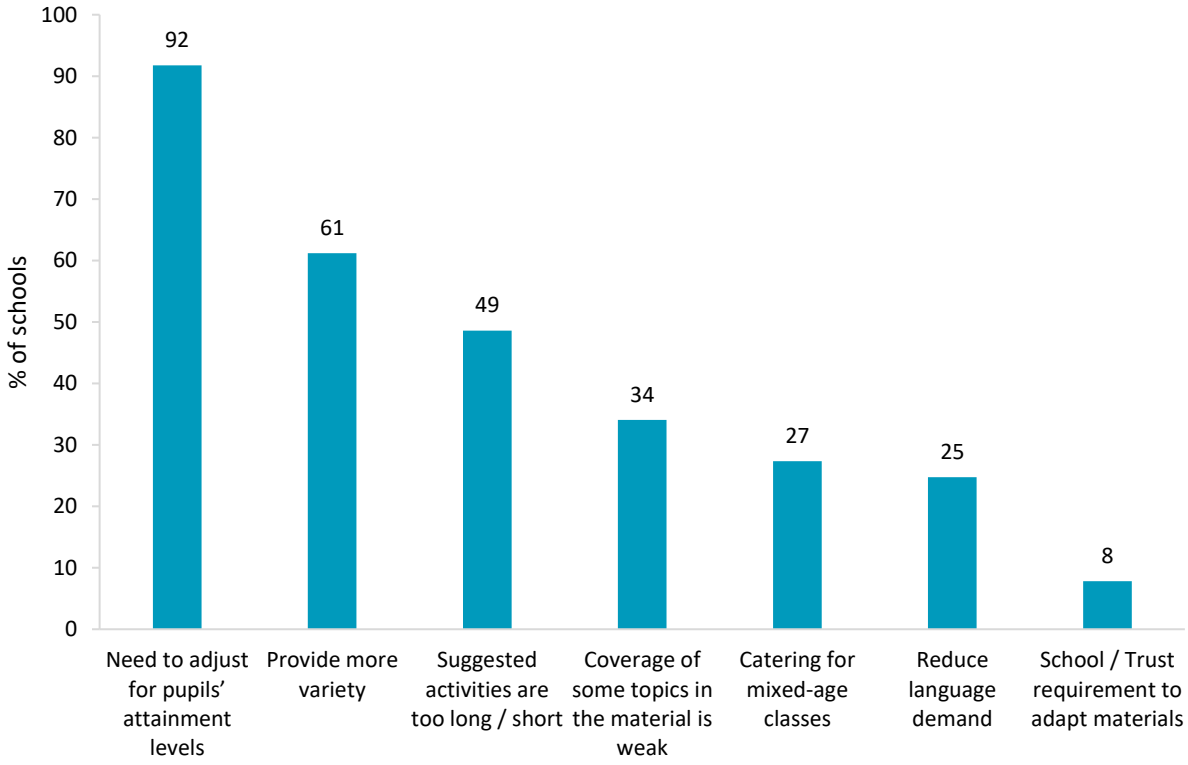


Figure 28: Percentage of schools giving each reason (multiple choice) for adapting curriculum resources

It is interesting to compare the graph arising from our Main Survey of schools in Figure 28 with that from our Subsidiary Survey of class teachers. In our Subsidiary Survey we asked the same question and gave the same responses for class teachers to select from but asked class teachers to tell us which of the factors had been pertinent to them in the last week (Figure 29). As we would expect, the percentage of class teachers reporting some factors as salient was lower than in the Main Survey as they were simply reporting what had happened in their class, rather than what happened across the school or academic year (so those reporting the need to adapt for mixed-age teaching was lower, for example). What is striking is the similarity in the ranking of each factor, with the two graphs appearing almost identical in shape.

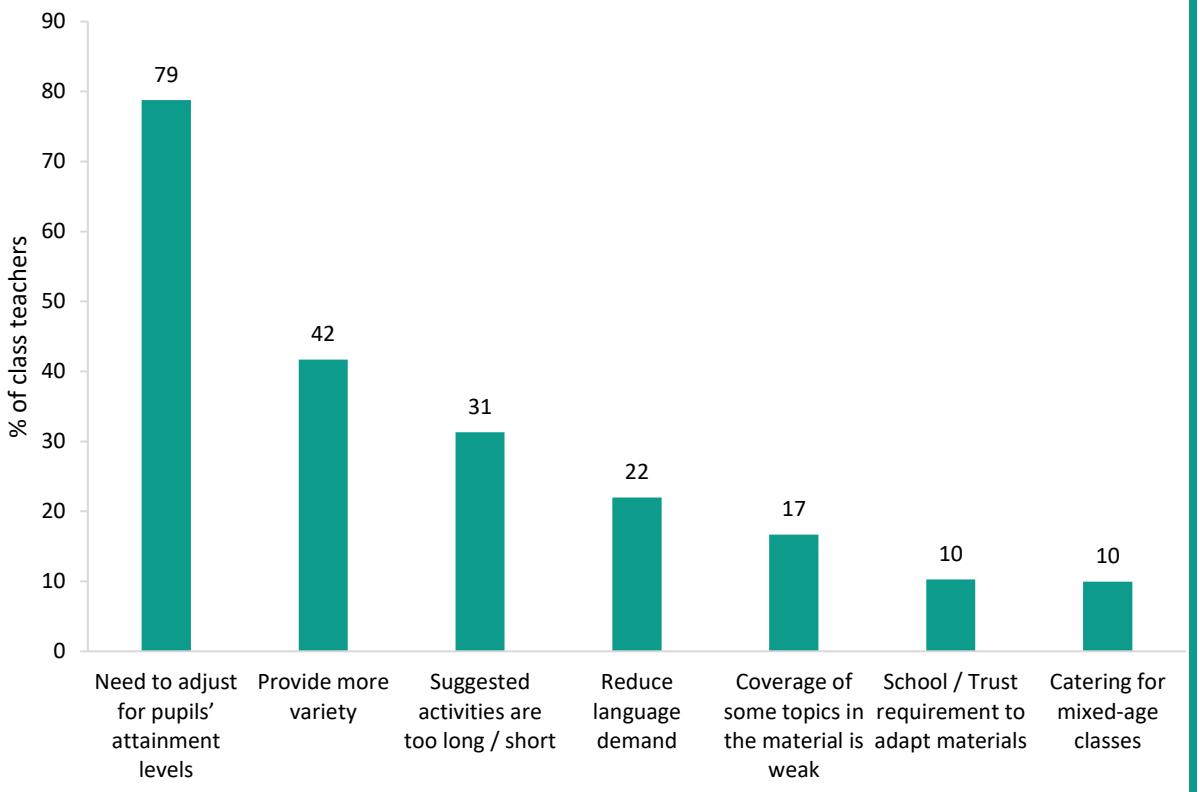


Figure 29: Percentage of class teachers giving each reason for adapting curriculum resources

Our data show that adaptation to meet pupils' needs (including the language demand), changing the activity nature or length, and ensuring the topic coverage is appropriate, are at the forefront of both schools' and class teachers' thinking when adapting curriculum resources. Each may suggest a possible mismatch with the lived reality of class teachers and point towards specific recommendations for policy and practice. Below we consider each in further detail. Catering for mixed-age teaching was also important, particularly to schools; we address this separately in Section 6.2 as the importance of this factor went beyond curriculum resource adaption.

Meeting pupils' needs

As with Silver's review, the most common reason given by our Main Survey respondents for making adaptations to curriculum resources was to enable the teacher to match the curriculum resources to the perceived attainment levels of the pupils. Overall, 92% of our Main Survey respondents said they made adaptations for this reason. Whether a school has a scheme as a central spine or not is not associated with the importance of this factor (90% vs. 93%). Likewise, for schools with a scheme as a central spine, whether this was a textbook-scheme is not associated with the importance of this factor (90% vs. 91%). It is important to note that this does not capture the direction of adjustment, that is whether teachers are finding curriculum resources to be pitched too high or too low; further research into both 'ends' of such an adjustment is warranted.

A further adaptation made to meet pupils' needs is seen in the 25% of schools who adapted curriculum resources to reduce the language demand. A review of a recent, but non-DfE-approved textbook-scheme, by Hall, Lindorff and Sammons (2016) found that teachers reported lower-attaining pupils "shutting down" as they became frustrated with the language demands of the textbooks. Teachers adapting to reduce the language demand may be acting proactively to mitigate this. Whether schools have a main scheme as a central spine or not is not associated with the importance of this factor, however the nature of this central spine does reveal a significant difference in how often schools need to adapt resources to reduce the language demand. Schools using a textbook-scheme are significantly more likely to adapt to reduce language demands than schools using a non-textbook-scheme as a central spine [$\chi^2(1) = 3.934$, $p = 0.047$]. This is an important finding; it may suggest a mismatch between publisher and school expectations.

Activity variety and length

Marple et al.'s (2017) study helps us to understand Silver's (2022) category of "perceived shortcomings". In Marple et al.'s study, teachers reported some curriculum resources simply not being engaging. This is picked up in the second and third more common rationale for adapting curriculum resources in our Main Survey. 61% of schools who made adaptations did so to add variety, while 49% did so as they felt the activities were not of the correct length (whether too long or too short). Schools without a scheme as a central spine were more likely than schools with a scheme as a central spine (71% vs. 50%) to adapt curriculum resources to provide more variety.

"We try to squeeze the whole of the year 6 curriculum in before SATs."

Adaptation to meet external pressures

Schools using schemes – both DfE-approved and others – talked about activities being too plentiful as well as too long. Across year groups, schools stated that they "won't teach all the lessons because there's not time" while in year 6, the pressure to cover the curriculum prior to the SATs saw schools finding they "definitely move things around more to fit with having everything covered in time for this SATs", making decisions about what is most important to cover. This results in schools "mess[ing] around with the journey a little bit and we'll go as far as we can with quite a few things and then we'll pick some of those things up again later" as they try "to squeeze the whole of the year 6 curriculum in before SATs" but know this is futile.

Topic coverage

A need to ensure topics were fully covered was given as a rationale by 34% of schools who made adaptations, the fourth most common reason. As with adaptation to support activity variety, schools without a scheme as a central spine were more likely than schools with a scheme as a central spine (44% vs. 22%) to adapt curriculum resources because of concerns over topic coverage, but again, we cannot tell the order of effect here. A greater percentage of schools using a textbook-scheme said they need to adapt the curriculum resources due to weak curriculum coverage in some topic areas than those using a non-textbook-scheme central spine. This may be important for publishers given these schemes are designed to cover the entire mathematics curriculum.

"When I've been teaching the lessons, I've added an extra layer."

Upscaling content

Some schools identified shortcomings in how specific mathematical topics or concepts were covered. One school, using a DfE-approved textbook-scheme, noted that although such a scheme is designed to provide full curriculum coverage, the resources didn't "do scales very well. There's not many number lines and scales [within the scheme]. So I've added in some extra lessons for that". In another school, using an online-scheme, a decision was made that the jump to an algorithm for long multiplication was taken too quickly, leaving pupils "a little bit wobbly … so when I've been teaching the lessons from [the online whole curriculum scheme] I've added an extra layer …; this is the grid method." In both cases, we see schools making adaptations due to perceived weaknesses in the schemes' content coverage.

5.4.3.3 How curriculum resources are adapted

We saw above that 70% of schools are adapting (including supplementing) their curriculum resources on a more than occasional basis. Here we examine the different ways in which schools adapt curriculum resources. The three most common approaches to adapting the resources were: the addition, removal or changing of activities, changing the amount of time recommended to be spent on particular units, and limiting the number of questions all or some pupils were required to answer, seen in 87%, 81% and 69% of schools respectively (Figure 30).

Each of these ways in which curriculum resources are adapted by schools represent what is often termed in the literature as a lack of implementation fidelity (McNaught, Tarr, & Sears, 2010, n.p.). Such changes may be problematic where the sequence of the activities or questions has theoretical underpinnings such as variation theory. Here, the questions set for pupils in the resource are claimed to be sequenced in very specific ways across the full set of questions, to draw the pupils' attention to, and embed, a concept. Further, textbook designers may have considered the careful placement of elements such as examples and diagrams in line with the 'spatial contiguity principle' (Woollacott, Alcock & Inglis, 2023). To snip items, to change them, or to move things around, may change how pupils respond to mathematical diagrams.

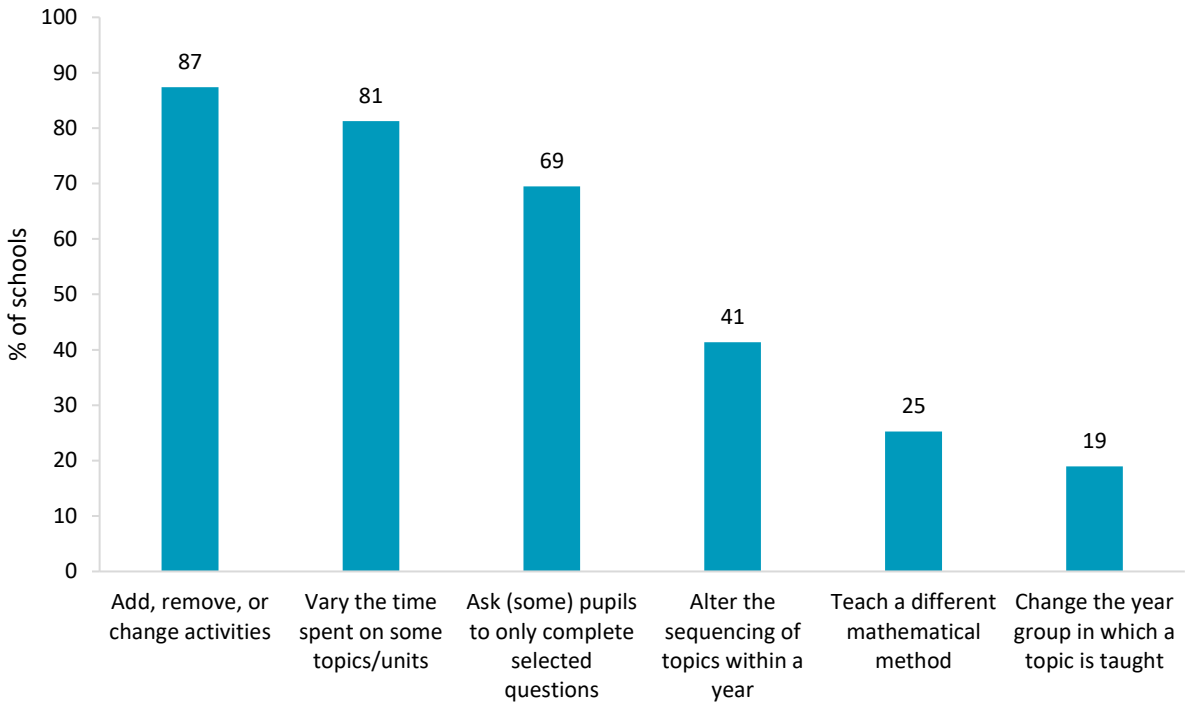


Figure 30: Approaches to adapting curriculum resources

As before, we were interested to understand further what was happening in schools who had selected a scheme as a central spine (whether supplemented or not) and whether this being a textbook-scheme was associated with how schools who did adapt curriculum resources went about this. We found that there was generally little difference in how schools with or without a central spine went about varying curriculum resources (Table 13). There was however an interesting difference in one of the lesser cited approaches: teaching a different mathematical method. Here we found that schools who use curriculum resources from various places are statistically significantly more likely to find the need to teach a different method from that in the curriculum resource to those schools who use a scheme as a central spine [$\chi^2(1) = 11.595$, $p = 0.001$]. This seems an intuitive finding, as an approach which involves curating curriculum resources from multiple sources is likely to bring with it a wide range of calculation approaches (such as different ways to complete a multi-digit subtraction algorithm) as favoured by the multiple resource authors, whereas a single scheme can be the basis of a whole school approach / calculation policy.

Approach to resourcing the curriculum map	Change the year group in which a topic is taught	Alter the sequencing of topics within a year	Vary the time spent on some topics/units	Teach a different mathematical method	Add, remove, or change activities	Ask (some) pupils to complete selected questions
We use curriculum resources from various places	23	46	83	33	89	68
We use resources exclusively or mainly from one scheme	14	36	79	17	86	72

Table 13: Common approaches to adapting curriculum resources by resourcing approach (%)

6 Key Findings: School Size, School Location, and Mixed-Age Teaching

As we highlighted at the beginning of Section 4, contrary to what might be expected, school demographics generally were not associated with schools' funding awareness, nor on their choice or use of curriculum resources. However, school size and location (urban/rural) did have some significant associations with how schools reported their curriculum resource choice or use (with it being noted that these are not independent variables). We also found, while not a demographic per se (and not included in the DfE data about schools as it is a variable so subject to flux), that schools which operated mixed-age teaching – for a variety of reasons, not always connected to school size – were a particular case. In this section we explore these three 'special cases':

- Very small schools
- Rural schools
- Mixed-age teaching

With school size and rural/urban location we can examine where there are statistical differences for these schools which set them apart from the rest of the population. We did not collect data on whether schools used mixed-age teaching, so our analysis here is based on free-text responses from our Main Survey and further information gleaned from our Subject Leader Interviews.

6.1 School size and location: very small and rural schools

Generally, research into or with very small, rural schools is limited, with claims that past research has lacked methodological rigour (Hargreaves, 2009). Small schools – and particularly very small rural schools – infrequently feature in educational research; indeed, there is no set definition used for 'small school' or 'very small school', hinting at how infrequently this demographic is considered. Our categorisation took the bottom quartile of schools' 'number on roll' as 'very small' yet these are not a homogenous group. The school with the fewest number on roll responding to our Main Survey had just 14 pupils; it would be inconceivable not to think that their experiences would differ from other schools still categorised as very small and certainly from our largest school with ~1700 on roll. There is also potentially a postcode lottery to consider; one rural school may be located close to the school leading the local Maths Hub making attendance at Professional Development activities feasible, while another may find attendance at Maths Hub events harder due to physical location and difficulty in being released (the Mathematics Subject Leader may also be leading several other subjects and teaching multiple year groups in a very small school).

As this project was interested in scoping the landscape of curriculum resource use, it is unable to identify – aside from free-text responses – meanings behind the quantitative findings from the Main Survey, but this opens further avenues for policy consideration and research.

6.1.1 Funding: awareness, eligibility, and participation in very small and rural schools

From the data provided to us by the NCETM/DfE, we know that there are no statistical differences between schools' eligibility for DfE-textbook funding based on the school demographics of school size or

location. However, while there are no differences in actual eligibility, our Main Survey data show us that very small schools, and those located in rural areas, are less likely to have *heard* of the DfE funding initiatives (Table 14 and Table 15). In relation to the previous DfE matched-funding initiative it is possible that these schools had less contact with their Maths Hubs or NCETM provided professional development and hence were less likely to have heard about the initiatives.

School size	Yes, we have heard of the DfE textbook-scheme funding initiative(s)	No, we have not heard of the DfE textbook-scheme funding initiative(s)
Very Small	34	66
Small	43	58
Medium	47	53
Large	47	53

Table 14: School size and awareness of DfE funding initiative(s) (%)

School setting	Yes, we have heard of the DfE textbook-scheme funding initiative(s)	No, we have not heard of the DfE textbook-scheme funding initiative(s)
Rural	38	62
Urban	46	54

Table 15: School setting and awareness of DfE funding initiative(s) (%)

Where schools were aware they are eligible for either funding initiative, school size or location had no impact on whether they chose to participate. This tells us is that the initial messages about funding initiatives are not reaching very small / small / rural schools as readily as larger or urban schools, but that once targeted messages have reached them, their response is on a par to all schools in the population.

For very small and small schools, funding is significantly less important in their decision making than for medium and large schools [$\chi^2(3) = 12.882$, $p = 0.005$]. It is likely that other factors – including the presence of mixed-age teaching as discussed in the following section – represent more pressing concerns.

"We know exactly which pupils have which needs. We only have 3 [classes] - we are making sure that everything is seamless."

Decision making in a very small school

One very small school reported that they didn't use a textbook-scheme. Whilst cost was a factor in this decision, the school had made an intentional shift towards a highly practical approach to learning mathematics that they felt would be inhibited if they used a textbook-scheme. In addition, the school found that schemes weren't "suitable for the current cohort" and their wide range of attainment. Through curating their own curriculum, they are better able to keep the class together and provide swift interventions as needed: "if there were pupils who needed more support, we could do it there and then, and we weren't losing them, or they weren't dropping far behind." With just 3 classes, the teachers "know exactly which pupils have which needs" and talk together when pupils encounter difficulties in mathematics, to resolve these as a team.

6.1.2 Choosing and using curriculum resources in very small and rural schools

Schools in urban locations are more likely than schools in rural locations to use a curriculum map directly from a scheme without adaptation. This may reflect rural schools being more likely to use mixed-aged teaching, making it harder to use directly a year-by-year map, something which was noted as a common reason for adapting a curriculum map. Larger schools are more likely than smaller schools to elect to use a scheme as a central spine. Similarly, rural schools are more likely than urban schools to use curriculum resources from various places. We noted no association between the types of mathematics curriculum resources schools chose to access and their school demographics, although very small schools were less likely to subscribe to online curriculum resources (especially Apps) designed to target fluency, in particular mathematical content.

Two curriculum resource usage dimensions were associated with school size and location. We found that large schools were statistically less likely than any other size of school to have pupils completing mathematical work in purchased workbooks or on photocopied downloadable worksheets [$\chi^2(3) = 17.192$, $p = 0.001$]. The reasons for this cannot be ascertained from our data although we would suggest that costs – a more important factor in larger schools' decision-making – come into play here. Further, rural schools were found to be significantly more likely to alter the sequencing of topics within a year than urban schools [$\chi^2(1) = 5.560$, $p = 0.018$]. One reason behind this may be the higher likelihood of mixed-age teaching which we turn to in the next sub-section.

6.2 Mixed-age teaching

27%

The percentage of all schools who adapted curriculum resources who did so for the purpose of catering for mixed-age classes.

While there will be specific reasons as to why very small schools or schools located in a rural location may choose and use curriculum resources in different ways to larger or urban schools, it is likely that an important reason is the greater likelihood of these schools having mixed-age teaching (that is, classes with more than one year group in each class). We did not collect data on whether schools used mixed-age teaching, nor do the DfE collate such data in their *Get Information About Schools* database. It is very difficult to know what percentage of schools use mixed-age teaching as this is quite a fluid measure (responding to local population surges and declines) and might be conceptualised within "four circumstantial categories – default, by product, mandate, and preference" (Cronin, 2019, p.165), each of which may make it more or less likely that a school needs to use mathematics curriculum resources in specific ways.

It is important, therefore, to remember that the issues faced by schools with all or some mixed-age teaching in relation to the selection and use of mathematics curriculum resources are not limited to very small or rural schools; the selection and use of curriculum resources can present challenges for schools with mixed-age teaching, irrespective of the size of the school:

"We weren't really entirely happy with anything that was out there."

Medium-sized school with mixed-age teaching

One medium-sized school using mixed-aged teaching had never used a scheme. They reported that they had explored the use of schemes and visited schools to see schemes in practice but "because of numbers we ended up with all mixed year 1-2 classes. So I was looking for something that covered the mixed key stage and we weren't really entirely happy with anything that was out there". Consequently, the school curated their own curriculum resources.

Although we cannot be sure how many schools – or even which schools – contain mixed-age classes, we know that an important reason behind schools needing to adapt curriculum resources, is to make them suitable for use in mixed-age teaching, with this rationale given by over a quarter of schools who made adaptations (27%). As the vignette above shows, a number of schemes are not written with mixed-age teaching in mind, meaning schools may elect not to use these or teachers may need to adapt the curriculum resources. This was made explicit in free-text comments left on our Main Survey by multiple schools:

"We are a very small school, with mixed ages (R/1/2 & 3/4/5/6) therefore it is very hard to find resources that can be used by all year groups."

[Very small rural academy, South-West England]

"In addition, we had some new mixed age classes and [our traditional textbook scheme] did not cater to that."

[Medium-sized urban LA maintained school, North-East England]

"We would benefit from access to more mixed aged resources, that cover more than two year-groups together."

[Very small rural LA maintained school, East Midlands]

"As a very small school with mixed age group classes, finding good curriculum materials is a challenge."

[Very small rural academy, East Midlands]

Schools without a central spine were more likely than schools with a central spine (31% vs. 24%) to adapt curriculum resources to cater for mixed-age teaching and schools using a non-textbook-scheme were more likely that schools using a textbook-scheme (27% vs. 12%) to adapt curriculum resources to cater for mixed-age teaching. These findings likely reflect that schools using mixed-age teaching, from the outset, have elected not to use a scheme (and certainly not a textbook-scheme) as many of these do not cater for mixed-age teaching (and certainly not for the range of ways in which ages might be mixed from two year-groups in one class to cross-key stage classes). These schools, despite drawing curriculum resources from various places, still subsequently find the need to adapt the resources that are available to meet the needs of mixed-age teaching.

7 Implications and Recommendations

Within Sections 4, 5, and 6, we have presented data and data analysis from across the project and the three research collection methods: our Main Survey, our Subsidiary Survey and our Mathematics Subject Leader interviews. These sections together respond to our three research questions outlined on p.12. As noted across our report sections, the perhaps surprising outcome of our analysis is that, overall, school demographics, and a schools' eligibility for the DfE funding initiatives, do not have a significant association with the uptake or use of curriculum resources in primary mathematics in England. It is important too to consider the time-period in which this project was conducted, with schools responding directly to the perceived impacts and legacy of the Covid-19 pandemic (see Annex 1: The Covid-19 pandemic).

Despite the caveats above, it can not be ignored from our findings that the current landscape of curriculum resource use in primary mathematics in England is rather different from that which might have been expected had the DfE funding initiative(s) had the intended impact. While one might argue over the interpretation of "access", it is not unreasonable to interpret Nick Gibb's statement that 8000 primary schools would be given access to "the south Asian 'mastery' approach to teaching maths … supported by the use of high-quality textbooks" (DfE, 2016, n.p.) as meaning we would see up upsurge in the number of schools using a mastery approach and that these schools would be supporting this approach with the use of the DfE-approved "high-quality" textbooks. It is true that mastery (in its many interpretations) is being seen as the (or a) underpinning approach in a growing number of primary mathematics classrooms, and it is also the case that the government ambition for the number of schools having been eligible (which might be a definition of having access) for the DfE-approved textbook-funding initiatives has essentially been met. However, while schools are employing mastery(like) approaches, very few of these schools are supporting this approach with the use of the DfE-approved textbooks and even fewer are using these with fidelity (without supplementation or other adaptation and in the intended year groups). Of note, we found that 37% of schools who had received funding to buy DfE-approved textbooks had now largely or completely abandoned these textbooks, while a further 24% were using them in a partial manner but putting no further funding into the provision of consumables associated with the schemes. Just 5% of schools educating pupils in the primary phase are currently using DfE-approved textbooks (in whole or part) which they originally purchased with DfE-funding. As far as we are aware, there has been no formal evaluation of the DfE-approved textbook-funding initiatives. There are questions to be raised here about the efficacy of these funding initiatives and whether future funding should be differently focussed, for example on the Professional Development aspects of the initiatives which our data suggest may be a stronger factor in pedagogic change than any specific curriculum resource.

Beyond the DfE-approved textbook-funding initiatives, a central finding of this project – and clearly exemplified in our Mathematics Subject Leader interviews – is the amount of thought and effort schools, school leaders, and individual class teachers put into decisions around devising their curriculum map, decisions about which curriculum resource(s) to use, and decisions about how these are used. There is nothing serendipitous about these decisions and everyone was able to give clear – and often heartfelt – rationale for their decision-making. These processes take time, and the ways in which schools and teachers in England resource their mathematics teaching may be particularly time heavy. 46% of schools curate curriculum resources from a variety of places while a further 51% also engage in a process of curation in supplementing their central spine. Even with this curation, many schools then employ a

process of resource adaptation (just 1% rarely or never make adaptations). Further, 33% of class teachers told us that they had created mathematics curriculum resources from scratch in the week they were surveyed.

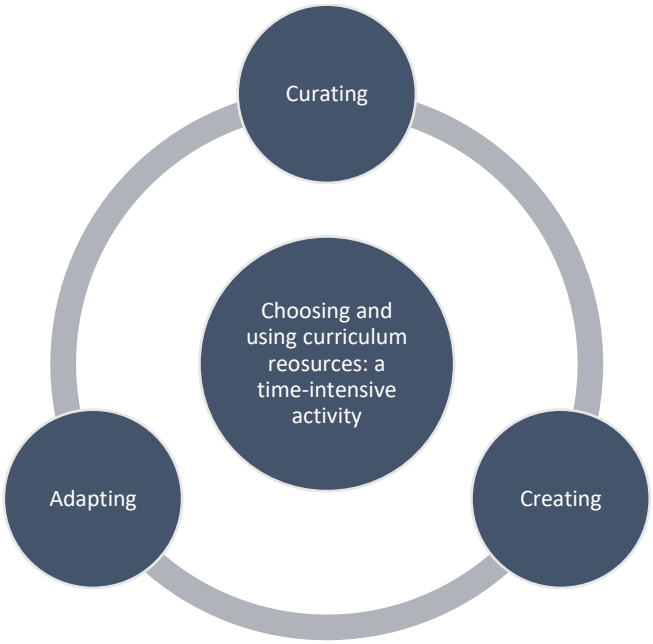


Figure 31: Key workload/time demands when choosing and using curriculum resources

It is clear from our data that the model of mathematical pedagogy seen in East Asian jurisdictions on which England's mastery agenda, and the DfE's funding initiatives, are predicated, are not being replicated with any fidelity here. This is not surprising. England has a very different educational history, and, importantly, a different relationship with design of and approach to using textbooks. Pedagogical practices in primary mathematics in England are – and have always been – far removed from a single jurisdiction-wide mandated textbook model. It is an extremely 'big ask', even with Professional Development, for a school to adopt a single textbook-scheme, with fidelity, without adaptation and without supplementation. Just 3% of schools are using a single textbook-scheme without any supplementation, and even here, they are often making some adaptations to the selected curriculum resource.

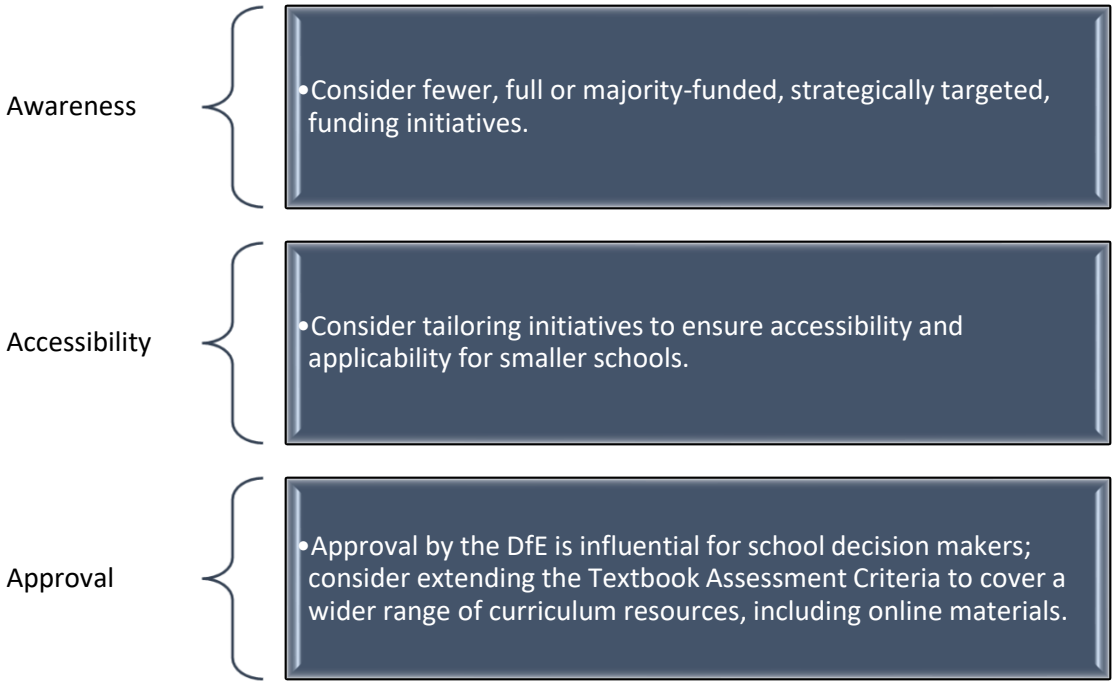
While school demographics were generally found not to be implicated in a school's decision-making, we did find that two linked demographics emerged across our analyses as important: school-size (particularly very small schools) and whether a school was situated in a rural or urban location. As noted, these variables are not independent and are likely getting at the same issues, namely that many available curriculum resources are designed to be used with classes of pupils of the same age and with an expected range of prior attainment. Many smaller schools – and some larger schools for a variety of reasons – have mixed-age and/or flexibly grouped teaching / classes and may find some textbook-schemes and curriculum resources to be unsuitable. Very small schools are not a trivial group in England; there are currently just under 2000 primary schools with fewer than 100 pupils on roll. These demographics must feature in the thinking of all players in this field; it is to these recommendations for various stakeholders which we now turn.

7.1 Key messages for the DfE

A central aim of this research was to understand how the DfE-funding initiative (which became two initiatives due to a policy change within the duration of this project) has been received by schools, and what has happened in schools because of these initiatives. This aim came against a backdrop of there being no existing large-scale survey of curriculum resource use in primary mathematics and hence there being a need for us to establish the landscape and the position of the DfE initiatives within this. It is important, as we have stressed within this report and address in Annex 1: The Covid-19 pandemic, that the unforeseen Covid-19 pandemic did change which curriculum resources some schools used and the ways in which they used them, and this is implicated in where things currently stand in relation to the uptake of DfE funding and schools' continuation of DfE-approved textbook-schemes funded by this initiative.

Our key finding in relation to the DfE funding initiatives is one of limited take up and retention (see Figure 4 on p.32) with very few schools now fully using all elements of a DfE-approved textbook-scheme having accessed a DfE funding initiative to originally support their purchase. However, this picture is somewhat skewed by the very low starting point, with over half of all primary schools in England unaware of the existence of either of the DfE funding initiatives. We found that very small and small schools were less likely to be aware of the funding initiatives, so there is an imperative here to ensure key messages reach all schools equally. We also found that there were a not insubstantial number of schools who were eligible for one/both funding initiative(s) but who were unaware of their eligibility. Discussion with members of our Advisory Group uncovered a potential plethora of information – both general and about funding streams – filling school leaders' inboxes and in-trays, and that as such, opportunities to process specific initiatives such as this DfE funding initiative to support the purchase of textbook-schemes, were possibly lost. We found that – while it being early days – awareness of the revised subsidy-funding initiative was higher than for the original matched funded initiative; potential reasons for this may be the direct targeting of priority schools or the higher proportion of funding offered (80%, rather than a maximum of 50%), meaning initial literature landing in an in-box was not rejected out of hand.

While awareness of, participation in, and continuation with, DfE initiatives may not be as extensive as hoped, we did note an interesting repetition in our free-text Main Survey responses, and in discussion with some Mathematics Subject Leaders, that it was not the funding per se that saw schools adopting, or considering adoption of, DfE-approved textbook-schemes, but the 'DfE-approval' itself. This perceived 'seal of approval' underpinned some schools' decision-making and saw some schools purchasing – outside of the DfE funding – elements of either DfE-approved textbook-scheme to supplement other curriculum resources being used across mathematics provision in the school. While these DfE-approved textbook-schemes where therefore not being used 'with fidelity' there is an important message here in relation to how bringing schools onboard with government agendas might occur outwith extensive funding provision.



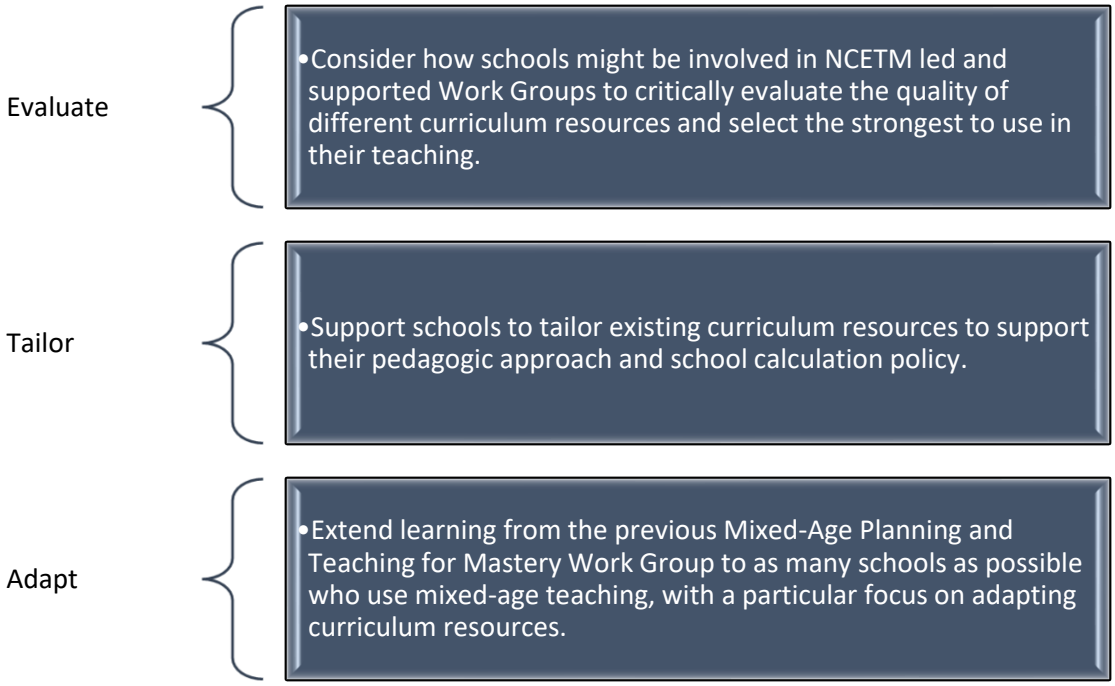
7.2 Key messages for the NCETM

The NCETM has a central role in how curriculum resources are adopted and used by schools. Above we noted that DfE-approval, perhaps more so than the available funding, was an important rationale for decision-makers. While this project looked at the DfE-approved textbook-schemes, it also mapped the wider landscape. At the time of our Main Survey, we identified over 100 curriculum resources in use by schools and we are aware of new players to the market since this count. While no school draws on all 100 curriculum resources, schools are curating from a wide and potentially unwieldy range, and while some of these come with statements of curriculum mapping, research support, or some assurance of quality, many do not. There is scope here for the NCETM to recognise that teachers are drawing on this range and that while schools may base their curriculum map on the NCETM provided-map, they are selecting curriculum resources beyond this.

Support for schools, perhaps through a Work Group, to enhance their critical evaluation of curriculum resources, may help to ensure that curriculum resources used are of a standard recognised by the DfE as "high-quality". Working with schools who wish to continue to curate from a variety of places, there is scope here for the NCETM to look at how they might provide support to schools in either identifying curriculum resources which fall within a mastery pedagogy or adapting resources to make them conversant with a mastery pedagogy.

As discussed earlier, the need to cater for situations involving mixed-age teaching (which were common in, but not limited to, smaller schools) saw many teachers and schools either rejecting a scheme or needing to engage in substantial adaptations to ensure the curriculum resources suited their context. While some curriculum resource providers have developed materials and/or guidance for mixed-age teaching, these are often for the standard mixed ages of Years 1 & 2, Years 3 & 4, and Years 5 & 6, rather than taking into account the wide-variety of mixed-age structures employed by schools or the need for

flexibility in these, particularly as population spikes or troughs move through schools. The NCETM have previously addressed mixed-age teaching with a Work Group examining Mixed-Age Planning and Teaching for Mastery. Given our findings, the time is now ripe for this work to be extended – with a focus on adapting curriculum resources – and perhaps targeted at schools who are known to use mixed-age teaching.



7.3 Key messages for curriculum resource publishers

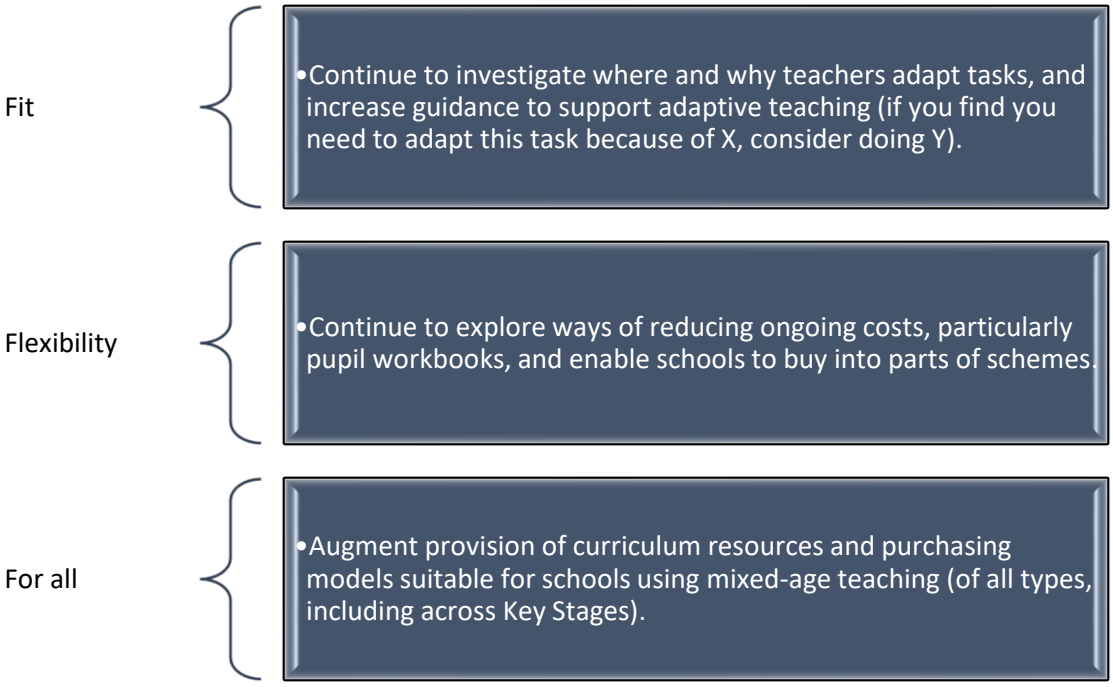
As noted above, teachers draw from a vast landscape of primary mathematics curriculum resources. Not only this, but pupils' activities within curriculum resources are often not used with fidelity or with the publisher's or author's original design in mind, but instead tasks are adapted in many ways on a regular basis, sometimes undoing the high-quality theoretical foundations.

Some curriculum resources – including the DfE-approved textbook-schemes – are underpinned by careful adherence to research-informed educational theory. While this is often communicated through Professional Development provided by the publishers and through the Teacher Guides, some schools do not access this and our earlier study (Marks, Barclay & Harvey-Swanston, 2019) noted that cascade models can be unsatisfactory here, meaning new teachers to the school may miss out on the important theoretical background. This limited awareness of the theoretical foundations may partially explain why, in this present study, we found that teachers were adapting curriculum resources in ways which act against the embedded theoretical principles, for example by asking pupils to complete only some of the set questions in a task which had been constructed with variation theory in mind.

The most common reasons given for adapting curriculum resources were to ensure a better match to pupils' current attainment levels, to cut down the language demands where the language – or amount of language – used did not align with pupils' reading ability, and to ensure full coverage of the curriculum.

Taken together, these reasons suggest that there may be a mismatch between some curriculum resource publishers and the 'on the ground' reality in terms of expectations for pupils' work. Further, as noted in the introduction to this section, many schools are making adaptations in response to the practicalities of mixed-age teaching, not just the more common dual-year classes (1/2, 3/4, 5/6) but more complicated arrangements, including those which span different Key Stages.

We found that curriculum resource cost was more important than other factors in decision-making for a third of schools and as important as other factors in a further third. Schools told us repeatedly how they found the cost of some curriculum resources – and the DfE-approved textbook-schemes featured heavily here – to be prohibitive. This was not just about the initial outlay, but in relation to ongoing subscriptions and the replacement of pupil workbooks. Further, some schools which chose not to buy fully into a particular curriculum resource but wanted to curate from across resources, found themselves barred from accessing parts of some schemes due to restrictive purchasing models.

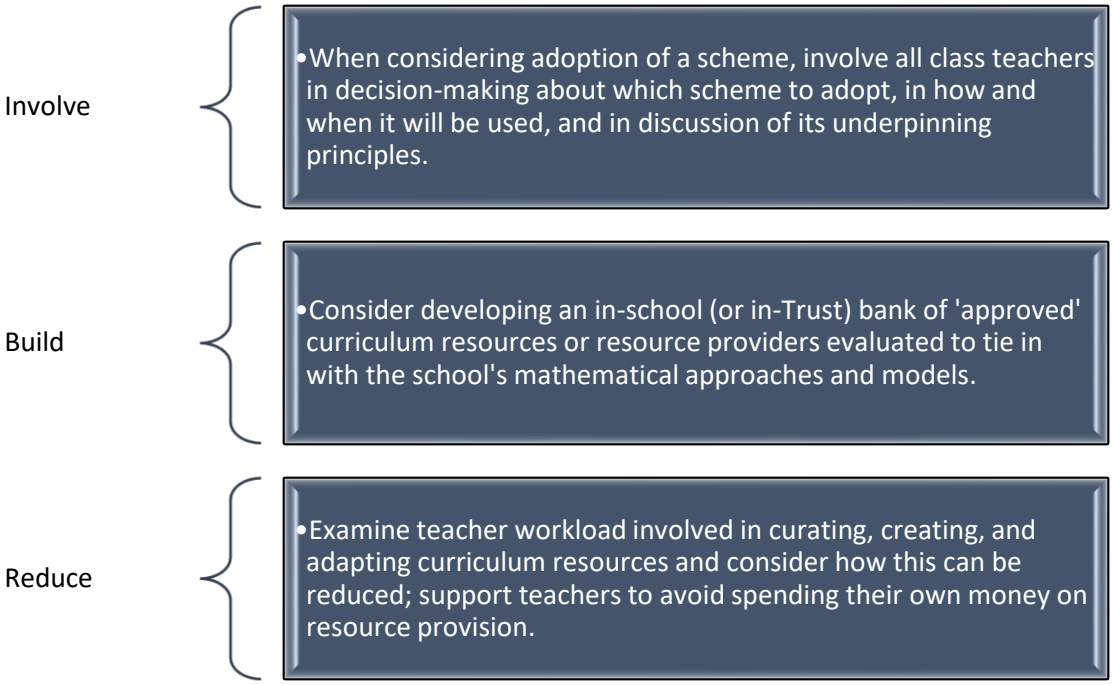


7.4 Key messages for school leadership teams

In schools which do have a central spine – supplemented or not – our findings indicate that scheme selection is usually made by the headteacher and senior leadership team. While it is beyond the scope of this study to understand the implications of class teachers frequently not being involved in this decision, we might hypothesise that there are links with teachers making adaptations to curriculum resources which may be unwittingly undermining the theoretical principles of the task. It may be that involving all teachers in the selection of curriculum resources, and discussions about how they are used, guards against such issues, but this of course has implications for teacher time and workload. We did note that although class teachers are rarely involved in selecting a scheme, most class teachers (86%) feel free, perhaps with negotiation with colleagues, to select curriculum resources of their choosing to support teaching and

learning. While this autonomy is a positive, it also carries inherent issues in relation to teacher workload and the quality of the curriculum resources selected.

A curated approach, drawing on a range of curriculum resources, inevitably means that, without adaptation, pupils will be exposed to a range of mathematical approaches and methods. School leadership teams – and Mathematics Subject Leaders – need to be aware of this and ensure class teachers are also aware, but this also brings workload implications if teachers do need to adapt curriculum resources regularly or spend time searching for and curating curriculum resources which follow the school calculation policy. While 92% of SLT or Mathematics Subject Leaders completing our Main Survey told us they were confident they knew the majority of curriculum resources being used by class teachers across their school, we know that over a third of class teachers are spending their own money on a range of supplementary curriculum resources, particularly those from resource repositories designed 'by and for' teachers. This raises questions over workload – particularly in a time of a teacher retention crisis – and resource quality.



7.5 Key messages for mathematics education researchers

In fulfilling the aim of this study, we have established the prevalence of textbook and other curriculum resource use in primary mathematics across England and uncovered how these curriculum resources are currently being used in primary mathematics. This broad landscaping provides the necessary, and repeatedly called for, foundation, providing a general understanding of the picture of curriculum resource use in primary mathematics in England. Our landscape mapping – and the tools we have developed to ascertain this landscape – should provide the basis for ongoing work and future research directions.

Our study revealed two areas where current understanding appears limited. Firstly, the DfE-funding initiatives and limited take up and retention documented in Figure 4 seems stark and provides a novel and

impactful way of looking at policy development and implementation. We do not know what the picture would look like in the absence of the Covid-19 pandemic or country-wide austerity measures, however it raises questions about how different policies – and particularly funding initiatives – can best be shared with schools and embedded in school practices.

Secondly, the absence of any association between most school demographic factors and schools' choice and use of curriculum resources served to highlight just how often, and to how great an extent, school size and setting (urban/rural) are associated with many of the aspects under investigation. We identified various reasons for this, but also noted that this was a demographic often missing in education research; this is something future research should seek to address.

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Annexes

Annex 1: The Covid-19 pandemic

While this project was conceived prior to the Covid-19 pandemic, its implementation was delayed because of it. Multiple studies have examined the impact of the Covid-19 pandemic on a wide range of pedagogic issues as well as on aspects such as pupil wellbeing. It was clear from discussion with both our Expert Teacher Panel and our Advisory Group that the Covid-19 pandemic had a critical impact on how schools selected and used curriculum resources.

While schools now consider themselves "post-pandemic", this critical phase impacted on how the DfE-funding initiatives played out, and on where things are now, in terms of curriculum resource choice and use.

We offer this Annex, examining the Covid-19 pandemic, as a necessary and critical, but no longer imperative, step in the story this report tells.

Changes to the curriculum resources used

As might be expected, the Covid-19 pandemic had a perceived impact on the curriculum resource choices schools made. In almost 20% of schools the Covid-19 pandemic had a perceived impact to a great extent, while in a further ~50% of schools, the Covid-19 pandemic had somewhat of a perceived impact, on curriculum resource choice (Figure 32).

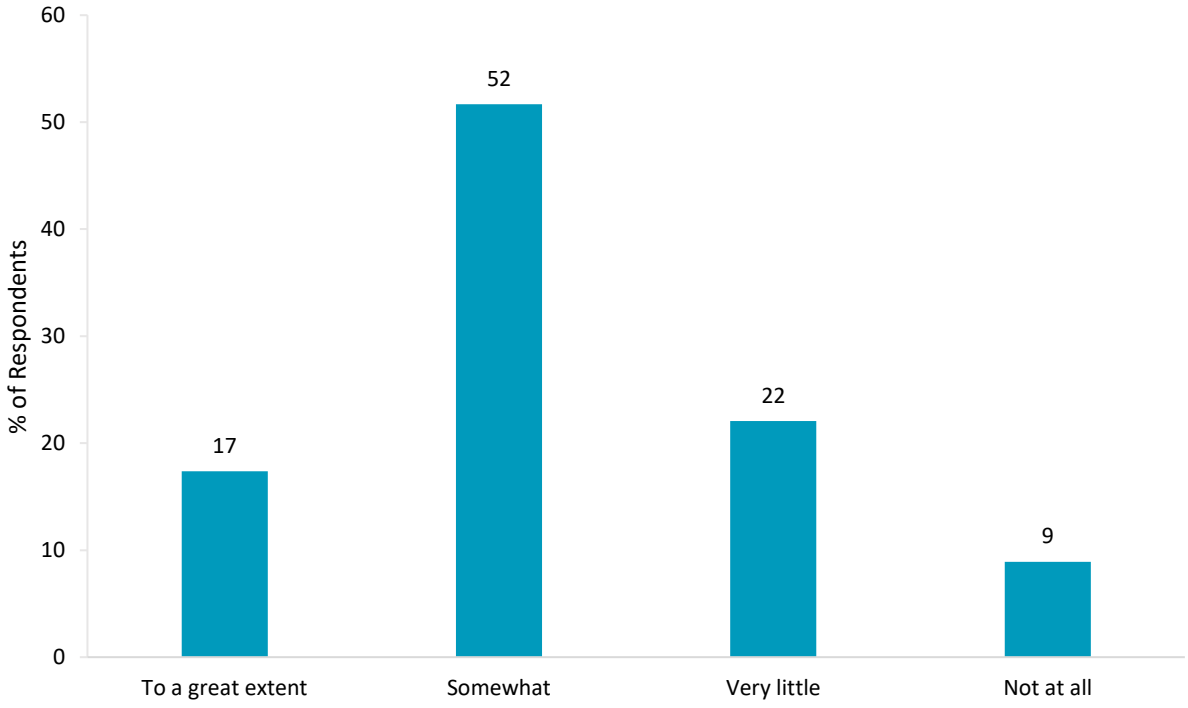


Figure 32: Perceived impact of the Covid-19 pandemic on choice of curriculum resource(s)

As Silver (2022, p.456) identified, the need for schools to have a remote offer during the Covid-19 pandemic (when many pupils were being taught at home, online) resulted in a "period of wild growth for

such websites". Schools looked for curriculum resources including videoed lessons to mitigate many of the complexities of live lessons. It would not be controversial to say that the Covid-19 pandemic represented a considerable "spanner in the works" for any textbook-scheme that relied on printed textbooks. Covid-19 pandemic restrictions meant textbooks were locked away for fear of cross-contamination. While both DfE-approved textbook-schemes include online features, they were originally designed to be delivered, physically, in the classroom, representing a specific complication if schools were to continue use of these during the Covid-19 pandemic and periods of home learning. While publishers did move to make all online content available and free to parents and carers at home, this may have felt different from the ways the physical textbooks had been used in the classroom. While our data only tell us about the adoption record of the central spine schools use now, of those schools who adopted their current curriculum resource during the Covid-19 pandemic (April 2020 – August 2021), 88% selected provision which was entirely online. This is illustrated through the following partial free-text responses demonstrating the adoption of a fully online central spine during the Covid-19 pandemic:

"[It was] too complicated to deliver [a textbook scheme] during the pandemic. Greater reliance on guided support. [An online scheme] enabled more independent work to take place with model videos children and families could watch."

[Small urban LA maintained school, South-East England]

"During the first Covid lockdown, we found the [online scheme] materials much more useful for setting work online so abandoned [textbook scheme] mid-year."

[Medium urban LA maintained school, North-East England]

"We were using [our textbook scheme] prior to lockdown, but [an online scheme] had the most accessible offer for home learning."

[Very small rural academy, East of England]

These, however, do not represent the complete journey for any of these three schools, and we return to their commentary below.

To support schools as they managed the second year of the Covid-19 pandemic and the required "catch-up" / intervention programmes during 2021-2022, the DfE and NCETM produced materials highlighting the areas of the curriculum schools should prioritise in their teaching to ensure pupils would be ready to move on to the next stage of their learning. Approximately 80% of schools made use of these materials in some way in selecting key foci or curriculum resources to use.

Of note, schools who took their curriculum map directly from a textbook (without adaptation) (see section 5.1) were statistically over-represented within the 9% of schools reporting that the Covid-19 pandemic had not had a perceived impact on their curriculum resource choices [$\chi^2(2) = 16.372$, $p < 0.001$]. This may be an artifact of having bought into a scheme and as such not wanting to create further disruption to the mathematics teaching by changing the curriculum mapping during a time of great change in schools or may suggest that such that a curriculum map provided within a scheme gave a degree of stability during turbulent times.

"We immediately gave all the parents online access to workbooks and textbooks"

Maintaining use of a DfE-approved textbook-scheme during lockdown

One school which made exclusive use of a DfE-approved textbook-scheme told us that they maintained use of the scheme and thus as much consistency as possible for pupils throughout periods of lockdown: "we gave all the parents access because [scheme publisher] allowed for online access for parents to workbooks and textbooks". As well as leading live lessons the teachers "made modelling videos - so we'd record ourselves doing the exploration and thinking about the lesson so that pupils could watch and watch again and then they'd explore". Despite this there were some topics, such as geometry, that couldn't feasibly be taught in this way; a process of auditing when schools re-opened together with the use of NCETM curriculum prioritisation materials supported effective catch up. Modelling videos made by teachers are still used now "if we've got a particular sticky subject or the pupils just want to look again at home, it has been really brilliant".

Changes to how curriculum resources were used

As might be expected, the Covid-19 pandemic had a perceived impact on how schools made use of their selected curriculum resources. In almost 20% of schools, the Covid-19 pandemic had a perceived impact on curriculum resource use to a great extent, while in a further ~55% of schools, the Covid-19 pandemic had somewhat of a perceived impact on curriculum resource use (Figure 33).

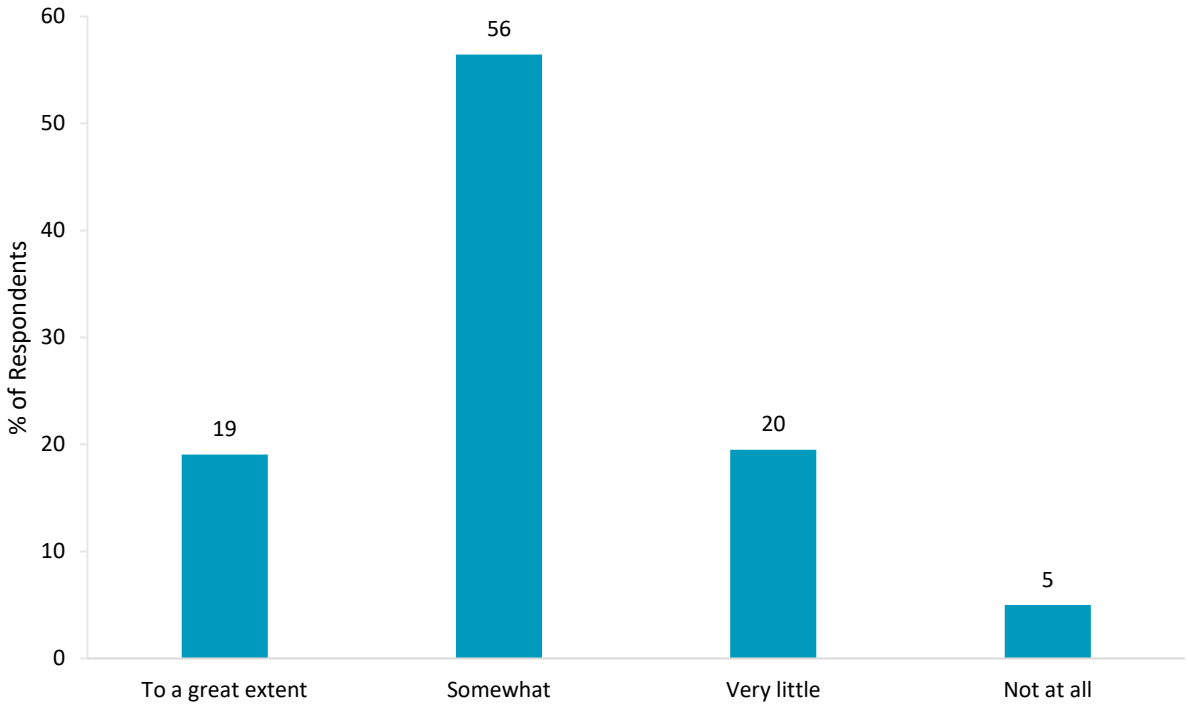


Figure 33: Perceived impact of the Covid-19 pandemic on use of curriculum resource(s)

The legacy of the Covid-19 pandemic

A recent study across all phases and subjects (PublicFirst, 2021) suggested that teachers were not keen to retain the digital first pedagogic strategies made necessary by the Covid-19 pandemic, but that they were keen to retain some of the digital tools they had been using. Our data reflect this. Returning to the free-text responses given in the Main Survey in which schools told us they had moved away from textbooks, we see that, for these schools, such changes became embedded, and the textbooks did not return:

> *"[It was] too complicated to deliver [a textbook scheme] during the pandemic. Greater reliance on guided support. [An online scheme] enabled more independent work to take place with model videos children and families could watch.* ***We decided not to change back when children returned."***
>
> *[Small urban LA maintained school, South-East England]*

> *"During the first Covid lockdown, we found the [online scheme] materials much more useful for setting work online so abandoned [textbook scheme] mid-year.* ***On our return, we thought that [the online scheme] was more flexible to allow for catch up, and considerably cheaper."***
>
> *[Medium urban LA maintained school, North-East England]*

> *"We were using [our textbook scheme] prior to lockdown, but [an online scheme] had the most accessible offer for home learning* ***and we stuck with them."***
>
> *[Very small rural academy, East of England]*

In these examples we see how inflexibilities, particularly in the textbook aspect of textbook-schemes (which is the format of both DfE-approved textbook-schemes) were revealed through the Covid-19 pandemic response and resulted in a permanent change, namely the decision not to return to textbook-schemes. However, not all changes were in this direction, nor were they limited to those who had originally used a textbook-scheme.

74% of schools were using an online-scheme as their central spine prior to the Covid-19 pandemic. These schools may have found themselves 'ahead of the game'. Unlike the schools who needed to quickly find an online alternative, schools already using an online-scheme potentially faced fewer problems in making provision for online home learning. What happened in these schools (using an online-scheme) during, and post-pandemic seems to have taken different directions. As far as we can ascertain, no demographic feature of the schools was associated with the direction of the decision made. In some cases, having to work intensely with the online-scheme allowed for greater understanding of the online-scheme's development and what it was designed to achieve. No longer being able to easily supplement or adapt such an online-scheme *during* the Covid-19 pandemic (due to the impracticalities of sending curriculum resources from a wide range of places home or in providing different instructions to different pupils) could result in a school honing in on that online-scheme *post*-pandemic, reducing the extent of supplementation from other curriculum resources:

"We're using more of it than we did before lockdown. I think it made us appreciate it, really."

Increased engagement with scheme because of the Covid-19 pandemic

One school had been using an online-scheme prior to the Covid-19 pandemic to support the planning of small steps but were supplementing this with curriculum resources from elsewhere. Covid-19 pandemic lockdowns afforded the opportunity to engage in more depth and detail with the online-scheme. The experience led them to understand the value of the online-scheme as a whole; they found that pupils liked the structure and presentation too. Now they are making greater use of the online-scheme and making fewer adaptations of them: "we used to turn them all into notebooks and add in different bits. But now we are using them much more as they come".

For other schools, the experience was different. While an online-scheme was undoubtedly supportive of the circumstances arising *during* the Covid-19 pandemic, in the *post*-pandemic phase, where schools were addressing learning loses, the online-scheme couldn't provide everything needed. As this school reported, it was the need to address these gaps which led to a change in how the online-scheme was used:

> *"We have significant gaps across the school due to inequality of disadvantaged children. Specifically teaching the Ready to Progress materials, moving away from [fully online scheme] between March and July helped though. Involvement with NCETM Maths Hubs has also been helpful, and they support our decision to balance some [fully online scheme] resources with a mixture of other things to balance our Concrete, Pictorial, Abstract approach for our children."*
>
> *[Large urban academy, East of England]*

Being forced through the circumstances of the Covid-19 pandemic to work so intensely with an online-scheme also proved a catalyst for reflection on what an online-scheme could and could not do. For one school, intense use of an online-scheme revealed limitations in that online-scheme, where the online provision became a performance and where teachers were subjugated to the role of deliverers or performers:

"It became a bit 'CBeebies'. We're moving away from actual learning and just performing this now."

Systemic changes accelerated by the Covid-19 pandemic

In one school, lockdown experiences intensified an existing dissatisfaction with an online-scheme. As a large school with many new teachers the subject lead wanted "to ensure that they had the opportunity to actually learn mathematics, I wanted them to have the knowledge of planning a coherent learning sequence that they had developed themselves rather than just deliver something verbatim from a slide." Dissatisfaction centred on coverage, and a view that the long-term plan lacked coherence "and then the boredom of delivering something that was so the same everyday. You know it kind of disempowered us. You know we want to own this again."

The school now curates its own curriculum drawing on NCETM resources for teaching mathematics and additional curriculum resources from various sources.

What we see is that the perceived impact and legacy of the Covid-19 pandemic has not been consistent, and we are likely to see Covid-19 pandemic-predicated decisions made for some time yet. Some schools have stuck with what they were using prior to the Covid-19 pandemic, others changed in response to the Covid-19 pandemic – particularly to allow for home learning – and since the pandemic some schools have reverted to pre-pandemic practices, some have kept their Covid-19 pandemic change, while others have employed a range of other practices, often in response to learning loses, both moving closer too, and further away from, a central spine.

Annex 2: Curriculum Resources Currently Used

At the time of our Main Survey, we identified 107 different curriculum resources used for the delivery of primary mathematics in schools across England (the initial list we compiled can be found in the Main Survey questions on p.100 while the ten most commonly cited curriculum resources can be found in Table 7 on p.47). These resources have been designed for different purposes. Some are schemes, designed to be used as a stand-alone resource covering all years and topics of the primary mathematics curriculum (e.g., the DfE-approved textbook-schemes). Others are curriculum resource banks, which may be designed by and for teachers. Some are designed with a particular topic or mathematics process (such as problem-solving) in mind and are designed, from the outset, to be supplementary. Curriculum resources take different formats, some being available in print only, some online only, and others hybrid. Some curriculum resources are free, while others attract a one-off cost (such as purchasing a book or downloading a specific worksheet) or have ongoing subscription costs.

To support analysis of our Main Survey data, we coded each of the 107 curriculum resources against the characteristics described above. This allowed us to pull out, for example, schools using textbook-based schemes and contrast their responses with schools using non-textbook-based schemes. It also allowed us to identify whether there were any clusters, for example identifying whether schools were more inclined to curate resources from free providers or those they needed to pay to access. The coded features, and categories used within these, are shown in Table 16. These of course do not capture everything about each curriculum resource but give a snapshot of features of the landscape.

Coded feature	Categories
Age	Primary (covers all of Key Stage 1 (5-7 year-olds) and Key Stage 2 (7-11 year-olds)
	KS1 (currently only covers Key Stage 1)
	KS2 (currently only covers Key Stage 2)
Mode	Hybrid (mainly online)
	Fully online
	Paper-based
	Hybrid (mainly paper-based)
Textbook-based	Textbook-based – includes physical textbooks
	Non-textbook – does not include physical textbooks
Format	Curriculum mapped scheme – designed to be used, if desired, as the sole curriculum resource
	Curriculum resource programme – may be mapped to the curriculum but not designed for sole use
	Resource bank – repository of activities/resources
	Online resource (App/game/CAI/video/etc.)
	Training/planning (no classroom resources)
Content	Stated skill/content area (if not a scheme)
	Intervention
Workbooks	With pupil workbooks
	Without pupil workbooks
Access	Free – all aspects are free to use / download
	Pay to access – all aspects (online or paper-based) must be paid for, either one-off or subscription
	Free and pay to access options – some aspects are free, others (usually a 'premium account') attract a cost

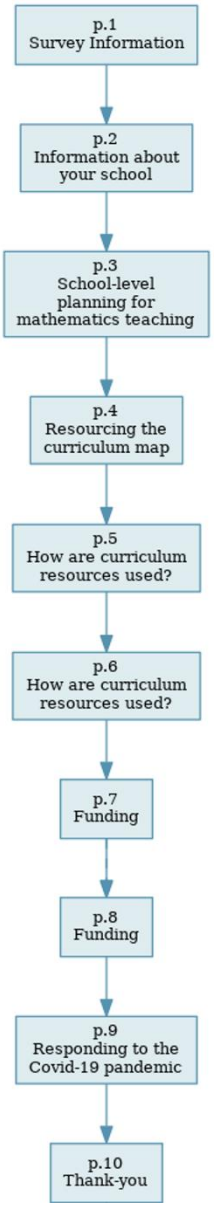
Table 16: Features of curriculum resources currently used

Annex 3: Main Survey

The Main Survey involved multiple-choice, ratings and free-text questions. We developed questions in collaboration with our Expert Teacher Panel, a group of Mathematics Subject Leaders from across England. Survey questions, and the survey itself, were structured to respond directly to our three Research Questions. The Main Survey was developed using *JISC [Joint Information Systems Committee] Online Surveys* allowing us to pipe respondents to specific questions based on earlier responses. The survey structure, survey questions including piping, and the achieved sample in comparison with the population, are detailed below.

Survey structure

The survey was structured in a linear fashion over ten sections. All participating schools answered questions within each section, but questions within these sections were piped based on earlier responses.



Section 1 (p.1) contained essential project information in line with both the British Educational Research Association and the University of Brighton ethical practice guidelines. It explained what information was being collected, for what purpose and how it would be processed and stored. Only participating schools who consented to this use of their data were able to proceed to the Main Survey.

Section 2 (p.2) collated three pieces of information about the participating school – name, address and Unique Reference Number (if known). This information was used to map the respondent to the information held in the DfE *Get Information About Schools* database providing demographic information about each school. Once mapped, school identification information was stripped from the database.

Sections 3 to 9 (p.3 to p.9) asked our Main Survey questions developed as detailed above and allowing us to address our research questions. These consisted of a range of response methods, including some free-text responses. Where a list of choices was provided which may not have covered all eventualities, schools were able to select "other" and provide further information in a free-text response.

Section 10 (p.10) concluded the Main Survey and allowed schools to enter contact details should they wish to be entered into an incentive draw. Most schools completed these, and these details were disaggregated before the data was downloaded and contact details were destroyed once the prize draw had been completed and winners contacted.

All questions were optional, and participants could move backwards and forwards through the survey questions before submitting their completed survey.

Survey questions

The questions asked in the Main Survey, along with the possible responses, are presented in Table 17. All participants started at Question 1, but based on the answers given to questions, may have been piped to different sections/questions. They would not have had sight of the questions which were not relevant for them.

Some questions contained pop-outs or hyper-links to additional information, such as information on the NCETM curriculum prioritisation materials. These questions are indicated by asterisks after the question wording.

Multiple choice questions were either single choice (highlighted in blue in the table) or allowed respondents to tick all options which applied (highlighted in green in the table). Where necessary, multiple-choice options also included "other" and respondents ticking this option were piped each time to a free text box asking for further information. These are not shown in the table for clarity. Some questions asked for a free text response without options (highlighted in red).

Section	Ref #	Question	Options	Next qu.
Section 1 Survey information and Privacy and consent statement	1	Thank-you for your interest in our survey. We are aiming to find out which mathematics curriculum resources schools use and how they use them. The survey should only take about 15 minutes. You can stop at any point and return later. As a thank-you, you will have the option on completion to include an email address for entry into a prize draw to win one of 25 £100 book tokens. Please ensure you click 'Finish' on the final page to submit your completed survey.		2
	2	I have read the information above and understand the purpose of this study and what is required from me. I understand that my participation is voluntary and that I am free to withdraw from the study at any time without giving a reason and without incurring consequences from doing so. Data will be treated confidentially. I understand that the name of my school is only being collected to support the data analysis (e.g., by geographical area) and that neither I nor my school will be identifiable in any project outputs.		3
	3	I agree to take part in this study.	Yes	4
			No – this will end the survey	EXIT

Section 2 Information about your school	4	If you are part of a Trust or (e.g.,) junior school with a neighbouring infant school, please answer based on your school only. If you are not sure, please just answer as best you can or leave questions blank; we are not expecting you to carry out extensive research to find the answers to our questions!		5
	5	What is the full name of your school (e.g., St Mark's C of E Junior School)?	***Free-text response***	6
	6	What is the address of your school (e.g., Bowling Green Lane, Middletown)?	***Free-text response***	7
	7	If you know your school's Unique Reference Number (URN – 6 digits) or Department for Education number (7 digits, often written on Ofsted reports) please enter it here.	***Free-text response***	8
Section 3 School-level planning for mathematics teaching	8	This section looks at your school's mathematics curriculum map (also known as a scheme of work / curriculum plan / long term plan etc.) outlining the topics or units taught to each year group. Many schools altered their planning and resourcing due to Covid-19. Please complete this section with respect to what your school is doing now, in the 2021-22 academic year.		9
	9	How is your school's mathematics curriculum map developed? (Please select one answer)	Our curriculum map comes directly from a textbook (e.g., Inspire, Cambridge Primary Maths) or online/hybrid programme/scheme (e.g. White Rose, MyMaths)	10
			Our curriculum map is based on a textbook or online/hybrid programme/scheme, but we adapt it	10
			Our trust or school creates its own curriculum map	10
			Other	10
	10	Why does your school or trust take this approach?	***Free-text response***	11
Section 4 Resourcing the curriculum map	11	Curriculum resources provide the basis of lessons or activities. They may come from complete programmes or additional sources. Importantly they are a teaching / learning activity in themselves, rather than an activity support (so we wouldn't include clock face templates as these are meaningless without activities alongside them).		12
	12	Which of the following best characterises your school's general use of curriculum resources to support the teaching of your curriculum map this academic year (2021-22)? (Please select one answer)	We use resources exclusively from one textbook programme or online/hybrid scheme (e.g., everyone uses Heinemann Maths and no additional items)	13
			We use resources mainly from one textbook programme or online/hybrid scheme but use additional resources as required	13

			We use curriculum resources from various places	19
			Other	19
	13	Who decides which main textbook programme or online/hybrid scheme is used in your school? (tick all that apply)	The trust	14
			Our Head or Senior Leadership Team	
			The mathematics subject lead / mathematics team	
			Key stages or year-groups teams	
			Other	
	14	Please select the main textbook programme or online/hybrid scheme used in your school / by your trust this academic year (2021-22) (tick one only)	Maths – No Problem!	15
			Power Maths	15
			White Rose (free + Premium content)	16
			White Rose (free content only)	16
			Abacus	16
			ARK Mathematics Mastery	16
			Big Maths	16
			Busy Ant Maths	16
			Cambridge Primary Mathematics	16
			Classroom Secrets	16
			Complete Maths	16
			Effective Maths	16
			Heinemann Maths	16
			Inspire Maths	16
			Kangaroo Maths	16
			Maths on Target (Target Maths)	16
			Maths Shed	16
			MyMaths	16
			Numicon (maths scheme)	16
			Oxford Mathematics	16
			Real Shanghai Mathematics	16
			Rising Stars Mathematics	16
			Scholastic National Curriculum Maths	16
			The Shanghai Maths Project	16
			Zap Maths	16

			Other	16
	15	We are interested in specific aspects of certain programmes. Which of the following aspects of Maths – No Problem! or Power Maths does your school have? (Tick all that apply)	Textbooks	16
			Printed practice books / workbooks (designed for pupils to write in, although you may not use them in this way)	
			Online subscriptions (which include the Teacher Guide for Maths – No Problem!)	
			Printed Teacher Guides (Power Maths only)	
			Assessment materials	
	16	Why did your school decide to use one main textbook programme or online/hybrid scheme?	***Free-text response***	17
	17	When did your school start using its selected textbook programme or online/hybrid scheme (if you are not sure, please give your best estimate)?	Before September 2000	19
			Between September 2000 and August 2014	19
			Between September 2014 and August 2016	19
			Between September 2016 and March 2020	19
			Between April 2020 and August 2021 (in response to the pandemic)	19
			Between April 2020 and August 2021 (not in response to the pandemic)	18
			Since September 2021	18
	18	Why has you school recently changed to / adopted this scheme?	***Free-text response***	19
	19	Which of the following resources are used somewhere in your school? Don't worry if you are not completely sure, we just want to develop a picture of the range being used. (Tick all that apply)	Abacus	20
			ABBC Maths	
			ARK Mathematics Mastery	
			Badger Maths	
			BBC Bitesize	
			BEAM resource books	
			Big Maths	
			Busy Ant Maths	
			Cambridge Primary Mathematics	
			CGP Maths (Schofield & Sims)	
			Classroom Secrets	
			Complete Maths	

			CorbettMαths	
			Deepening Understanding	
			Diagnostic Questions.com	
			Effective Maths	
			Grammarsaurus Maths	
			Hamilton Trust	
			Heinemann Maths	
			Insights	
			Inspire Maths	
			I See Maths - Gareth Metcalfe	
			Kangaroo Maths	
			Khan Academy	
			Learning by Questions	
			Let's Think (Primary CAME)	
			Mathletics	
			Maths Bot	
			Mathsbox	
			Maths Flex	
			Maths Frame	
			Maths – No Problem!	
			Maths on Target (Target Maths)	
			Maths Shed	
			Mathsteasers	
			Mr Bee Teach	
			MyMaths	
			NCETM Materials (Mastering Number, PD materials, etc.)	
			Nrich	
			Number Sense Maths	
			NumberStacks	
			Numbots	
			Numicon (maths scheme)	

			Oak Academy	
			Oxford Mathematics	
			Power Maths	
			PurpleMash	
			Real Shanghai Mathematics	
			Rising Stars Mathematics	
			Scholastic National Curriculum Maths	
			School Jam	
			Secure Maths (Collins)	
			SumDog	
			Talk It, Solve It	
			Teach Active Online	
			TES Teacher	
			The Shanghai Maths Project	
			Third Space Learning	
			Times Tables Rock Stars	
			Twinkl	
			White Rose (free + Premium content)	
			White Rose (free content only)	
			You Cubed	
			Zap Maths	
			Other	
	20	How confident or not are you that your answer to the above question captures the full range of resources being used in your school?	Not at all confident	21
			I know some of the more common resources being used but not what individual teachers do	
			I have captured many of the resources being used but not the practice of all teachers	
			I am confident I have captured the majority of the resources being used by most teachers	
			I am very confident this is an accurate picture	
	21	Do you anticipate any major changes to the resources your school will select for the 2022/23 academic year?	Yes	22
			No	23

	22	What changes might your school make?	***Free-text response***	23
Section 5 How are curriculum resources used?	23	Are there any mathematics curriculum resources your school uses for the purpose of planning only?*	Yes	24
			No	26
	24	Which curriculum resource(s) does your school use for the purpose of planning only?	***Free-text response***	25
	25	Why has your school decided to make use of this resource for the purpose of planning only?	***Free-text response***	26
	26	Are there any curriculum resources your school uses just for the purpose of setting work to be completed at home?*	Yes	27
			No	29
	27	Which curriculum resource(s) does your school use for the purpose of setting work to be completed at home only?	***Free-text response***	28
	28	Why has your school decided to make use of this resource for the purposes of setting work to be completed at home only?	***Free-text response***	29
Section 6 How are curriculum resources used?	29	When preparing lessons, how often do teachers in your school find they need to adapt the available curriculum resource materials?	Every lesson/session	30
			Most lessons/sessions	30
			More often than not	30
			Occasionally	30
			Rarely or never	32
	30	In what ways do teachers adapt the material? (Tick all that apply)	Change the year group in which a topic is taught	31
			Alter the sequencing of topics within a year	
			Vary the time spent on some topics/units (more or less time)	
			Teach a different mathematical method	
			Add, remove, or change activities	
			Ask pupils / some pupils to only complete selected questions from a page / worksheet	
			Other	
	31	Why might teachers need to adapt the curriculum resources? (Tick all that apply)	School / Trust requirement to adapt materials	32
			Catering for mixed-age classes	
			Coverage of some topics in the material is weak	
			Need to adjust for pupils' attainment levels	
			Reduce language demand	
			Provide more variety	

			Suggested activities are too long / short	
			Other	
	32	Which of the following approaches do teachers in your school commonly use during teaching inputs? (Tick all that apply)	Material shared via an interactive screen, projector, or visualiser	33
			Material shared via pupils' tablets/laptops	
			Pupils have access to textbooks (shared or individual)	
			Pupils have access to a photocopied sheet (e.g., downloaded sheet, page from textbook)	
			Other	
	33	Approximately, how much of pupils' recording in mathematics in your school is in/on purchased or downloaded workbooks or worksheets?	None	34
			25%	34
			50%	34
			75%	34
			All / nearly all	34
	34	When completing mathematics tasks are pupils in your school:	More likely to work on the same task	35
			More likely to work on differentiated tasks	35
			Approximately an equal split	35
Section 7 Funding	35	This section is about DfE funding available to help schools buy primary mathematics textbooks. Your school might have had this funding.		36
	36	Were you aware of the existence of the DfE textbook funding scheme?*	Yes	37
			No	49
	37	How did you hear about the DfE funding for primary mathematics mastery textbooks?	***Free-text response***	38
	38	Do you know if your school has ever been eligible (whether used or not) for DfE funding for primary mathematics mastery textbooks?	Yes, we have previously been eligible for the matched-funding scheme (running from 2016-2020)	39
			Yes, we were eligible last year for the subsidy funding scheme	46
			No, we have never been eligible for funding	49
			I don't know whether we have been eligible or not	49
	39	Did your school make use of the DfE matched funding you were eligible for? (Please select one answer)	Yes, we made our first purchase of some or all of Maths – No Problem!	40

			Yes, we made our first purchase of some or all of Power Maths	40
			Yes, we made our first purchase of some or all of both Maths – No Problem! and Power Maths	40
			Yes, we had previously purchased some or all of Maths – No Problem! or Power Maths and used the funding to top up our supplies	40
			Yes, we had previously purchased some or all of Maths – No Problem! or Power Maths and used the funding to purchase some or all of the alternative scheme	40
			No, we decided not to apply for the funding	45
	40	What did your school purchase with the DfE matched-funding (including your school's contribution)? (Tick all that apply)	Textbooks	41
			Printed practice books / workbooks (designed for pupils to write in, although you may not use them in this way)	
			Online subscriptions (which include the Teacher Guide for Maths – No Problem!)	
			Printed Teacher Guides (Power Maths only)	
			Assessment materials	
	41	Did your school use the DfE matched-funding (including your school's contribution) to purchase materials for:	All or most primary year groups in your school?	43
			Just selected primary year groups?	42
	42	Why did your school decide only to purchase items for some year groups?	***Free-text response***	43
	43	Which of the following best characterises your school's use of Maths – No Problem! or Power Maths today?	We have continued to use the programme and now fund consumables (e.g., pupil workbooks) ourselves	49
			We have continued to use the programme and the materials we have, but we no longer buy new consumables	49
			We have largely or completely stopped using this resource	44
	44	Why did your school decide to stop using Maths – No Problem! or Power Maths?	***Free-text response***	49
	45	Why did your school decide not to apply for this funding?	***Free-text response***	49
	46	Did your school make use of the DfE subsidy you were eligible for? (Please select one answer)	Yes, we made our first purchase of some or all of Maths – No Problem!	47

			Yes, we made our first purchase of some or all of Power Maths	47
			Yes, we made our first purchase of some or all of both Maths – No Problem! and Power Maths	47
			Yes, we had previously purchased some or all of Maths – No Problem! or Power Maths and used the funding to purchase some or all of the alternative scheme	47
			No, we were not successful in our Expression of Interest for the subsidy	49
			No, we decided not to apply for the subsidy	48
	47	What did your school purchase with the DfE subsidy? (Tick all that apply)	Textbooks	49
			Printed practice books / workbooks (designed for pupils to write in, although you may not use them in this way)	
			Online subscriptions (which include the Teacher Guide for Maths – No Problem!)	
			Printed Teacher Guides (Power Maths only)	
			Assessment materials	
	48	Why did your school decide not to apply for this subsidy?	***Free-text response***	49
Section 8 Funding	49	To what extent is funding a factor or not a factor in the curriculum resources your school has chosen to use?	Funding is not a factor in our decision making	50
			Funding is a minor factor in our decision making	50
			Funding is of equal consideration to other factors in our decision making	50
			Funding is a major factor in our decision making	50
			Funding is the most important factor in our decision making	50
	50	To what extent is funding a factor or not a factor in **the ways in which your school uses** curriculum resources (i.e., photocopying / using the visualiser rather than all pupils having a textbook)?	Funding is not a factor in how we use curriculum resources	51
			Funding is a minor factor in how we use curriculum resources	51
			Funding is of equal consideration to other factors in how we use curriculum resources	51
			Funding is a major factor in how we use curriculum resources	51

			Funding is the most important factor in how we use curriculum resources	51
	51	If there were no funding constraints, would your school have made different decisions about the curriculum resources they buy and how they use them?	Yes	52
			No	53
	52	Please tell us about these different decisions.	***Free-text response***	53
Section 9 Responding to the Covid-19 pandemic	53	To what extent has the Covid-19 pandemic impacted or not impacted on the choices you've made as a school about which curriculum resource(s) to use in this academic year (2021/22)?	To a great extent	54
			Somewhat	54
			Very little	54
			Not at all	54
	54	To what extent has the Covid-19 pandemic impacted or not impacted on the choices you've made as a school about the ways you have used curriculum resource(s) this academic year (2021/22)?	To a great extent	55
			Somewhat	55
			Very little	55
			Not at all	55
	55	Has your school used the Ready to Progress Criteria (DfE non-stat. guidance documents) and/or the NCETM Curriculum Prioritisation materials to adapt your school's mathematics curriculum map this year (see 'more info' for details of these publications)?*	Yes, throughout the school	56
			Yes, for some year groups only	56
			Yes, for intervention groups only	56
			No / Unsure	56
	56	Is there anything else you would like to tell us about your school's choice of, or use of, curriculum resources more generally?	***Free-text response***	57
Section 10 Thank-you	57	By way of a thank-you, we are offering you the chance to win one of 25 £100 National Book Tokens. If you would like to be entered into the draw, please enter your email address below.* Whether or not you decide to enter the draw, please click "Finish" below to submit your survey responses.	***Free-text response***	END

Table 17: Main Survey questions

Achieved sample and comparison with population

Table 18 shows the breakdown by school demographics (as available in the DfE Get Information about Schools tables, accessed for the purpose of our analysis on 20.12.2021) for the school population (of schools meeting our inclusion criteria) and for our achieved sample. We constructed our own categorisation for two demographic variables:

- Number on Roll (NOR) is provided by the DfE as a discrete number. No agreed categorisation of school size exists, so we divided the population data into quartiles to establish four school size groups for ease of analysis.
- Eligibility for Free School Meals (FSM) is provided by the DfE as a percentage. We have categorised each school on the basis of this data as being at or above the national average, or being below the national average.

Data available on a school's location is particularly fine-grained in the DfE dataset (e.g., Rural hamlet and isolated dwellings in a sparse setting). For our analysis, we collapsed the data into two categories: Rural and Urban.

For some categories, particularly Ofsted rating, information for some schools was missing from the DfE dataset. All analysis of the association between Ofsted ratings and questions of interest is based on schools where data were available.

The Main Survey returned 664 unique and valid responses, more than the minimum ideal sample size of 639 (based on a power calculation with a robust 99% power to detect an effect with a 5% margin of error). Chi-squared tests of our achieved sample against the known population (from the DfE database) indicated that the distribution of sample proportions (respondents to the Main Survey) was not significantly different (at $\alpha = 0.01$) from the distribution of population proportions across all demographics. Based on this we can assume that our sample is representative of the population, and we are therefore able to draw conclusions about the population from our sample where questions were answered by the full sample.

Demographic	**Subgroups**	**Population n**	**Population %**	**Survey n**	**Survey %**
School type	Local authority maintained schools	10379	60.9	439	66.1
	Academies	6375	37.4	217	32.7
	Free Schools	284	1.7	8	1.2
Phase	Primary	16779	98.5	655	98.6
	Middle deemed primary	6	0.0	0	0.0
	Middle deemed secondary	96	0.6	6	0.9
	All-through	157	0.9	3	0.5
NOR	Very Small	4176	24.5	115	17.3
	Small	4162	24.4	173	26.1
	Medium	4191	24.6	161	24.2
	Large	4210	24.7	211	31.8
	Not Known	299	1.8	4	0.6

Demographic	Subgroups	Population n	Population %	Survey n	Survey %
FSM above national average	Yes	7069	41.5	286	43.1
	No	9664	56.7	374	56.3
	Not Known	305	1.8	4	0.6
Region	East Midlands	1661	9.7	59	8.9
	East of England	2022	11.9	87	13.1
	London	1841	10.8	77	11.6
	North East	890	5.2	27	4.1
	North West	2460	14.4	100	15.1
	South East	2633	15.5	129	19.4
	South West	1923	11.3	67	10.1
	West Midlands	1814	10.6	62	9.3
	Yorkshire and the Humber	1794	10.5	56	8.4
Urban / Rural	Rural hamlet and isolated dwellings	742	4.4	22	3.3
	Rural hamlet and isolated dwellings in a sparse setting	82	0.5	2	0.3
	Rural town and fringe	1793	10.5	68	10.2
	Rural town and fringe in a sparse setting	87	0.5	4	0.6
	Rural village	2062	12.1	67	10.1
	Rural village in a sparse setting	150	0.9	2	0.3
	Urban city and town	6563	38.5	291	43.8
	Urban city and town in a sparse setting	25	0.1	0	0.0
	Urban major conurbation	4973	29.2	192	28.9
	Urban minor conurbation	560	3.3	16	2.4
Ofsted Rating	Good	10767	63.2	423	63.7
	Outstanding	2045	12.0	69	10.4
	Requires improvement	1261	7.4	68	10.2
	Serious Weaknesses	20	0.1	1	0.2
	Special Measures	34	0.2	0	0.0
	Unknown	2911	17.1	103	15.5

Table 18: Main Survey achieved sample

Annex 4: Subsidiary Survey

For our Subsidiary Survey of teachers' practices in relation to the choice and use of curriculum resources in primary mathematics, we commissioned, and worked with, Teacher Tapp, to host, administer, and return data from, an online survey.

Intent of the instrument

Teacher Tapp is a convenience sample, with all teachers able to download the survey app and answer questions. The claim it is nationally representative is made because analysis is restricted to those who can validate that they do indeed teach in a state-funded mainstream primary school, and where sample weights can be calculated by comparing the demographic profile of the sample against the School Workforce Census in England. All questions used in this study are multiple and single response questions.

Target population and sample weights

This study targeted all teachers who taught in a state-funded, mainstream primary school in England. Teacher Tapp reweights responses to survey questions to ensure the panel reflects the demographics of the national population of teachers in England (using the School Workforce Census for the state schools in this study[11]). The process for calculation of post-stratification weights is as follows:

- The results of all users who declare that they are not a teacher are dropped from the sample
- The results of any teacher who has not yet provided us with valid information for teaching phase, school funding, seniority or job post, gender, age, and school type are dropped. These respondents cannot be used because these are the characteristics that allow matching against the population in the School Workforce Census.
- Population shares are calculated in School Workforce Census data for 24 groupings of teachers who are allocated according to their phase, funding, region, gender, age, and job post.
- Sample shares are calculated in the Teacher Tapp valid responses for each question, which yields sample weights as the ratio of population to sample share.
- The smallest sample weights are applied to those who are most over-represented in the convenience sample. These are senior leaders and headteachers of both genders in primary schools across all regions in England, who have calculated sample weights between 0.4 and 0.5.
- The largest sample weights are applied to those who are least well represented in the convenience sample. These are female classroom teachers in their 20s who have sample weights of between 1.8 and 2.1.

Analysis of representativeness of the sample

Whilst the Teacher Tapp sample can be re-balanced to reflect measured demographic characteristics, it is not possible to re-balance against characteristics that are not measured in the entire population. These include commitment to teaching, interest in educational research, involvement in education

[11] Details of the School Workforce Census can be found here:
Department for Education (2022). *Statistics on the size and characteristics of the schools' workforce in state-funded schools.* Available at: https://www.gov.uk/government/collections/statistics-school-workforce

communities, and so on. To check the extent to which unmeasured characteristics may be causing bias, the following checks are regularly performed:

- Teachers who have been on the panel since 2017 and so we suspect are particularly research active are excluded to check they not materially changing results.
- Teachers who say they are heavily active on education-related social media or who say they write blog posts regularly are excluded, which does not materially change results.
- Selected questions from the OECD TALIS survey, the sole recent random sample of teachers with over 75% response rate, are asked on the app to check those findings can be replicated. Note that the Teacher Tapp experience profile of the weighted sample mirrors that in the OECD's TALIS 2018 sample, even though years of experience is not a variable used in the weighting procedure.[12]

To be clear, these problems of representativeness of sample afflict all surveys of teachers, whether they employ random sampling or not. This is because survey response rates are typically very low (a 5% response rate is very common) and so no survey can rely on random sampling to achieve confidence that they have matched population characteristics.

Survey questions

The survey questions were adapted directly from the Main Survey. There were some minor adaptions to these questions made to fit the need for simple multiple response questions within the Teacher Tapp app. The questions asked are in Table 19, along with the possible responses. The questions were asked over three days (18th-20th March). All state-funded mainstream primary teacher who opened the app on any of these three days was offered the opportunity to respond. 75% of the sample responded on day one, with 15% on day two and 10% on day three. Count of valid responses varies from 2017 through to 1958. This small fall-off happens because some respondents fail to answer all questions on the day; they become distracted, have a poor mobile signal, or because they actively choose not to continue answering.

Question text	Single or multiple response	Responses	Response options
In the last week, which of these approaches have you used in your maths teaching?	Multiple response	2001	a. I used materials or activities from a textbook, workbook or other worksheets exactly as they came b. I selected and used only parts of a worksheet or textbook page c. I drew on a range of sources to produce my own materials or activities d. I produced my own materials or activities from scratch e. Not relevant / cannot answer

[12] See Appendix C in Jerrim, J. and Sims, S. (2019). *The Teaching and Learning International Survey (TALIS) 2018*, Department for Education Research Report, Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/919064/TALIS_2018_research.pdf .

Question text	Single or multiple response	Responses	Response options
In your current school, do you feel free to use maths materials (e.g. worksheets, PowerPoints and games) that you have found yourself?	Single response	2012	a. No, our school mandates for the materials we can use b. Yes, but only in exceptional circumstances c. Yes, but I would need to discuss it with colleagues (such as other year group teachers) first d. Yes, I am completely free to use materials of my choosing e. Not relevant / cannot answer
In the last week, in which of the following have your pupils recorded their written work in maths?	Multiple response	1796	a. In an exercise book or on paper b. On a worksheet/booklet I made myself for my personal use c. On a worksheet/booklet provided by my school or Trust d. On an externally created worksheet/booklet that is NOT part of our main curriculum scheme e. On an externally created worksheet that IS part of our main curriculum scheme f. On an externally created booklet that IS part of our main curriculum scheme g. None of the above - no written work completed in maths h. None of the above - I haven't taught a class maths in the last week i. Not relevant / cannot answer
In the last week, which of these most closely reflects how you sourced your maths planning and teaching materials?	Single response	2017	a. I used one maths scheme only (e.g., I only used White Rose and nothing else) b. I used one main maths scheme but added in some material from other schemes / sources c. I used material from a range of schemes / sources (including my own) d. Not relevant / cannot answer
In the last week, how often have you used maths materials which you have personally paid for yourself, perhaps as a one-off payment to download a sheet or through a personal subscription?	Single response	2006	a. Every lesson b. At least half of the lessons c. Less than half of the lessons d. Never e. Not relevant / cannot answer
In the last week when preparing maths lessons, how often did you find you needed to adapt materials?	Single response	1997	a. Every lesson b. At least half of the lessons c. Less than half of the lessons d. Never, because I used the materials exactly as they came e. Not relevant / cannot answer

Question text	Single or multiple response	Responses	Response options
In the last week, if you have adapted any material, was it for any of these reasons?	Multiple response	1991	a. My school / Trust requires me to adapt materials b. I have a mixed-age class c. I found that coverage of the topics in the material was weak d. I needed to match the work to pupils' attainment levels e. I needed to reduce the language demand f. I wanted to provide more variety to the activities g. I thought that the suggested activities were too long / short h. Not relevant / cannot answer
In your last maths lesson, did you plan for the children to...?	Single response	1977	a. Keep together, generally working on the same tasks at a similar pace b. Start together and generally work on the same tasks, but with some pupils expected to complete more or less work c. Start together, but then work on a range of differently levelled tasks d. Work on a range of differently levelled tasks from the beginning of the lesson e. None of the above f. Not relevant / cannot answer
Thinking about the last time you introduced new maths content to your class, which of these approaches did you use?	Multiple response	1967	a. I shared material via an interactive screen, projector, or visualiser b. Pupils had access to material on their tablets/laptops c. Pupils had physical access to textbooks (shared or individual) d. Pupils had access to a photocopied sheet or booklets (e.g., downloaded sheet, page from textbook) e. None of the above f. Not relevant / cannot answer
In your last maths lesson, which of the following was used MOST by your pupils to record their written work in maths?	Single response	1958	a. An exercise book or on paper b. A worksheet/booklet I made myself for my personal use c. A worksheet/booklet provided by my school or Trust d. An externally created worksheet/booklet that is NOT part of our main curriculum scheme e. An externally created worksheet that IS part of our main curriculum scheme f. An externally created booklet that IS part of our main curriculum scheme g. None of the above - no written work completed in maths h. Not relevant / cannot answer

Table 19: Subsidiary Survey questions, responses and response counts

Annex 5: Subject Leader Interviews

Subject leaders were contacted with an invitation to take part in the interviews through members of our Expert Teacher Panel, Advisory Group, and the University of Brighton Schools Partnership. Potential interviewees were asked to provide the following information:

- Their name and email address
- The name and postcode of their school and number of pupils on roll
- Usual approach to Curriculum Resource provision in their school.

The responses were used to select 12 mathematics subject leaders, each from different schools, for interview. As noted in Section 6, generally, school demographics were not generally associated with schools' choice or use of curriculum resources, but school size and location (urban/rural) were associated with how schools reported their curriculum resource choice or use. Table 20 details the demographic characteristics and mathematics curriculum resource for the 12 schools represented in the interviews.

School characteristics		**Number of schools interviewed**
NOR	Very small	1
	Small	2
	Medium	3
	Large	6
Location (urban or rural setting)	Rural town and fringe	1
	Urban city and town	9
	Urban major conurbation	2
Geographical region	East of England	1
	Midlands	2
	North-West	2
	South-West	7
School type	Academies	3
	Local authority maintained schools	9
Approach to resourcing the curriculum map	We use one scheme exclusively (textbook-based)	3
	We use one scheme exclusively (online)	4
	We mainly use one scheme but supplement it as required	2
	We use curriculum resources from various places	3

Table 20: Characteristics of interview participants' schools

The schedule of interview questions was piloted with one interviewee who had had recent experience of working in several schools that used an online published scheme and multiple additional curriculum resources. The participant had worked in different schools prior to the pandemic, during the Covid-19 pandemic lockdowns, and post-pandemic in 2022-23. Following the pilot, the interview schedule was refined, and three versions of the schedule were created:

A. Questions for participants who mainly use a text-book scheme
B. Questions for participants who mainly use an online scheme
C. Questions for participants who do not use a scheme.

Below we provide interview schedule A as an example of the schedules used.

Thank you for sharing some information about your school with us ahead of this interview. You told us that your school uses *[interviewer select 1 option]*

- one main published mathematics scheme in use called *[interviewer add]*

  OR

- more than one published mathematics scheme called *[interviewer add]*

1. Before I ask you about [main textbook scheme], may I start by asking, why did your school choose to use **a** published scheme?

2. Why did your school choose the [specific] scheme/s (or if more than one scheme, why did you decide to use more than one scheme?).
    a. (for those using more than one scheme only) Do you use one scheme more than the other? How and why?
    b. How happy are you with this approach?
    c. What has been the perceived impact of using this approach on staff and children?
    d. Do you anticipate that your school will make changes to this?

3. We'd like to know a little more about the parts of the [main textbook scheme] that you have bought and how you use them
    a. Which parts of the [main textbook scheme] do you have? Why did your school choose these?
        i. Which parts do you use? And how?
            - Prompt children's workbooks
        ii. What reasons were there for these [usage] decisions?
    b. Can you tell me more about when and how children use a textbook in maths lessons - prompt for:
        - Access
            - Children have access to shared/individual textbooks
            - Children don't have textbook but use photocopied/printed sheets from textbook
        - Phase of lesson
            - Children use textbook during teaching input
            - Children use textbook during children's activities
        - Differentiation
            - do children tend to work on the same task, on differentiated tasks, a blend of both
    c. Why do you use the textbook in this way?
    d. Is this use of textbooks and workbooks consistent across the school (KS1, KS2)?

4. We'd like to know a little more about if and how teachers in your school **adapt** [the main textbook scheme] to prepare lessons:
    a. When preparing lessons, do teachers in your school find they need to adapt [the main textbook scheme] and materials?
    b. Can you tell me more about how the scheme and materials are adapted and why you make these adaptations? E.g.,
        i. Why do teachers in your school make adaptations to the material in the scheme? Prompt for
            - coverage
            - language demand of text
            - attainment levels
            - variety, mixed age
            - engagement
            - [if they say to meet children's needs – probe the specific needs]
        ii. Which of your reasons for adapting curriculum resources is most common in your school?
            - [if they say to meet children's needs – probe the specific needs]
        iii. Can you give me some examples of how (the ways in which) teachers in your school make adaptations to the curriculum resource for these reasons? Prompt for:
            - change of year group when topic taught;
            - change sequencing of topic; change time spent on topic;
            - teach a different method;
            - add, remove,
            - change activities;
            - ask children to compete differing questions
        iv. Are any changes to curriculum materials required by your school, maybe because of school policy?

5. Do you supplement your scheme(s) with any additional materials?
    a. In no, why not?
    b. If yes, why do you supplement the main scheme(s)? Probe for:
        - coverage
        - focus on particular topics/approaches/homework
        - SEN etc,
        - preference for particular old resources
        - [if they say to meet children's needs – probe the specific needs]
    c. Is this supplementary use decided by individual teachers or led by SLT
    d. How often/when are supplementary materials used? (if not already answered in part b)

6. The last few years have seen a lot of changes in schools because of the pandemic
    a. Did your school make any new decisions about which curriculum resources to use as a result of the Covid pandemic? What were these? Probe for:
        - catch-up programmes (eg immediate aftermath; 8 March 2021 schools re-opened)
        - use of new resources

- changed ways of using existing resources

b. If so, what has happened now that more normal working practices have resumed – have you returned to pre-pandemic decisions, or kept with the new decisions?

7. Is there anything else you would to tell us about your use of curriculum resources in your school?

8. A final quick question, overall, how happy are you with your approach? If you had no funding constraints, would you change it?

Interviews were conducted on Microsoft Teams with the transcription function enabled. They were additionally audio recorded to enable refinements to the accuracy of the transcriptions. Transcriptions were uploaded to Nvivo where data was coded using codes drawn from the interview questions and from themes arising from analysis of the Main Survey.

To construct the illustrative vignettes, coding reports related to selected narratives in the main report were exported from Nvivo and the account(s) synthesised to create third person narratives, exemplified with summative direct quote from the interviewee.