The teacher as street-level bureaucrat: science teacher’s discretionary decision-making in a time of reform

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ABSTRACT
This article explores teacher discretion in the context of the English 2014 science curriculum and assessment reforms. The study positions primary and secondary school science teachers as “street-level bureaucrats” in which they are not just mere implementers of policy but instead pivotal actors with much agency. Through the analysis of questionnaire and interview data drawn from a sample of 26 science teachers in England, this empirical research advances our understanding of teachers’ discretionary decision-making considering policy change and reform. The findings indicate that discretion varied, not simply between the secondary and primary sectors, but within each key stage. With the introduction of the new curriculum, secondary teachers expressed higher levels of autonomy and more discretion teaching key stage 3 than with key stage 4 and key stage 5. Despite this, we argue that it has become more difficult for teachers to circumvent the “rules” associated with the attainment measures in the ways that were previously possible. We conclude that the embodiment of teachers as street-level bureaucrats is not perfect as the boundaries around teacher’s discretion and decision-making are heavily dependent on the school and national policy context, but it remains a useful theory in advancing our understanding of teacher.

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Introduction
Abundant research has considered the association between student attainment in science and teacher classroom practice (e.g. Hanna et al., 2010; Muijs & Reynolds, 2017). However, less research has considered the implications of education reform demands on science teachers’ classroom practice (for exceptions see Baird et al., 2019; Ryder et al., 2014; Ryder & Banner, 2013). Much of the education reform in STEM (Science, Technology, Engineering, and Mathematics), both nationally and internationally, have been driven by a perceived need to develop a highly-skilled workforce in order to bring about economic growth (House of Commons Committee of Public Accounts,
2018; OECD, 2010). Whatever the desired outcomes of the STEM agenda maybe, what remains constant is government action and reform of science education in the UK (HM Treasury, 2014) and that seems unlikely to change in a post-COVID19. Of course, teachers have a large and significant role to play in enacting and implementing education policy and reform and, as such, are key actors in realising government STEM policy agendas. How they adapt their practice to accommodate or indeed mould these policies and reforms is the focus of this study.

The aim of this research was to explore how teachers adapted their classroom practice in response to the 2014 to 2016 science national curriculum (NC) reforms and to uncover the extent to which they actively used professional discretion in responding to the new curriculum and its assessment. Previous research has explored teachers’ experiences of NC reform through the expression of agency (Ryder et al., 2018; Ryder & Banner, 2013). The research presented in this article, however, makes a distinct contribution by situating teachers’ exercising their professional discretion in response to science curriculum reform within the framework of Lipsky’s characterisation of public sector as acting as street-level bureaucrats (SLBs) – i.e. agents of public sector organisations such as the police, social workers, nurses, and doctors whose patterned behaviour becomes the face of public policy. This framing recognises that schools possess many of the organisational structures featured in a bureaucracy, including a hierarchy of authority, division of labour, objective standards, rules and regulations. Schools often work under budgetary constraints and with limited resources. Furthermore, they ‘process’ a large number of people with a degree of efficiency, often using ‘one size fits all’ solutions imposed through the implementation of external policy (Hoy, 2003; Lieberman, 2000).

Science reform in England since 2010

Prior to 1986, two tiers of certification for school science at 16 were available, the Certificate in Secondary Education (CSE) and the more academically demanding Ordinary Levels (O-level). The newly introduced National Curriculum (NC) brought with it the General Certificate of Secondary Education (GCSE) qualification, positioned science as a core subject within the curriculum offer (Donnelly & Ryder, 2011) and heralded significant standardisation of science education.

In 2010, plans were confirmed that a complete revision of the NC would take place with changes to the assessments for 11-year-olds at key stage 2 (KS2) alongside the reforms to the assessment of the curriculum through the GCSE and Advanced level (A-level) qualifications (Long, 2017). Attracting a mixed response, and subsequently undergoing further consultation and review (DfE, 2013; Long, 2017), the new NC was published for first teaching in 2014 (Roberts, 2018) with the reformed GCSEs introduced for English Language and Literature, and mathematics in September 2015 (Long, 2017).

Secondary School: key stages 3 and 4

The curriculum at key stage 3 (KS3) for 11-to-14-year olds is designed to cover a broad range of subject knowledge but allow a flexibility of approach to meet the needs of all students (DfE, 2014a). National tests to measure student attainment in English, maths and science at the end of KS3 were introduced in 1994 (Dearing, 1993) but were
withdrawn in 2008 due to a controversy over marking accuracy and teacher workload (Whetton, 1989). Subsequently, attainment at KS3 is no longer formally assessed or published for individual schools and students.

GCSEs mark the completion of the key stage 4 (KS4) NC for 14–16-year-olds in the English (and Welsh) system(s). Student performance in GCSE examinations is used to assess individual student attainment and aggregated to report whole school performance. Headline figures are published that summarise absolute attainment and the relative progress of students from the end of primary school (i.e. end of KS2 at aged 11) (Leckie & Goldstein, 2017). In 2016, two new headline measures – Attainment 8 and Progress 8 – were introduced to judge school performance. These replaced the previous measure that counted the number of students achieving 5 or more GCSEs in grades C and above including English and Maths (5A*-C E&M) (DfE, 2019b). Attainment 8 is a point score calculated from a pupil’s best eight grades across three subject-based categories. Progress 8 compares a pupil’s Attainment 8 score to the national average for pupils who scored the same in English and maths tests at primary school (DfE, 2019b). In addition, the English Baccalaureate (Ebacc) which is not a qualification in its own right is a performance indicator linked to student entry and achievement in a core number of GCSE subjects (English, Mathematics, Science, History/Geography and a Modern Foreign Language).

Since their introduction, criticisms have been directed at GCSE qualifications challenging their validity as a measure of student attainment (Baird et al., 2013, 2019). Past reforms to the qualification involved the inclusion and subsequent removal of teacher assessments such as coursework and controlled assessments and the introduction and subsequent removal of modularisation (Long, 2017). The 2014 reforms to GCSEs altered the grading of the qualification, removing the familiar letter grades A* (highest grade) through to G (lowest grade) and replacing them in 2017 with a numbered system grade 9 (highest) to grade 1 (lowest) (Ofqual, 2016). A ‘pass’ was widely understood by students, parents, employers, etc. as achieving a C grade or above. The new number system of grades created two new equivalents. These were the grade 4 referred to as a ‘standard pass’ and grade 5 as a ‘strong pass’ (Long, 2017).

Prior to the introduction of the new science NC at KS4 in 2016, schools retained a degree of freedom to select from a suite of GCSEs specifications in science based on knowledge of their students (Baird et al., 2019). The range of certifications included Double Award, Core Science, Additional Science, Applied and Additional Applied Science, Biology, Chemistry, Physics, Environmental Science, Geology, Astronomy, BTEC (Business and Technology Education Council, work-related qualifications) Levels 1 and 2 qualifications (Gill, 2012; Pearson, 2018). However, the performance measures used to judge schools, in particular the Ebacc, only credits the new Double Award Combined Science or separate sciences as counting towards the student’s Progress 8 or Attainment 8 scores (DfE, 2019a). Therefore, for schools, the options to adopt alternative pathways to achieving a GCSE science qualification must be balanced against the drive to meet the accountability targets.

Greater rigour and increased volume of course material were introduced to the GCSE science curriculum in 2016. For example, the number of statements in the National Curriculum Programme of Study (PoS) for KS4 Biology: Organisms and Health in 2007 was five (QCA, 2007); in the 2014 NC there are 45 statements across seven sub-headings (DfE, 2014b). Additionally, practical skills are no longer assessed through teacher-
marked coursework or controlled assessments scheduled by individual schools. Instead, focused questions covering a series of specified required practical activities are set within the terminal examinations at the end of the two-year course (DfE, 2014b; QCA, 2007).

**Primary school: key stages 1 and 2**

At key stage 1, standard assessment tests (SATS) and teacher assessments for 5–7-year-olds, are used to develop a baseline from which to measure student progress at the end of key stage 2 (Roberts, 2017). The inclusion of science as a core subject led to science national curriculum tests being administered to the majority of students at the end of KS2 (Bew, 2011). Before 2009, the results of the science tests at KS2 were published to parents but not used as accountability measures (Bevan et al., 2009). The findings from the Bew Review (2011) highlighted the need for a change to the accountability system at KS2 to make it more transparent, fairer and with an equal emphasis on progress and attainment. Post-2009, the national science tests at the end of KS2 were removed and replaced by biennial testing of a 5% representative sample of 11-year-olds in England (Wellcome Trust, 2011). However, different sampling methodologies were used in 2010, 2012, and 2014. This coupled with changes to NC frameworks has made a year-on-year comparison of student outcomes from the external examination samples far more problematic. Moreover, results from the science sampling tests are not published to parents or used to hold schools accountable but are designed solely to give an estimate of attainment nationally (DfE, 2016). Teacher assessment of attainment in KS2 science is the predominant means of identifying whether students are ‘working at the expected standard’ (Standards and Testing Agency, 2018). Whereas, pre-COVID19, yearly national examinations in English (grammar, punctuation and spelling) and Maths were taken by the majority of KS2 students, the results of which are published for school accountability (DfE & Standards and Testing Agency, 2018).

**Teachers as street-level bureaucrats**

In this study, we explore the position of teachers as *Street-level bureaucrats* (Lipsky, 2010). Lipsky’s perspective offers what Evans and Harris (2006) suggest is a tentative framework for the exploration of how all street-level bureaucracies work that can be used as a starting point for the analysis of complex public sector organisations, like schools.

Almost two decades ago it was argued that schools possessed many of the organisational structures featured in a bureaucracy, including a hierarchy of authority, division of labour, objective standards, rules and regulations (Hoy, 2003). Cast as bureaucracies that work through hierarchical structures, schools ‘process’ a large number of people with a degree of efficiency, often using ‘one size fits all’ solutions imposed through the implementation of external policy (Hoy, 2003). This framing has remained the case even in the shift towards greater distributed leadership (Hartley, 2010; Lumby, 2013). Coupled with this, Michael Lipsky in his seminal work in the 1980s described teachers along with other public sector workers as ‘street-level bureaucrats’ (2010). This term is an analytical framework used to examine the similarities and differences in the collective behaviour of public sector professionals, such as police, social workers, nurses, and doctors. The commonality found among SLBs is in their ability to provide benefits
and allocate sanctions through the stereotyping and mass processing of their service users (Gilson, 2015). Teachers teach whole classes in established routines; devise strategies to overcome work-place limitations; adjust their practice and make judgments to cope with the uncertainties encompassed in their role. Thought to distort the service ideals and pure policy aims, these ‘unsanctioned coping mechanisms’ (Lipsky, 2010, p. xv) helped to compensate for the ever-increasing demands found in the working environment. Ultimately, the actions and routines of SLBs then become the public policies carried out. Hence, teachers are no longer seen as mere education policy implementers or enactors but as policymakers, pivotal actors, moulding public policy as they delivered public services (Adami, 2014). As such, they have a great deal of agency and they have scope to use their professional discretion.

Discretion is about making decisions involving personal judgment in the assessment of a situation. It is a space in which individual choice is exercised in the interpretation of the rules and is used to meet the needs of competing demands (Loyens & Maesschalck, 2010). Lipsky (2010) used the concept of discretion as a unifying characteristic in his definition of the street-level bureaucrat. While seeming not to preference one definition over another, Lipsky theorised that public sector workers enacted discretion in the course of their work. SLBs as professionals were expected to use their discretion to respond to unforeseen incidents and make on-the-spot decisions for the benefit of both the service user and the organisation in which they work. Tummers and Bekkers (2014) further suggested that from the top-down perspective of policy implementation, use of discretion at the street-level leads to the worker’s pursuit of their own goals. However, they also argued that taking the bottom-up perspective was an inevitable necessity if policy programmes were to be effective. In essence, discretion is the mechanism through which SLBs applied the ‘rules’ of a policy in different circumstances, to meet the needs of large numbers of service users, whilst satisfying the performance requirements of their organisations. SLBs mediated the relationship between the state and the citizen; the ‘face’ of public policy in the daily reality of most people’s experience (Gilson, 2015). Policy is no longer an abstract, faceless document but one that a person experiences through the decisions taken by the street-level bureaucrat.

The position that places teachers as the front-line face of education policy was used in this research as an analytical tool to explore teachers’ perspectives in response to reforms to science curriculum and its assessment. In this context, the students, as the non-voluntary clients or service users experienced reforms to education policy through the decisions made by their teachers. In contrast to Lipsky’s suggestion, teachers did not distance themselves from their students, indicating that the framing of teachers as SLBs is nuanced and reflected the particular interactions found in schools. Exploring classroom practice shone a light on the extent to which ‘benign modes of mass processing’ were used that permit teachers to deal with their students successfully (Lipsky, 2010, p. xiv).

Street-level bureaucrat behaviour is complex and contextual. Specialisation among the variety of roles and expectations across the teaching profession means that discretionary powers are not evenly distributed or easily attributable (Lipsky, 2010). For example, teachers in primary school settings, as non-subject specialists with weaker discretionary powers, faced different dilemmas to those of their secondary science counterparts. Consequently, a Head of Science with stronger discretionary powers can play a significant role in deciding, for instance, which GCSE exam board the students will follow. Those
SLBs with substantial discretion can decide the criteria for decision-making and make the final decisions. Meanwhile, those with weak discretion tend to work within the school and government policy ‘rules’ (Gilson, 2015).

The original theorisation of teachers as SLBs came at a time before the Education Reform Act of 1988. The marketisation of education has become one mechanism of the new public management through which successive governments have introduced policy (Taylor, 2007). As such, the notion that as SLBs in Lipsky’s 1980 original description, teachers used their discretion in the face of vague policy documentation holds less well. This is due largely to the introduction of prescriptive curricular documents, standardised school organisation into key stages and standardised assessments that allow less scope for individual interpretation and decision-making. The introduction of Ofsted inspections, teacher performance management, and publication of performance tables further challenged the definition of teachers as being street-level bureaucrats. In the context of these control mechanisms, ‘discretion is a relative concept’ (Lipsky, 2010, p. 15) and applying this fluidity gave scope to analyse the contextually driven behaviour of teachers as public sector workers.

Classrooms are complex often unpredictable spaces, and teaching cannot be reduced to a formulaic process. Arguably, teachers’ personal views, pedagogic skills and priorities come into play as SLBs, seeking the best course of action for their students (Taylor, 2007). When teachers were able to use discretion to modify, adapt and integrate education policy in a way that benefited students, there was greater willingness to implement it, thereby raising the effectiveness of the policy (Tummers & Bekkers, 2014). With the introduction of the new NC and the teaching of new specifications in science since 2016, it could be suggested that teachers have lost some of their valued decision-making power, possibly becoming more policy-dependent. Teachers do not face the simple choice between either blindly following the rules to get children through exams and ready for the jobs market or developing the whole child through constructivist methods, both are equally important. However, it has been found that the measurable evidence of success required by managers and policymakers discouraged a developmental approach to teaching (Taylor, 2007). Arguably, SLBs practices are defined more by pragmatic improvisation than discretionary decision-making, relying on a delicate balance between following the prescribed directives and exercising agency, particularly when policy conflicts with teachers’ beliefs and understanding of the purpose of education (Maynard-Moody & Musheno, 2012).

Methods

This research is the qualitative element of a larger mixed-methods study (Hall, 2020) that combined large-scale national level student attainment at GCSE and KS2 with a qualitative component that collected data on the perspectives of primary and secondary teachers in state schools in England. The qualitative part of the study involved a teacher pre-interview questionnaire followed by a semi-structured face-to-face interview in order to describe and explore the aspects of teacher classroom practice affected by education reform. The questionnaire listed a range of teacher-led and student-led classroom practices and asked respondents to indicate how often these were usually carried out. This questionnaire used 14 closed ordinal responses listing a range of teaching activities.
common to many classrooms and representing classroom practices derived from the TALIS survey (OECD, 2013). Surveys such as those conducted by TIMSS (Trends in International Mathematics and Science Study) (IEA, 2014) and TALIS (OECD, 2013) aim to capture the essence of what makes a good teacher whilst acknowledging that understanding the effectiveness of instructional quality is complex. High-quality teaching depends on establishing a positive, supportive classroom climate, an element of direct instruction through well-paced, well-structured lessons; support for student autonomy and self-determination and opportunities for students to face cognitive challenges and undertake problem-solving (Vieluf et al., 2012).

The semi-structured interviews were used in synergy with the critical realist standpoint of the overall research. All the participants were asked the same questions to ensure comparability and ease of analysis, ensuring that the interview and data collected covered all the topic areas sufficiently to address the research questions. The teacher interviews generated approximately 23 hours of audio recordings that were transcribed and converted from audio to text. The analysis of the qualitative data was conducted using thematic analysis (Braun & Clarke, 2006). From an initial reading of the early interview transcripts, extracts of text were highlighted which captured a cross-section of issues and experiences relevant to addressing the research question which asked ‘What are teachers’ perspectives on the 2014 science education reforms and how has this affected their practice?’

The key terms, representing common ideas or signifying emerging patterns, were identified and used to generate nodes in NVivo (version 11). Through subsequent readings, the initial template of nodes was evaluated and revised to ensure that unexpected responses were included. Final revisions produced three semantic themes (Braun & Clarke, 2006) that were used to capture knowledge of the participants’ interaction with the new reforms. Firstly, the semantic themes ‘Curriculum’, ‘Teaching and Learning’ and ‘Assessment and Attainment’, categorised what teachers did in the classroom, their teaching and learning activities, whole school issues and perspectives on the new science curriculum. Secondly, the theme of ‘Discretion’ was used to capture where teachers expressed aspects of discretion in relation to the semantic themes and in their response to curriculum reforms and classroom decision-making.

**The participants**

There were 26 teachers who volunteered and gave their informed consent to participate in the study. The convenience sample consisted of 12 females and 14 males, of which 16 of the teachers taught in secondary schools and 10 were primary specialists. The mean length of teaching experience was 14 years and 11 months, with the longest-serving teacher working for over 30 years and the least experienced teacher had been teaching for two years (Appendix). The participants were working in a variety of positions, in addition to main-scale teachers, including KS2, KS3 or KS4 Coordinators, Head of School or other senior leadership roles. Secondary science teachers had a range of subject specialisms, but biology was the most frequently cited specialist qualification (7 out of 16). Although, 8 of the 10 primary school teachers had non-science backgrounds, one primary teacher had a specialism in biology and two others specialised in maths.
The first part of the findings section summarises the participants self-reported teaching practices from their responses to the pre-interview questionnaire. The remainder of the findings explores the interview responses through the three themes identified in the analysis that highlight significant areas of the participants classroom practice and interaction with reform: ‘Curriculum’, ‘Teaching and Learning’ and ‘Assessment and Accountability’. In this section, Lipsky’s theoretical lens is used as an analytical tool to explore teacher’s expression of discretionary power in terms of how they bring their experiences to bear in decision-making and how they use their discretion in challenging circumstances on a day-to-day basis. Thereby drawing out the nuanced responses associated with teacher professional discretion as distinct from their individual agentic power.

Findings

Teacher classroom practice

A summary of the data from pre-interview questionnaire, respondents’ teaching and learning practices and classroom activities are presented in Table 1. Of the teaching practices listed, checking learning by asking questions was most frequently reported as being carried out often or in every or almost every lesson, by 25 of the 26 respondents. Explicitly stating learning goals was also a common practice, 22 of the respondents claimed to do this often or more, alongside posing open-ended questions (23 teachers of 26), checking exercise books (21 teachers of 26) and engaging in whole-class discussions (24 of 26 teachers). Almost all participants (25 of 26) indicated that questioning for understanding was part of their routine classroom practice, occurring often or in almost every lesson and that this aspect of their practice had not changed over the past two years. Asking students to suggest or plan classroom activities was the least stated activity with only 3 teachers reporting that they did this often or more.

| Activity                                                                 | Every or almost | Often | Sometimes | Rarely | Never |
|--------------------------------------------------------------------------|-----------------|-------|-----------|--------|-------|
| I check, by asking questions, whether or not the subject matter has been understood. | 19              | 6     | 1         | 0      | 0     |
| Engage the whole class in discussions                                    | 13              | 11    | 2         | 0      | 0     |
| Organise practical hands-on/laboratory science activities or investigations | 9               | 15    | 2         | 0      | 0     |
| Pose open-ended questions                                                 | 14              | 9     | 3         | 0      | 0     |
| I explicitly state learning goals                                        | 16              | 6     | 3         | 1      | 0     |
| I check my students’ exercise books.                                     | 11              | 10    | 5         | 0      | 0     |
| At the beginning of the lesson I present a short summary of the previous lesson. | 7               | 10    | 8         | 0      | 1     |
| I administer a test or quiz to assess student learning.                  | 3               | 14    | 4         | 2      | 3     |
| I present new topics to the class (lecture-style presentation).           | 4               | 10    | 9         | 1      | 2     |
| I review with the students the homework they have prepared.              | 3               | 11    | 2         | 5      | 5     |
| I work 1-to-1 with individual students                                  | 2               | 11    | 6         | 5      | 2     |
| I give different work to the students that have difficulties learning and/or to those who can advance faster. | 3               | 9     | 12        | 2      | 0     |
| I ask my students to remember every step in a procedure.                 | 2               | 7     | 7         | 6      | 4     |
| I ask my students to suggest or to help plan classroom activities or topics. | 1               | 2     | 9         | 9      | 5     |
Curriculum: increased demands

There was consensus among all secondary teachers interviewed that the new science curriculum and its assessment, with its aim to increase academic rigour, was suitable for students progressing to study science to an Advanced Level. However, it was deemed by many of the participants in the study as not always being appropriate for all students, particularly the less academically able. An experienced head of physics commented on the difficulties students faced in recalling the added content in the new GCSE curriculum, saying that:

I think it will turn a lot of kids off from education. We are only really narrowing the doors that were open to kids from the different styles of course and different ways that we could educate… Compulsory double science is again in the same reason, I’ve got kids who I’m turning off science because they have to learn these formulas, they have to learn so much content …

Similarly, a young head of chemistry commented that open-ended questions were previously used to stretch the more able learners in lessons, but now, with the new GCSE curriculum, the use of this style of question is not always necessary as the course is inherently more challenging. Teachers felt that for the less academically able or those experiencing problems in their lives outside of school, learning about topics such as bond energy or memorising the set physics equations was unnecessarily burdensome. This extract demonstrates how one secondary biology teacher empathised with their students:

… that’s what’s difficult, is trying to excite weak students who have got social problems coming out of their ears, problems at home they might be a LAC child they might be looked after they might have not slept last night cos’ they you know, whatever it is and then you’re … here you go bond energy!

Nevertheless, the teachers felt there was no other option as one biology teacher, Cerise added:

Those kids are really struggling, it’s so hard to keep them jolly and motivated when they don’t want to do it and we’ve also lost that you could always, they could always manage some of the core, do you know what I mean, even if they were a bit challenged but now it’s no, no I can’t … so that’s has made a big difference.

Evidently, teacher’s ability to secure an alternative, more appropriate science certification route for students had been limited by the high level of importance placed on examination outcomes. Consequently, they were less able to introduce the unsanctioned coping mechanisms suggested by Lipsky (2010) as a way to meet the increasing demands in their working environment.

It was found that teachers used their discretion to devise strategies to overcome workplace limitations where it was felt that time constraints brought on by the increased subject content at GCSE reduced the use of alternative student-led teaching practices. The frequent use of lecture-style delivery by secondary teachers when introducing new topics was also an example of strategies used for mass processing and the rapid delivery of material. There was agreement amongst the participants that there was far more lecture-style teaching occurring at KS4 following the increased content and demands in maths skills; particularly with groups being taught the separate sciences where there was much less curriculum time to complete the course. Most secondary teachers often felt
constrained by the lack of opportunity to provide alternative options to students or to present the material more engagingly. An alternative interpretation might frame the difficulties in delivering the new curriculum across the ability range as a symptom of the teacher’s pedagogical content knowledge (Park et al., 2011) rather than the deficit lying with the student (Sharma, 2018). However, contrary to the notion that SLBs distance themselves from their ‘clients’ teachers were seen to use their power to benefit classes by changing the order of the topics taught so that practical activities could be introduced or enhanced. One head of science, Amber, expressed how they introduced more light-hearted activities to an otherwise academically demanding Biology GCSE topic:

the new B6 unit on … genetics, evolution and fossil records … yesterday we made some fossils … and I just thought you know sod it; I’m doing something fun …

This suggests that a strategy for managing the increased curriculum demand was linked to teacher’s beliefs and pedagogic skills, and displayed a high capacity for discretionary decision-making, with an understanding of the possible positive and negative consequences.

Teaching and Learning: practical science
Despite continued debate on the effectiveness of practical science to bring about student conceptual change (Abrahams & Reiss, 2012; Ofqual, 2015; Toplis & Allen, 2012), of the 26 teachers interviewed, organising practical activities was frequently cited and remains a key feature of their classroom practice. One secondary head of science, saw practical activities as ‘a very happy excuse to get the kids to do science’, another teacher was adamant that they did no physics without a practical, but noticed that some colleagues were substituting whole class practicals for teacher demonstrations particularly for triple science GCSE classes. This sentiment was echoed by Chestnut, a chemistry teacher

… we don’t do investigations as much as we used to, I think they’ve kind of been squeezed out by the volume of content …

At GCSE, the newly introduced required practicals dictate the range and scope of the knowledge, skills and understanding of the working scientifically strand of the KS4 curriculum. Secondary teachers explained how this high level of prescription had bled into the activities undertaken by students in KS3, effectively squeezing out opportunities for younger students to take part in more open-ended investigative tasks. The imposition and subsequent accommodation of the changes created tensions and left previously held routines liable to break down, as this physics teacher exemplified:

As an experienced teacher I know which practicals are important to keep for new teachers coming in that is a real difficulty … Gone are the days of doing a practical for investigative exploratory experience, for the fun of it, gone are those days with the time constraints we’ve got … .

Internal assessment of practical science skills can be argued to be a distinct area in which secondary teachers’ persona as SLBs is exerted through their interpretation of the rules. On the one hand, the removal of the school-based assessments may help to eradicate the differential interpretations found in coursework and controlled assessment across different schools (Opposs, 2016). Conversely, participants indicated that at the
GCSE level the uncertainty surrounding successful delivery of practical work had introduced a variety of different coping mechanisms and strategies to achieve the same goal. It can be argued that the new assessment strategy for GCSE practical skills narrows the role of the teacher and can be construed as a means to ‘manage’ SLB behaviour bringing it closer to desired policy aims.

The primary teachers emphasised the importance for students to have direct hands-on experiences in practical investigations to build a range of skills. How these experiences were achieved was often at the discretion of the individual teacher as this KS1 teacher, Lilac, shared with me,

I always remember, years ago I had a boy in year 2 who had learning difficulties … we were doing up thrust and we doing it using a balloon … pushing balloons in water and demonstrating … he couldn’t write about it but he drew me a brilliant picture and talked about it …

Open-ended investigations tended to be spread across several lessons but access to budgets and supplies for practical activities emerged as a significant issue, echoing the suggestion that SLBs often work with inadequate resources. Several teachers were concerned that budgetary constraints affected their creativity and ability to react to the unanticipated questions from students by using practical activities; equipment was often not available and that the schools begged and borrowed what they needed. For instance, a KS1 teacher and science co-ordinator, Olive said

… around science week, where you’re asking people to come up with fun ideas but then you are saying that we’ve only got £20 or something ….

Across the data there was variation in the use of discretionary powers and embodiment of teachers as SLBs, reflecting the relativity associated with professional discretion in relation to the cycle of reform and policy implementation (Gilson, 2015). Whilst the reforms introduced a high degree of teacher conformity in the delivery of science at KS4 resulting in the gradual erosion of options for teachers at KS3, primary colleagues retained a degree of discretionary power constrained by budget and curriculum time.

Assessment and Accountability: new accountability measures
It is suggested that, for the most part, SLBs agree with the legitimacy of the formal structure of authority and worked towards shared goals (Lipsky, 2010). In the main, teacher’s interests are the same as that of the school, both of which mirror government policy. This can be seen in the data where secondary participants were positive in their attitude towards the new accountability measure, Progress 8, as one chemistry teacher who was also an assistant head remarked:

… it is far from perfect … . But we don’t have the boundaries that we had before where we were pressured to look at particular students on the C-D border. So, if a child at progress 8 gets a D and that’s brilliant progress because actually they might have got an E. That’s really important that is the main basis for me being positive about Progress 8 every child counts …

In contrast, the constraints placed by the Ebacc performance measure on teacher’s discretionary power to decide student’s tier of exam entry whether double or triple science
GCSE pathways were viewed negatively. With one biology teacher, head of science exclaiming:

Ebacc, why! … it’s just why? I mean surely you want to go on to achieve stuff that you enjoy and become skilled in. And yet we’re going to be having conversations about 13- and 14-year-old students just to make school figures look better, and not depending on what the child actually enjoys …

Every secondary science participant was concerned about the suitability of the curriculum for different groups of students and the limitations that meeting the Ebacc measure placed on school’s curriculum offer.

Irrespective of the NC constraints and accountability measures, it can be argued that individual teachers have freedom to decide how they will teach a particular topic, what resources to use, and tasks to set. Lipsky (2010) also suggested that teachers exert considerable power over their students’ self-image, expectations and achievement; and that stereotyping of students is a means by which SLBs can allocate resources and process the class through their learning. Therefore, the way teachers labelled their students can be associated with expectations for attainment and was fundamental to the way in which students were processed. From the data, the primary participants reported that they adapted their lessons to suit all abilities using access to teaching assistants and purchased work schemes. However, all secondary participants articulated that students with low GCSE targets e.g. grades 1 and 2, should not be ‘dragged through the really complicated stuff’. This was keenly expressed by one biology teacher, who talked of their frustrations:

… whereas if they did the certificate of science, it would be more enjoyable, … but we are not allowed to because it will affect the raw figure you know …. I’ve tried three times I’ve spoken to people higher up but they said that they won’t do it they can’t because the school’s figure will go down ….

It could be maintained that while the new accountability measures blocked teacher’s attempts to introduce the entry-level certificate for particular groups of students, reflecting a reduction in the actualisation of SLB status, in doing so, the measures ensured the equal access to knowledge promised at the introduction of the national curriculum (HMSO, 1988). Secondary participants did display greater discretionary powers over how they planned the future learning of younger students. For example, using ‘key stage 3 more strategically …’ introducing more rigour into KS3 schemes of learning in recognition of the increased cognitive and content load at KS4. A chemistry teacher reflected that, whilst the staff considered the work to be more challenging, the younger students did not feel the same way:

So, I think for the younger students, it’s kinda just how it is, you know, they have quite pacey, quite challenging lessons … but they kinda don’t know any different ….

Here, the lack of a formal accountability measure for science attainment at KS3 allowed secondary science departments to use their judgement to create the conditions for managing future implementation of reforms in practice and reduce levels of ambiguity.

The ability to make decisions about the timing and structure of lessons also reflected in the high degree of autonomy in primary settings for teaching science. However, the
perceived freedoms in the primary curriculum are hampered only by the limitations in time and resources associated with science no longer being included in the formal assessments along with the other core subjects (English and Maths) at KS2. It could be argued that the focus on literacy and numeracy as school accountability measures has relegated some school’s assessment of science to discrete weeks in the school calendar, leaving little opportunity to revisit or build on new concepts.

Reflecting on teachers’ perspectives on the 2014 science education reforms and its impact on their practice, the secondary and primary participants talked of the uncertainty and ambiguity surrounding the assessment focussed elements of the current reforms. The impact of this uncertainty in their day-to-day decision-making within the confines of the standardised curriculum led teachers to create their ‘own’ rules for managing cohorts of students. This Lipsky (2010) claimed was synonymous in the theorisation of teachers as street-level bureaucrats. In the classroom, during this period of transition from the familiar to the new, the data found how teachers used a combination of professional discretion, agency, beliefs and pedagogical content knowledge to conduct their day-to-day practice.

**Discussion**

Lipsky (2010) suggested that SLBs cannot be fully controlled; neither can the discretion inherent in their jobs be easily eliminated. However, we suggest that policy makers through the national curriculum reforms have designed accountability measures that ensure SLBs patterned agency is limited to a narrow focus. This research purports that the internalisation and reinterpretation of policy text that is synonymous with SLBs expressing their discretionary power in order to deliver the public face of top-down mandates has been greatly reduced. In this article, the term ‘discretion’ is taken to mean an authority granted to front-line workers to make decisions within the rules of law and policy (Maynard-Moody & Musheno, 2012). However, by locating discretion alongside the more difficult to define concept of agency – an inherent quality of what it is to be human, rooted in the individual irrespective – we assert that everyone can exhibit a sense of agency, but not everyone can be described as a SLB with discretionary power to make decisions that will benefit or sanction others.

Previous research on teacher response to curriculum reform constructed from an agentic perspective theorised the interplay between teacher practice and reform (Ryder et al., 2018; Ryder & Banner, 2013) examining the extent to which teacher practice changed over time relative to the meeting of intended reform goals. Furthermore, as key actors in the policy process teachers are both an agent and a subject of policy enactments through the contextualised interpretation, translation and decision-making of policy text (Braun et al., 2011). Teachers, as policy actors, are thereby positioned as decision-making, whether by virtue of their experience, subject department or the school phase in which they work (Braun et al., 2011). Research that is more recent lead us to conclude that there is a need for a reappraisal of the positioning of teachers as SLBs. Although many of the key criteria for belonging to this group of public sector workers are still present in teacher’s working lives, we would suggest that the increasingly prescriptive nature and restrictive use of accountability measures renders the top-down
reforms less open to the bottom-up interpretation expected of teachers as SLBs. Arguably, the consequence of this is to raise the effectiveness of the policy as it was written.

At the time of the research, teachers had less voice in negotiating the top-down mandated curriculum and accountability regime and relied instead on their ability to ‘get through’ the period of instability and ambiguity. They faced challenges looked forward to a time when collectively their efforts would be rewarded through improved outcomes for both themselves and their students. It has been suggested that contextualising the language of reform text plays a significant role in science teacher decision-making due to the specific nature of science as a curriculum subject (Melville, 2008). However, we argue that it has become more difficult for science teachers to circumvent the ‘rules’ associated with the attainment measures. These manifest as control mechanisms, limiting discretion and autonomy, despite government policy (Roberts, 2016) suggesting that schools have more scope to determine what they do and how they are organised.

It is useful to point out that teachers may have experienced repeated reforms to England’s education system during their working life; and while teachers operate in the present, other temporal locations play a minor role in their interaction with current reforms as they use experiences from the past and aspirations for the future to guide their actions. Habit and routine are typical of social spaces such as schools, as it allows for the mass processing of large numbers of students (Lipsky, 2010). Over time, habits and routines can change as a result of conscious response and collegiate interactions as well as changing contexts, expectations and innovation (Davis, 2003; Henze et al., 2009). In the UK, studies that examined the introduction of new elements to the science curriculum such as scientific literacy (Ryder & Banner, 2013) and the scientific inquiry strand (Sci1) (Jenkins, 2000) concluded that changes to the curriculum at GCSE altered the practices of secondary science teachers in response. Further research suggests that there is an interaction between teachers self-regulation, goal orientation, curriculum and context which guides their classroom decision-making (Davis et al., 2016). Additionally, test-based accountability, albeit not the only top-down policy reform, was also found to correlate with changes to teaching practice, the amount of science delivered and teacher satisfaction, in both positive and negative ways (Anderson, 2012). What this seems to suggest is that over time, as new reform becomes part of everyday habit and routine. As such, teachers will find new ways to exert their discretionary power.

The embodiment of teachers as SLBs is not a perfect one. The boundaries surrounding teacher’s discretion and decision-making are heavily context-dependent. As suggested earlier, teachers’ personal views, pedagogic skills, and priorities come into play as SLBs seek the best course of action for their students (Taylor, 2007). While the primary teachers were able to use discretion to modify, adapt and integrate education policy in a way that benefited their students, the secondary teachers appeared less able to do so. It appears that the mechanisms of standardisation and datafication used to drive the relationship shifts accountability for student attainment from government to teachers (Winter, 2017). This, we argue, commits teachers to regulatory frameworks, limiting their interactions with students to delivering a narrowly defined core curriculum. This does not rule out pockets of resistance (Robertson, 2015) or prevent teachers from attempting to use their discretion to deliver what they believe is the best for their students (Moore & Clarke, 2016; Taylor, 2007). From a critical realist perspective, education
policy acts as a mechanism to generate change and achieve government outcomes. Therefore, teachers’ practice in the face of mandated policy then becomes both mechanism and outcome. The UK government aims for education are clearly stated with the teacher identified as the means through which the goals, such as raising standards, will be met (DfE, 2010a, 2010b; DfE & Gove, 2013). However, the intended outcome is dependent on how teachers internalise and integrate these aims into their work.

**Limitations and conclusions**

**Limitations**

The outcomes from this study like any other are subject to the decisions taken by the researcher throughout the process (Creswell, 2018). The study aimed to uncover new knowledge and meaning with a focus on understanding that the impact on teacher practice is relative, and through a temporal lens, related to teachers’ beliefs in their ability to adapt to changes. In 2017, there were approximately 498,220 contracted teachers in state-funded schools in England (DfE, 2019c). As such, this research cannot presume to be representative of the varied perspectives and lived experiences of each practitioner. From the responses to the questionnaire and interview, it was evident that specific questions were more relevant to the secondary teachers than to the primary teachers, meaning that the interpretations may have been biased towards the changes occurring in secondary education. Specifying in advance the topics to be investigated may have limited the exploration of unanticipated issues. Additionally, no data was collected via lesson observations with the participants and their classes. Observing teachers in action, although still open to researcher interpretation (Wragg, 2011) may have introduced a degree of confirmatory evidence to the qualitative findings, adding reliability to the data collected from the pre-interview questionnaire (Creswell, 2018).

**Conclusion**

In reality, the complex process in which teachers’ engagement in educational change involves professional efficacy beliefs, a willingness to adopt and adapt, and is rooted in layers of contextual factors (Pyhältö et al., 2014; Ryder et al., 2018). Applying the framework of street-level bureaucracy as an analytical tool opened up teacher classroom practice in the face of reform to examine against one element of teachers working lives. This study highlighted the implications for teachers in accommodating the scale of recent reforms. In turn, this limited teacher agency through the restriction of pedagogic choices and shut down areas of discretion in decision-making in the management of large groups of students. However, throughout the embedding of these new reforms to science education, assessment and curriculum, the yearly publication of performance tables means that teachers and schools remain under the spotlight.

Whilst it is unlikely that the support for policy implementation on the scale of the national strategies (DfE, 2011) will occur again. It was evident from the research that teachers required more time to develop their understanding of the new curriculum and to address the issues relating to the teaching of the more rigorous content to a wider ability range of students. The results from this research suggest that there are implications for
subject associations (e.g. Institute of Physics and STEM learning centres (2018)) in continuing, possibly increasing their role to provide additional continued professional development for teachers. Acknowledging that the success of any reform is a two-way process of interaction (Ball et al., 2011; Braun et al., 2010), giving teachers greater involvement in the decision-making on the direction of their professional learning with the opportunity to reflect on and adapt their practice may have long-term gains for student progress, teacher pedagogical content knowledge and teacher self-efficacy (Hardy & Melville, 2019; Murphy et al., 2015).

Notes

1. The first GCSEs course was first introduced in 1986 and first examined in 1988 (Childs & Baird, 2020).
2. This research received ethical approval from the university’s Cross-Schools Research Ethics Committee (C-REC). All of the research was conducted in accordance with C-REC and the British Educational Research Association (BERA) ethical guidelines.
3. A more detailed report of the findings can be found in Hall (2020).

Disclosure statement

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References

Abrahams, I., & Reiss, M. J. (2012). Practical work: Its effectiveness in primary and secondary schools in England. Journal of Research in Science Teaching, 49(8), 1035–1055. https://doi.org/10.1002/tea.21036
Adami, S. (2014). Street-level bureaucrats: Role and dimension in the policy arena. https://steveadami.myefolio.com/Uploads/Street-Level%20Bureaucracy.pdf
Anderson, K. J. (2012). Science education and test-based accountability: Reviewing their relationship and exploring implications for future policy. Science Education, 96(1), 104–129. https://doi.org/10.1002/sce.20464
Baird, J.-A., Ahmed, A., Hopfenbeck, T., Brown, C., & Elliott, V. (2013). Research evidence relating to proposals for reform of the GCSE (Centre for Educational Assessment Report OUCEA/13/1). Oxford University.
Baird, J.-A., Caro, D., Elliott, V., El Masri, Y., Ingram, J., Isaacs, T., de Moira, A., Randhawa, A., Stobart, G., & Meadows, M. (2019). Examination reform: Impact of linear and modular examinations at GCSE (Ofqual/19/6506/2). Ofqual.
Ball, S. J., Maguire, M., Braun, A., & Hoskins, K. (2011). Policy actors: Doing policy work in schools. Discourse: Studies in the Cultural Politics of Education, 32(4), 625–639. https://doi.org/10.1080/0158025X.2011.601565
Bevan, Y., Brighouse, T., Mills, G., Rose, J., & Smith, M. (2009). Report of the expert group on assessment (DCSF 00532-2009-EN). Department for Children, Schools and Families.
Bew, P. (2011). Independent review of key stage 2 testing, assessment and accountability. DfE.
Braun, A., Ball, S. J., Maguire, M., & Hoskins, K. (2011). Taking context seriously: Towards explaining policy enactments in the secondary school. Discourse: Studies in the Cultural Politics of Education, 32(4), 585–596. https://doi.org/10.1080/01596306.2011.601555

Braun, A., Maguire, M., & Ball, S. J. (2010). Policy enactments in the UK secondary school: Examining policy, practice and school positioning. Journal of Education Policy, 25(4), 547–560. https://doi.org/10.1080/02680931003698544

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Childs, A., & Baird, J.-A. (2020). General Certificate of Secondary Education (GCSE) and the assessment of science practical work: An historical review of assessment policy. The Curriculum Journal, 31(3), 357–378. https://doi.org/10.1002/curj.20

Creswell, J. W. (2018). Research design: Qualitative, quantitative, and mixed methods approaches (5th ed). Sage.

Davis, E. A., Janssen, F. J. M., & Driel, J. H. V. (2016). Teachers and science curriculum materials: Where we are and where we need to go. Studies in Science Education, 52(2), 127–160. https://doi.org/10.1080/03057267.2016.1161701

Davis, K. S. (2003). "Change is hard": What science teachers are telling us about reform and teacher learning of innovative practices. Science Education, 87(1), 3–30. https://doi.org/10.1002/sce.10037

Dearing, R. (1993). The national curriculum and its assessment. National Curriculum Council, York, England.

DfE. (2010a). The importance of teaching: The case for change.

DfE. (2010b). The importance of teaching: The schools white paper.

DfE. (2011). The national strategies 1997-2011: A brief summary of the impact and effectiveness of the national strategies (No. 00032-2011PDF-EN-01). DfE.

DfE. (2013). National curriculum in England consultation report—FINAL.

DfE. (2014a, December). National curriculum in England: Framework for Key Stages 1 to 4. GOV.UK. https://www.gov.uk/government/publications/national-curriculum-in-england-framework-for-key-stages-1-to-4-the-national-curriculum-in-england-framework-for-key-stages-1-to-4

DfE. (2014b). Science KS4 programme of study. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/381380/Science_KS4_PoS_7_November_2014.pdf

DfE. (2016). Section 8: Science sampling - 2016 Key Stage 2: Assessment and reporting arrangements. https://www.gov.uk/guidance/2016-key-stage-2-assessment-and-reporting-arrangements-ara/section-8-science-sampling

DfE. (2019a). Key stage 4 including multi-academy trust performance, 2018 (revised).

DfE. (2019b). Secondary accountability measures: Guide for maintained secondary schools, academies and free schools (DFE-00278-2017; p. 56). DfE.

DfE. (2019c). School workforce in England: November 2018.

DfE, & Gove, M. (2013, February). Curriculum, exam and accountability reform. https://www.gov.uk/government/speeches/curriculum-exam-and-accountability-reform

DfE, & Standards and Testing Agency. (2018). National Curriculum Assessments at Key Stage 2 in England, 2018 (provisional)—Gov.uk. https://www.gov.uk/government/publications/national-curriculum-assessments-key-stage-2-2018-provisional/national-curriculum-assessments-at-key-stage-2-in-england-2018-provisional–2

Donnelly, J., & Ryder, J. (2011). The pursuit of humanity: Curriculum change in English school science. History of Education, 40(3), 291–313. https://doi.org/10.1080/0046760X.2010.521196

Evans, T., & Harris, J. (2006). A case of mistaken identity? Debating the dilemmas of street-level bureaucracy with Musil et al. European Journal of Social Work, 9(4), 445–459. https://doi.org/10.1080/13691450600958494

Gill, T. (2012). Provision of GCSE subjects 2010 (No. 34; Statistics Report Series, p. 16).
Gilson, L. (2015). Michael lipsky—street-level bureaucracy: Dilemmas of the individual in public service. In M. Lodge, & S. Balla (Eds.), The Oxford handbook of classics in public policy and administration (pp. 383–404). Oxford University Press.

Hall, M. (2020). Science education in England: Exploring the evidence for, and evidence of, reform [PhD Thesis]. http://sro.sussex.ac.uk/id/eprint/93728

Hanna, D., David, I., & Francisco, B. (Eds.). (2010). Educational research and innovation: The nature of learning using research to inspire practice. OECD Publishing.

Hardy, I. J., & Melville, W. (2019). Professional learning as policy enactment: The primacy of professionalism. Education Policy Analysis Archives, 27(90), 1–23. https://doi.org/10.14507/epaa.27.4401

Hartley, D. (2010). Paradigms: How far does research in distributed leadership 'stretch'? Educational Management Administration & Leadership, 38(3), 271–285. https://doi.org/10.1177/1741143209359716

Henze, I., van Driel, J. H., & Verloop, N. (2009). Experienced science teachers’ learning in the context of educational innovation. Journal of Teacher Education, 60(2), 184–199. https://doi.org/10.1177/0022487108329275

HMSO. (1988). Education Reform Act 1988. http://www.legislation.gov.uk/ukpga/1988/40/pdfs/ukpga_19880040_en.pdf

HM Treasury. (2014). Our plan for growth: Science and innovation (CM 8980). Department for Business Innovation & Skills.

House of Commons Committee of Public Accounts. (2018). Delivering STEM skills for the economy: Forty-Seventh Report of Session 2017-2019 (HC 691; p. 21). House of Commons.

Hoy, W. K. (2003). An analysis of enabling and mindful school structures: Some theoretical, research and practical considerations. Journal of Educational Administration, 41(1), 87–109. https://doi.org/10.1108/09578230310457457

IEA. (2014). TIMSS 2015 Teacher Questionnaire Science Grade 8. https://timssandpirls.bc.edu/timss2015/questionnaires/downloads/T15_TQS_8.pdf

Jenkins, E. W. (2000). The impact of the national curriculum on secondary school science teaching in England and Wales. International Journal of Science Education, 22(3), 325–336. https://doi.org/10.1080/095006900289903

Lieberman, A. (2000). Networks as learning communities: Shaping the future of teacher development. Journal of Teacher Education, 51(3), 221–227. https://doi.org/10.1177/002248710051003010

Lipsky, M. (2010). Street-level bureaucracy, 30th Ann. Ed.: Dilemmas of the individual in public service. Russell Sage Foundation.

Long, R. (2017). GCSE, AS and A level reform (England) (Briefing Paper No. 06962). House of Commons Library.

Loyens, K., & Maesschalck, J. (2010). Toward a theoretical framework for ethical decision making of street-level bureaucracy: Existing models reconsidered. Administration & Society, 42(1), 66–100. https://doi.org/10.1177/0095399710362524

Lumby, J. (2013). Distributed leadership: The uses and abuses of power. Educational Management Administration & Leadership, 41(5), 581–597. https://doi.org/10.1177/1741143213489288

Maynard-Moody, S., & Musheno, M. (2012). Social equities and inequities in practice: Street-level workers as agents and pragmatists. Public Administration Review, 72(s1), S16–S23. https://doi.org/10.1111/j.1540-6210.2012.02633.x

Melville, W. (2008). Mandated curriculum change and a science department: A superficial language convergence? Teaching and Teacher Education, 24(5), 1185–1199. https://doi.org/10.1016/j.tate.2007.03.004
Moore, A., & Clarke, M. (2016). ‘Cruel optimism’: Teacher attachment to professionalism in an era of performativity. *Journal of Education Policy, 31*(5), 666–677. https://doi.org/10.1080/02680939.2016.1160293

Muijs, D., & Reynolds, D. (2017). *Effective teaching: Evidence and practice* (4th ed.). Sage.

Murphy, C., Smith, G., Varley, J., & Razi, O. (2015). Changing practice: An evaluation of the impact of a nature of science inquiry-based professional development programme on primary teachers. *Cogent Education, 2*(1), 1–19. https://doi.org/10.1080/2331186X.2015.1077692

OECD. (2010). *Learning for jobs: Synthesis report*. OECD. (2013). *Teaching and Learning International Survey (TALIS) teacher questionnaire*. OECD.

Ofqual. (2015). *Assessment of practical work in GCSE Science Regulatory Impact Assessment* (Ofqual/15/5625; p. 10). Ofqual.

Ofqual. (2016). *Postcard grading new GCSEs*. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/537147/Postcard_-_Grading_New_GCSEs.pdf

Opposs, D. (2016). Whatever happened to school-based assessment in England’s GCSEs and A-levels? *Perspectives in Education, 34*(4), 52–61. https://doi.org/10.18820/2519593X/pie.v34i4.4

Park, S., Jang, J.-Y., Chen, Y.-C., & Jung, J. (2011). Is pedagogical content knowledge (PCK) necessary for reformed science teaching? Evidence from an empirical study. *Research in Science Education, 41*(2), 245–260. https://doi.org/10.1007/s10833-010-9164-9

Pearson. (2018). *BTEC works for science*. https://qualifications.pearson.com/content/dam/pdf/btec-works/leaflets/BTEC-Science.pdf

Pyhältö, K., Pietarinen, J., & Soini, T. (2014). Comprehensive school teachers’ professional agency in large-scale educational change. *Journal of Educational Change, 15*(3), 303–325. https://doi.org/10.1007/s10833-013-9215-8

QCA. (2007). *Science Programme of Study for Key Stage 4*. QCA. https://www.stem.org.uk/system/files/elibrary-resources/legacy_files_migrated/11571-QCA-07-3345-p_Science_KS4_tcm8-1799.pdf

Roberts, N. (2016). *The school curriculum and SATs in England: reforms since 2010*. (Briefing Paper No. 06798). House of Commons Library.

Roberts, N. (2017). “SATS” and primary school assessment in England (Briefing Paper No. 07980; p. 18). House of Commons.

Roberts, N. (2018). *The school curriculum in England* (Briefing Paper No. 06798). House of Commons Library.

Robertson, S. (2015). What teachers need to know about the global education reform movement. In G. Little (Ed.), *Global education “reform”: Building resistance and solidarity* (pp. 10–17). Manifesto Press.

Ryder, J., & Banner, I. (2013). School teachers’ experiences of science curriculum reform. *International Journal of Science Education, 35*(3), 490–514. https://doi.org/10.1080/09500693.2012.665195

Ryder, J., Banner, I., & Homer, M. S. (2014). Teachers’ experiences of science curriculum reform. *School Science Review, 95*(352), 126–130. http://eprints.whiterose.ac.uk/83044/

Ryder, J., Lidar, M., Lundqvist, E., & Östman, L. (2018). Expressions of agency within complex policy structures: Science teachers’ experiences of education policy reforms in Sweden. *International Journal of Science Education, 40*(5), 538–563. https://doi.org/10.1080/09500693.2018.1435921

Sharma, M. (2018). Seeping deficit thinking assumptions maintain the neoliberal education agenda: Exploring three conceptual frameworks of deficit thinking in inner-city schools. *Education and Urban Society, 50*(2), 136–154. https://doi.org/10.1177/0013124516682301

Standards and Testing Agency. (2018). *2018 Key Stage 2 teacher assessment exemplification science*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/763065/2018_key_stage_2_teacher_assessment_exemplification_science.pdf

STEM Learning. (2018). *What we do*. STEM. https://www.stem.org.uk/what-we-do
Taylor, I. (2007). Discretion and control in education: The teacher as street-level bureaucrat. *Educational Management Administration & Leadership*, 35(4), 555–572. https://doi.org/10.1177/1741143207081063

Toplis, R., & Allen, M. (2012). “I do and I understand?” Practical work and laboratory use in United Kingdom schools. *Eurasia Journal of Mathematics, Science & Technology Education*, 8(1), 3–9. https://doi.org/10.12973/eurasia.2012.812a

Tummers, L., & Bekkers, V. (2014). Policy implementation, street-level bureaucracy, and the importance of discretion. *Public Management Review*, 16(4), 527–547. https://doi.org/10.1080/14719037.2013.841978

Vieluf, S., Kaplan, D., Klieme, E., & Bayer, S. (2012). *Teaching practices and pedagogical innovation: Evidence from TALIS*. OECD Publishing.

Wellcome Trust. (2011). *Wellcome trust primary science survey report*. Wellcome Trust.

Whetton, C. (1989). A brief history of a testing time: National curriculum assessment in England. *Educational Research*, 51(2), 137–159. https://doi.org/10.1080/00131880902891222

Winter, C. (2017). Curriculum policy reform in an era of technical accountability: ‘Fixing’ curriculum, teachers and students in English schools. *Journal of Curriculum Studies*, 49(1), 55–74. https://doi.org/10.1080/00220272.2016.1205138

Wragg, T. (2011). *An introduction to classroom observation (classic edition)*. Routledge.

### Appendix. Anonymised biographical profiles of the participants

| Alias     | Gender | Specialism | Age   | Years Teaching | Key Stages | Role             |
|-----------|--------|------------|-------|----------------|------------|------------------|
| Amber     | F      | Biology    | 30–39 | 8              | 3 & 4      | Head of Science  |
| Auburn    | F      | Chemistry  | 40–49 | 18             | 3 & 4      | Head of Science  |
| Blue      | F      | Biology    | 30–39 | 10             | 3, 4 & 5   | Head of Science  |
| Briar     | M      | Biology    | 30–39 | 8              | 3 & 4      | KS4 Coordinator  |
| Blossom   | F      | Chemistry  | 22–29 | 8              | 3 & 4      | Head of Subject  |
| Brown     | M      | Physics    | 50–59 | 31             | 3, 4 & 5   | Head of Science  |
| Citrine   | M      | Physics    | 30–39 | 3              | 3 & 4      | Main scale       |
| Chestnut  | F      | Chemistry  | 40–49 | 20             | 3 & 4      | Head of Science  |
| Cerise    | F      | Biology    | 40–49 | 18             | 3, 4 & 5   | KS3 Coordinator  |
| Cerulean  | M      | Chem/Phys  | 50–59 | 28             | 3, 4 & 5   | Head of Science  |
| Ecru      | M      | Chemistry  | 50–59 | 33             | 4          | Senior Leadership |
| Ebony     | M      | Biology    | 50–59 | 29             | 3 & 4      | KS3 Coordinator  |
| Coral     | M      | Physics    | 40–49 | 23             | 3 & 4      | Head of Science  |
| Emerald   | M      | Physics    | 30–39 | 10             | 3, 4 & 5   | Head of Dept     |
| Garnet    | F      | Chemistry  | 40–49 | 9              | 3 & 4      | Head of Science  |
| Green     | M      | Biology    | 40–49 | 22             | 3 & 4      | Head of Science  |
| Jade      | M      | Maths      | 30–39 | 2              | 2          | Science Co-ord.  |
| Jet       | F      | Biology    | 50–59 | 22             | 2          | Science Co-ord.  |
| Mustard   | M      | Primary    | 40–49 | 7              | 2          | Science Co-ord.  |
| Khaki     | F      | None       | 22–29 | 2              | EYFS       | Main Scale       |
| Lavender  | M      | Primary    | 30–39 | 4              | 2          | Science Co-ord.  |
| Mocha     | F      | Primary    | 40–49 | 12             | 2          | Science Co-ord.  |
| Olive     | F      | Primary    | 40–49 | 20             | 1          | Science Co-ord.  |
| Lime      | M      | Maths      | 30–39 | 6              | 2          | Science Co-ord.  |
| Lilac     | F      | Biology    | 50–59 | 19             | 1          | Head of School   |
| Lemon     | M      | English    | 40–49 | 15             | 1 & 2      | Science Co-ord.  |