



King's Research Portal

DOI:
[10.1002/sce.21291](https://doi.org/10.1002/sce.21291)

Document Version
Peer reviewed version

[Link to publication record in King's Research Portal](#)

Citation for published version (APA):

Archer, L., Dawson, E., DeWitt, J., Godec, S., King, H., Mau, A., Nomikou, E., & Seakins, A. (2017). Killing curiosity? An analysis of celebrated identity performances among teachers and students in nine London Secondary Science Classrooms. *Science Education*, 101(5), 741-764. <https://doi.org/10.1002/sce.21291>

Citing this paper

Please note that where the full-text provided on King's Research Portal is the Author Accepted Manuscript or Post-Print version this may differ from the final Published version. If citing, it is advised that you check and use the publisher's definitive version for pagination, volume/issue, and date of publication details. And where the final published version is provided on the Research Portal, if citing you are again advised to check the publisher's website for any subsequent corrections.

General rights

Copyright and moral rights for the publications made accessible in the Research Portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognize and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the Research Portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the Research Portal

Take down policy

If you believe that this document breaches copyright please contact librarypure@kcl.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

Killing curiosity? An analysis of celebrated identity performances among teachers and students in nine London Secondary Science Classrooms

Louise Archer, Emily Dawson, Jennifer DeWitt, Spela Godec, Heather King, Ada Mau, Effrosyni Nomikou, Amy Seakins

Abstract

In this paper, we take the view that school classrooms are spaces that are constituted by complex power struggles (for voice, authenticity and recognition), involving multiple layers of resistance and contestation between the ‘institution’, teachers and students, which can have profound implications for students’ science identity and participation. In particular, we ask what are the celebrated identity performances within science classes, how are these re/produced and/or contested, and by whom? Analysing data from 9 months of observations of science classes with 9 teachers and c. 200 students aged 11-15 from six London schools and 13 discussion groups with 59 students, we identify three dominant celebrated identity performances (‘tick box’ learning, behavioural compliance and muscular intellect) and discuss the complex ways in which these are promulgated both institutionally and interpersonally by teachers and students, drawing out the implications for students’ performances of science. The paper concludes with reflections on the equity implications for science education policy and practice.

KEYWORDS: Identity, celebrated identity performances, teachers, students, performativity

Science classrooms - sites of power and identity struggle

Science classrooms - like any site - are complex spaces that are constituted through multiple power relations and involve ongoing negotiations and struggles over the relative dominance of a range of competing identities, values and practices. We understand these spaces as being produced through repeated struggles for 'voice', authenticity and recognition – for instance, concerning who is, or is not, recognised as being 'good at school science'. Classroom norms and teachers play an important part in shaping the extent to which students can perform themselves scientifically, learn science and are encouraged, or discouraged, from pursuing a science trajectory. For instance, Olitsky & Weathers (2005) point out how classroom discourse norms can facilitate or hinder urban students' potential to identify with science. Likewise, Elmesky (2005) and Emdin (2010) discuss how whereas prototypical and abstracted approaches to science content and pedagogy can alienate urban students from science, approaches that value and engage diverse student cultural styles, identities and resources can help engage urban students with science. Indeed, as Carlone et al. (2014) explain, "the literature that exists is in unequivocal agreement that environment matters to students' sustained or declining science interests and motivation" (p.837).

For instance, Calabrese Barton et al. (2013) discuss how girls' science identity work across both school and out-of-school settings is 'a reflection of the opportunities they have had to participate in and with science ... and how the nature of the opportunities afforded or constrained greater movement in science' (p.36). Likewise, Jackson & Seiler (2013) discuss how the dominant cultural models that operate in a particular college science classroom and program, act like 'forces' on student trajectories, moving college students 'towards or away from science' (p.831). Verelas, Kane & Wylie (2011) show how even very young (first grade) children can be constrained in their ability to perform scientifically by wider school norms and practices, notably those that are designed to control behaviour through what they term a 'pedagogy of control'

(p.834). Thus the literature suggests that a student's identification with school science is more complex than being merely a reflection of a student's interest in science (Archer et al., 2010) and/or one's own, or others', perceptions of one's ability to "do" science (Elmesky et al., 2006, p.768). Rather, student engagement with science is produced (and diminished/ negated) through multiple layers of interactions between a student (their identity, background, cultural resources) and science settings. In this respect, 'learning science' is not a neutral activity, but involves processes of dis/identification for those involved. For instance, as Brown et al. (2005) discuss, learning to use scientific discourse can entail both affiliation and alienation for students. Likewise, as Nasir & Hand (2008) explain, student engagement with science will be shaped by the extent to which students experience the science content and learning context as offering 'relationships that support and value their unique selves' (Nasir & Hand, 2008, p.145).

As discussed in more detail below, Carlone et al.,'s work provides a particularly valuable understanding of the ways in which the particular identities and practices that are celebrated (normalised and dominant) by different teachers can have a profound and differential effect on the science identities and trajectories of different students. Yet, Carlone et al. (2014) also point out that this body of work remains relatively small and they draw attention to the need for more studies to unpick "the relationships between social context and students' science trajectories" (p. 837).

In this paper we attempt to engage with the complexity of identity negotiations among teachers and students in nine urban secondary science classrooms in London, England. In particular, we aim to explore the complexity of who, and what, is valued as a 'celebrated' identity performance in these spaces, unpicking the ways in which these performances may be differently configured/ constructed, enacted, subverted and/or resisted between teachers, students and wider education policy discourse. In other words, we seek to build upon and extend existing work that traces the celebrated identity performances within science classes and we extend this

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

work to consider the role of teachers in establishing and reproducing – albeit sometimes reluctantly – dominant/ proto-typical notions of what counts as ‘good’ science student identity. Our analysis suggests that the identity performances that get celebrated within science classrooms are shaped not just by teachers’ personal values and teaching practices (as per Carlone et al., 2014) but also by wider education policy and managerial contexts, which act upon and constrain both teachers and students.

Our interest in this area is driven by a social justice concern to make science a more equitable and accessible field for minoritized young people. Across most western nations the general profile of a ‘typical’ graduate or professional in the physical sciences or engineering remains white, male and middle-class (e.g. AAUW, 2010; Adamuti-Trache & Andres, 2008; Smith, 2010a, 2010b, 2011). Moreover, concerns remain that the dominant culture of science remains persistently white, male and middle-class (Harding, 1998) and that, within many science classrooms, minoritized students feel marginalised and excluded schools (e.g. Atwater, 2000; Brickhouse & Potter, 2001) and higher education (e.g. Atwater & Simpson, 1984; Marlone & Barabino, 2009; Ong, 2005; Russell & Atwater, 2005). We consider that achieving more equitable participation in science is desirable on many levels, not just to meet national economic goals (e.g. House of Lords, 2012; US President’s Council of Advisors on Science and Technology, 2010), but more importantly to achieve social justice, social mobility and active citizenship through high levels of public scientific literacy (Durant, 1993). As we have argued previously (Archer et al., 2015), we see science education as an important form of symbolic capital (Bourdieu, 2010) which can facilitate agency and the re/production of relations of subordination and/or privilege. Hence we consider it a social justice imperative to find ways to disrupt (and make more equitable) current patterns of participation.

Celebrated identity performances in science classrooms. Our paper is, in no small part, inspired by Carlone et al.’s (2014) study, in which they investigated the ways in which two

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

teachers created very different conditions within their classrooms with regard to what, and who, is valued as being ‘smart at science’, tracing the resultant implications for student engagement and identification with science. Through a longitudinal case study of three diverse students’ identity work from fourth to sixth grade, Carlone et al. detail how it was easier for students like Aaliyah (an African American girl) to identify with science and perform herself scientifically within the context of the more progressive teaching practice of her 4th grade teacher, Ms. Wolf, who encouraged student curiosity (and ‘asking questions’) in ways that valued and enabled students to bring their own identities and cultural resources (or ‘funds on knowledge’, Moll et al., 1992) to bear within the science classroom. However, Aaliyah found it harder to see and perform herself scientifically in the context of the more ‘traditional’ teaching style of her 6th grade teacher, Mr. Campbell. As Carlone et al. explain, Mr. Campbell’s valuing of student behavioural ‘compliance’ had ‘nearly nothing to do with engaging in scientific practices, thinking scientifically or problem-solving’ (p.853) and closed down the identification possibilities for minoritized students, like Aaliyah.

As such research indicates, identity is a key symbolic resource within classrooms and the extent to which non-dominant students’ identities and capital are valued within a class can have profound effects on the extent to which young people are able to perform a science identity and develop science trajectories. As Calabrese Barton & Tan (2010) explain, when a student’s cultural background and identity practices are valued and leveraged in support of doing science, this can substantially facilitate their ability to learn science and participate in school science. Likewise, where a student experiences their identity as being unvalued and/or in tension with school science, this may constrain their science learning and participation (see also Brickhouse, Lowery and Schultz, 2000; Carlone, 2004; Emdin 2010).

Yet, traditional/ dominant forms of school science tend to exclude and diminish non-dominant youth cultural expressions of identity and forms of capital (Gonsalves, Rahm &

Carvalho, 2013). For instance, some students' agentic identity performances – such as performances of voice by African American girls like Tanisha (in Brickhouse et al.'s 2000 study) and Kay (in Tan et al., 2013) – are interpreted negatively by teachers, as problematic and counter to celebrated school performances of behavioural compliance. As Brickhouse et al. and Tan et al. discuss respectively, in both cases the girls' identity performances are read by educators as threatening their potential to simultaneously be recognised as good science students. In sum, the dominant culture of school science has been identified as produced through - and thus reflective and sustaining of - wider intersecting social inequalities in relation to racism, sexism and social class (e.g. Mutegi, 2013; Marlene & Barabino, 2009; Atwater, 2000), which limit the engagement and identity possibilities for minoritized youth in science.

In this paper, we look at the ways in which science classroom practices (as enacted by schools, teachers and students) attempt to author and restrict which performances as celebrated (dominant) and the implications of these for student engagement with science. In particular, we ask:

- What are the main celebrated identity performances in nine urban secondary science classrooms?
- How are these reproduced and/or contested, and by whom?

Theoretical framework

'Identity' is a topic that has been approached and theorised in many different ways within science education – from more positivist and psychological stances, which see identity as relatively 'fixed' and measurable, through to social constructionist approaches that understand identity as discursive and socially produced. For our conceptual framework, we draw on the feminist poststructuralist work of Judith Butler. In particular, we employ Butler's concepts of

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

intelligibility and *identity as performance* as a means to understand and identify ‘*celebrated identity performances*’ within nine secondary science classrooms.

Butler (1990, 1993) proposes that identity should be understood as a ‘performance’. Writing within the context of gender, Butler proposes that gender identity is not the ‘result’ of a person’s sex and does not simply follow ‘naturally’ from particular (sexed, racialised, classed, etc.) bodies. Rather, Butler argues that gender is socially constructed through discursive and bodily ‘acts’. In this respect, gender is not what we ‘are’ but is rather something that we ‘do’ (perform) and continually re-do. It is the repeated performance of gender that creates the ‘illusion’ (Butler, 1990, p. 185-6) that gender is stable and ‘real’. Moreover, she proposes that there is no single set of performances that constitutes gender, rather there are a plurality of ways of ‘doing boy’ or ‘doing girl’, that are mediated in no small part by other intersecting axes of identity, such as social class, age, ethnicity, dis/ability and so on.

We thus understand identity as a performance that is constituted through intersecting social axes, such as ‘race’/ethnicity, gender and social class (Archer 1 & Francis, 2007; Calabrese Barton and Brickhouse, 2006). In this respect, we treat identity as performative, non-essentialised, fluid, contested and produced through discourse (Anthias, 2001; Burman & Parker, 1993; Gee, 1996). Identities are ‘always in process’ (Hall, 1990, p. 222), forever being constituted, and contested, within and through discourse and relations of power (Foucault, 1978). In this way, we see the performance of identity as both an expression, and a mediation, of the extent to which a student may see science as being ‘for me’, or not.

Although identity is performed, this does not mean that it is freely chosen. That is, while agency is possible, the extent to which a person’s identity performances are possible and recognised by others will be constrained by factors such as the body of the actor and by the social field – for instance, what is valued, recognised as authentic and ‘allowed’ (‘intelligible’) within any given space, such as a school or classroom or indeed by dominant discourses of ‘school science’. That is:

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

the “coherence” and “continuity” of “the person” are not logical or analytic features of personhood, but rather, socially instituted and maintained norms of intelligibility” (Butler, 1990, p. 23).

We find Butler’s (1990) notion of ‘intelligibility’ to be a particularly useful tool for exploring minoritized students identity performances within science because it foregrounds the social pressures that students may experience to conform to particular dominant norms. That is, an ‘intelligible’ identity (one that can be read as valid) will be one that re-inscribes and supports particular dominant/ normative values and relations within a given context. Thus, identity performances which are subversive or challenging of dominant identities and practices within the science classroom will be ‘unintelligible’ and will be seen as ‘out of place’ by those in authority, potentially attracting disapproval, sanctions and even fear or disgust. As Butler explains, the cultural matrix through which identity becomes intelligible “requires that certain kinds of “identities” cannot “exist”” (Butler, 1990, p. 24). Hence, we are interested in the extent to which minoritized students are able to perform identities that are recognised as ‘scientific’, given that, as a field, science is dominantly inscribed as high status, white, male and middle-class.

Following the work of Edley and Wetherell (1995), we understand performances of identity as being enacted within an ‘ideological battlefield’, in which different actors compete for authenticity, voice, recognition and dominance. Not all identity performances carry equal power: the more powerful, or hegemonic, performances are those ‘dominant and dominating modes [...] which claim the highest status and exercise the greatest influence and authority’ (Skelton, 2001, p. 50). These identities are often based on the disavowal, negation and/or oppression of Other (less powerful) identities. For instance, Connell (1989) explains how a common feature of hegemonic masculinity is its discursive organisation around the subordination of Others, notably women and gay men. However, as Gramsci (1971) reminds us, no hegemony is ever complete – hegemony always entails and generates spaces of resistance. Hence we are also interested in how

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

students and teachers challenge celebrated identity performances and resist, or subvert, dominant notions of who, or what, counts as ‘scientific’.

Carlone and Robertson (2006) propose that science identity comprises not only a student’s sense of self recognition (e.g. seeing oneself as being scientific and/or ‘good at science’) but also requires recognition by others (such as teachers, parents and peers) that the student is performing scientifically. Hence, Carlone et al. (2014) reveal how students’ identity work may have very different interpretations and outcomes depending on the particular norms and values that are set up within different classrooms. For instance, where a student’s identity work is congruent with the celebrated (dominantly valued) subject positions within a particular science class, that student is more likely to be able to perform a science identity and to be recognised by others as performing themselves scientifically. Likewise, where a student’s identity performances sit in tension with, or opposition to, the celebrated subject positions in a class, it is unlikely that they will be able to see and perform themselves (and be seen by the teacher as performing themselves) scientifically.

In this paper we seek to identify and examine the culturally dominant, hegemonic (Gramsci, 1971) identity performances within our nine classrooms, to delineate the constitutive discourses which produce some performances as more valid than others, to the point that they become taken for granted and ‘assume the status of facts’ (Edley, 2001, p. 190). As Althusser (1971) argues, ideology provides the conditions that shape identity and subjectivity – such that subjectivity can be understood as being a product of ideology. He proposed that ideology shapes people’s experiences, opportunities and their sense of self and the world and that identities are ‘hailed’ (called into being) by particular discourses. We are thus interested in what identity performances are encouraged and brought into being (or, conversely are constrained or rendered unintelligible) within the dominant discourse and ideology of the science classroom. What identity performances and subject positions are celebrated and what are the implications for students’ science learning and identity possibilities?

Methodology

The data reported in this paper come from a nine month research and development programme conducted with nine teachers from six inner London schools as part of a longer, five year [*project name*] study. Three of the participating schools (Coleville, Mareton and Northfields) are state-run, co-educational and within $\pm 20\%$ of the GCSE¹ results of other schools within their local area. Given the aims of the wider project, to understand engagement with science education among students non-dominant communities, these three schools were recruited because they had relatively high proportions of students who spoke English as a second language and were registered as eligible for free school meals, compared to other schools in the same region. In each of these schools, we asked for two KS3/4 (students age 11-16) science teachers to volunteer to take part in the study (i.e. teachers who teach at least one class in the 11-16 age range). The remaining three teachers (who taught at a further three different schools) had previously taken part in a professional development course that had been conducted in an earlier phase of the project (see King et al., 2015) and had expressed an interest in continuing to work with the project. We included these teachers in order to help mitigate against potential attrition and because they knew the project and had expressed an interest in being involved with future phases. Details on the participating teachers and their classes are provided in Table 1.

Table 1 about here

As detailed in Table 1, our sample comprised a spread of year groups (1x Y7 class, 3 x Y8, 3x Y9 and 2x Y10) and attainment (set/ track) groupings (4 x bottom set, 2 x middle set and 3 x top set). With the exception of students in Ms. Smith's school, students came predominantly from working-class backgrounds and a range of ethnic backgrounds. Urdu/ Bengali, Turkish, Polish and Portuguese languages were the most frequently spoken languages among the students.

¹ GCSE's (General Certificate of Secondary Education) are series of exams students take in the UK when they are 16.

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

The core data drawn on in this paper come from field notes of classroom observations, a teacher workshop and discussion groups with students.

Observations. Each class was observed by one or two researchers over the nine month period (September to June). Researchers attended classes for one day approximately every 2-3 weeks to observe lessons and to meet with the teachers. Length of time in lesson observations varied from approximately 1 hour to 3 hours per visit. Researchers usually sat at the back or the side of the classroom and recorded field notes either by hand (pen and paper) or on a lap top computer or iPad. For our observations we used an ethnographic approach, following an observation guideline that had been developed and agreed by the research team, including recording how students behaved, what they were doing during the lesson, what they said, how they interacted with the teacher and peers and whether they appear to be engaged with particular aspects of the lesson, or not. We also noted observed group dynamics, which students were being more or less dominant, facilitation from teachers and the content of student discussions as well as other events of note (Hammersley & Atkinson, 1997).

Discussion groups. Towards the end of the field work period (April – May) we conducted 13 discussion groups with 59 students – as detailed in table 2. These students were drawn from the observation classes and comprised all students for whom we had obtained parental consent for both observation and discussion group participation. The aim of these groups was to elicit students' views on their science classes and their views on some of the themes that were emerging and which guided our research (such as their views on celebrated identity performances within classes, who is regarded as being a 'science person', their teacher and their teaching approach and gender dynamics within classes). Although we asked to conduct discussion groups with each teacher's class, the logistics meant that this was not possible in every instance. Discussion groups were conducted in a quiet space (usually an empty classroom) during class time and varied in length between 20 minutes and 1 hour, depending on the time available.

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

Potential student discussion group participants were identified and grouped by teachers, dependent on parental consent to participate.

Table 2 about here

Teacher interviews and workshop. All teachers were interviewed twice, once prior to the start of data collection (to collect personal, career and demographic data on each teacher and to understand their personal motivations for taking part in the study) and once at the end of the fieldwork (in which teachers were asked to reflect back on their experience of taking part in the study, their reflections on the research process and any differences that they had observed in their students over the course of the nine months). Interviews lasted between 30 minutes and 1 hour and were conducted either face-to-face or by telephone by one of the authors. As part of the wider study, teachers took part in two day long Saturday workshops, one in early Autumn at the start of the project (covering the study scope and approach) and one mid-way through (in February) during which teachers shared their experiences, raised any issues and reflected on emergent themes and data presented by the researchers. The two workshops were primarily designed as professional development opportunities, in line with the aims of the wider project, but they were also used as data collection spaces, to gather the views, experiences and reflections of participating teachers. In the February workshop, teachers were specifically asked to discuss and reflect on which performances they felt were celebrated in their classrooms. These discussions were audio recorded and observed by three members of the research team who made extensive field notes on what was said and the interactions between teachers during both small group and whole group discussions. All the participating teachers attended.

Ethics. Consent for classes and teachers to take part was obtained from school managers and personal consent was obtained from all teachers prior to the commencement of fieldwork. Parental consent was obtained to report and use the data for participating students.

Analysis. In line with our theoretical framework, our approach to analysis treated identity performances as combining talk, gestures, embodiment and behaviours (Butler 1990). Analysis of the field notes and discussion group transcripts was carried out by the lead author, followed by a secondary analysis by all the other authors. The lead author developed the coding framework (see below) and searched the data to populate this framework, which was then further analysed through an iterative process of moving between the data and theory. The final framework was checked by all authors. Following an ethnographic approach to qualitative data analysis, themes were interrogated as to their prevalence within the data, convergent and divergent examples were explored and data were analysed in relation to the three data sets in order to develop analytic reliability (Cohen, Manion, & Morrison, 2011; Miles & Huberman, 1994).

Data were analysed using a discourse analytic approach (Burman & Parker, 1993), informed by a Butlerian conceptualisation of gender identity as performance, as discussed earlier. As Alldred & Burman (2005) discuss, discourse analytic approaches differ from more general approaches to discourse analysis (Wilkinson & Kitzinger, 1995) in that they do not attempt a close, 'micro' textual analysis but rather look for patterned talk (discourses) within the data. A key feature of a discourse analytic approach is looking for how power is organised within talk and drawing out the social implications of particular constructions. In other words, our analysis asks: What is the talk 'doing'? What is being normalised or defended? Where is the locus on power within a particular construction – whose interests are being asserted? Who or what is being othered? What is normalised or closed down?

To begin with, data were searched to identify the celebratedⁱ identity performances in the nine urban secondary science classrooms. As Gore (1995) explains, power is vested in pedagogies that define anticipated norms – hence our analytic interest in identifying those performances which carry the most symbolic 'weight' within the classrooms. Like Carlone et al., (2014) we searched the data to identify "the normative practices in each setting; these were the

practices in which students were held accountable to be considered good participants in the setting' (p. 842). We grouped responses into five categories: teachers' talk about what they personally value, teachers' views on what schools (and their colleagues) value, students' views on what teachers value, students views on what schools (and other teachers) value and students views on who is a 'science person' in their class, and identified the range of characteristics and individuals contained within each. These categorisations were tested and refined through successive phases of coding and analysis, iteratively testing out emergent themes across the data set to establish "strength" and prevalence (Miles & Huberman, 1994). From this, we identified three main performances which appeared the most frequently within teachers' and students' talk and within lesson observations. The first grouping comprised performances relating to educational performativity, namely instrumental performances of teaching and learning 'to the test', which we characterised as 'tick box' learning. This grouping was found primarily in the teacher and student discussion data, rather than the observation data (which contained far fewer instances compared with examples of behavioural compliance and muscular intellect). The second grouping involved performances of pro-typical 'good' student behaviour, which we termed 'behavioural compliance' and was found across all three data sets, with examples noted in all observation lessons and all discussion groups. The third grouping comprised performances of confident, assertive scientific knowledge and 'talking science' (Lemke, 1990), which we termed 'muscular intellect', which was also noted across all three data sets and examples were identified in all observation lessons and in all discussion groups.

Next, we sought to identify how these are reproduced and/or contested, and by whom? In this respect, our analytic approach borrows from critical discursive approaches, aiming to draw attention to the role of power and whose interests are being served, what sets of relations are being supported/ defended (Foucault 1980). For this we followed Carlone et al.'s (2014) lead in looking at 'how the ascribed meanings of [students'] identity work positioned them in relation to each classroom's celebrated subject positions and to science' (p. 841). That is, for

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

each of the three main celebrated identity performances we mapped out (i) what institutional (school managerial and policy level) discourses and practices (“ideological apparatus”) were involved in ‘hailing’ (calling into being) these performances and then (ii) who reproduced and sustained or challenged/ resisted the performance (e.g. which students and teachers were compliant and enacted or verbally supported/ endorsed the celebrated performance and those who resisted or challenged it). This process revealed that all three main celebrated performances were all classified as being ‘hailed’ by wider institutional managerial and policy discourses but, as discussed below, a complex picture emerged in terms of the categorisation of teachers’ and students’ observation and interview/ discussion group data, as many individuals were categorised as both reproducing *and* resisting particular discourses. For instance, Mr. Hobbes both verbally challenged the ‘tick box’ approach yet also explained that he sometimes reproduced it – a behaviour that was also noted within some lesson observation data.

Findings: What are the main celebrated identity performances? How are these reproduced and/or contested, and by whom?

The teachers and students articulated and enacted a range of celebrated identity performances in their classrooms – with varying points of agreement or tension within and between these viewpoints. In the interviews and workshops, teachers in particular also recognised that there were tensions between these ideals and practice. For instance, teachers identified a range of behaviours and science performances that they *personally* valued and wanted to encourage in their classes – yet they also recognised that these were not always realised in practice due to the wider institutional and policy context which they felt pushed teachers and students into more instrumental approaches to teaching and learning.

In terms of their personal pedagogy, during the interviews and workshops teachers articulated a common set of values, notably wanting students to be intellectually engaged (e.g.

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

“curious”, ‘questioning’, “thoughtful”, “open minded”, “problem-solvers” and not seeking “right/wrong answers”), social and co-operative (“engaging in discussion”, “sharing each other’s knowledge and ideas”, “good communicators” and “team players”) and self-directed learners (“conscientious and self-motivated”) who are also “creative” and appreciate how science is “connected to other subjects”.

Data from the discussion groups also revealed that students largely agreed with their teachers’ views. When asked what they thought their teacher valued in students, most students identified intellectual engagement, social and co-operative behaviours and self-directed learning, for instance saying that their teachers want them to be “interactive”, “taking part in class discussions” (Y10 girls’, Ms. Dennis’s class) and being “curious” (e.g. “I think she just wants us to be, like, interested in Science, 'cos like in the future, she knows that we’d hope to do well and she just wants us to be curious, yeah”, Y9 boys, Ms. Arkwright’s class).

Students also largely reported that their teacher was more concerned with teaching for understanding and teaching ‘around’ the specified curriculum content (often referred to as going ‘off topic’), rather than narrowly ‘teaching to the test’.

“Mr. Hobbes is different from other teachers because some other Science teachers, they try to make the lessons boring, so I don’t really understand what they say, but Mr.

Hobbes has a very different way of teaching, for example, like he makes us watch videos, so we can understand it properly” (Ali, Y7 boys, Mr. Hobbes’s class).

“She teaches us a lot about the subject [...] but then she also sometimes goes off topic, which like keeps the lesson moving, so we don’t just keep on focussing on one thing until it just becomes a jumble of mess” (Sam, Y9 boys, Ms Randel’s class).

However, the teachers and students also recognised that the identity performances that teachers personally valued and celebrated as ‘good’ science performances were not necessarily shared by

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

all their colleagues (within and beyond the science department), nor were they necessarily those that were the most powerful or prevalent in their classrooms.

Next, we discuss the three most dominant and prevalent celebrated identity performances (as identified by the teachers and students and as corroborated by our observations) – that is, those which carried the most discursive power and were most often observed within the classrooms. Two of the performances were celebrated ways of ‘doing school’ (namely, ‘tick box/instrumental learning’ and ‘behavioural compliance’) and one was a performance of ‘doing science’ (namely ‘being right/ brainy’ which involved performances of ‘muscular intellect’).

‘Tick box learning’ – educational performativity.

The teachers all identified a dominant, symbolic discourse of ‘tick box’ or ‘instrumental’ learning, that they felt was institutionally celebrated in their schools, in that it was required, inculcated (and compliance was rewarded) through the management, curriculum, structures and practices of their schools and the wider English education policy system. This ‘tick box’ approach required teachers and students to perform in certain ways, as demanded by an institutionalised audit and inspection culture, which holds schools to account for examination results league tables and places them in competition with other schools within an educational ‘market’. As Ball discusses, performativity is a key, common technology within current UK educational reform, and plays “an important part in aligning public sector organizations with the methods, culture and ethical system of the private sector” (Ball, 2003, p.216).

The teachers characterised this form of educational performativity as demanding and rewarding practices such as ‘teaching to the test’, which prioritises short-term attainment results over ‘deep’ or ‘real’ learning. Students were also highly aware of the primary importance that the

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

school placed on examinations and ‘good results’. They described the ‘stress’ and ‘pressure’ around examinations and reflected on the different approaches employed between those teachers who ‘teach to the test’ and those who go ‘off topic’.

Across the board, teachers felt that high stakes public examinations at age 16 (GCSEs) and age 18 (A Levels) created a culture of instrumentalism, in which students resist teachers’ preferred science identity performances (e.g. being curious, dialogic) and instead focus on what science content they need to learn to pass examinations. As Mr. Sharma reflected:

“As soon as we mention exams, we kill that bit of passion. When you mention exams, it’s like OK, you have to stop being curious now, you’ve got to work hard. The purpose [for students] is not to learn science, it’s to get GCSE” (Mr. Sharma).

Mr. Sharma went on to share the case of a particularly popular teacher at his school, who “gives students all the exam answers that have ever come up in the A level”. He reflected “students love her” but felt ‘it is intensely frustrating when a teacher is perceived as a very good one when all they ever do is going over past exam questions’.

Students were also very aware of differences between the teachers at their school regarding their practice in relation to ‘teaching to the test’ – although they expressed a range of conflicting and ambivalent views as to whether this was a ‘good’ or ‘bad’ practice. For instance, the Y9 Northfields girls were all clear that they enjoyed Ms Arkwright’s lessons, learned a lot from them and thought she was an excellent teacher. Yet they also felt they needed more specific examination preparation. As one Y9 girl put it:

I think we should have like more exam question based lessons, like where we focus on like what kind of questions would come up on test (Zakia)

However, other students roundly agreed that they preferred Ms Arkwright’s approach and would not want to be taught to the test:

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

“I think it’s boring if they just like, oh, you're going to do a GCSE, let’s prepare for it, yeah, I do” (Jose)

Likewise, girls from Ms Dennis’s class asserted that they would not want to just be taught to the test, with Hannah asserting that she remembers and learns things better from Ms Dennis’s more interactive and contextualised approach.

While, as noted above, teachers valued a range of behaviours and dispositions (such as ‘curiosity’) that they saw as authentic ways of being scientific, they also felt that the education system mitigated against them fostering these practices among their students. For instance, Ms. de Luca concurred that although, like other teachers, she valued curiosity as key facet of performing scientifically, she also felt that ‘time against me’ in being able to support and promote curiosity among her students due to the demand for examination preparation and content coverage at KS4 (the two years of GCSE preparation classes, with students aged 14-16). She reflected darkly, “being curious - at some point in KS4 you have to kill it”.

For instance, while almost all lesson observations (exceptions being revision lessons) included various examples of teachers consciously trying to contextualise science, encourage students to discuss and relate science content to their own lives, behave scientifically and value students’ interests, identities and cultural resources (in line with the approach being developed with teachers within the wider project), we also recorded moments within most lessons where the demands of educational performativity and ‘tick box learning’ seemed to percolate through. For instance, as illustrated by the following fieldnotes, Ms. Dennis usually introduced her lessons by asking students to focus strategically on learning objectives, paying attention only to those objectives relating to their expected examination grade attainment.

Ms. Dennis shows the students the learning objectives on the board. There are different colours according to grades expected, e.g. green for A*(the top grade) and red for a C/D (pass/

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

fail boundary). Ms. Dennis asks the students to copy down their learning objective - not all of them, just the one they are aiming for (Ms. Dennis, April field notes).

All the teachers agreed about the negative science learning consequences incurred at KS4, which leaves “less time for discussion” (Ms. Randel) and less time for inquiry (“KS4 has a knuckle down atmosphere – not much inquiry and not so active”, Ms. Arkwright; “practicals go out the window”, Ms. Dennis) – points that were borne out within the observations. Students in their classes concurred, for instance:

I think we used to do more practicals, like year seven to year nine, we did like more / practicals, but now it's like once in a while. [...]It's kind of like where it's like our year for GCSEs, we're not doing as much fun stuff. (Sarah, Ms. Dennis' class).

“I enjoyed the lessons for a while but I feel we should do more practical stuff.” (Alfie, Y9 boy, Ms. Arkwright's class).

Teachers also recounted how some of their students are ‘captured’ by the dominant educational performativity discourse, in that they resist teaching that is not ‘to the test’. As Ms. Randel explained, some students actively resisted her attempts to go beyond straight content coverage during her classes (“they said they don't want to waste time on that - want to get on with content coverage”). The result being, as Ms. Dennis reflected sadly, that “KS4 is where you lose the kids from science”, as intrinsic interest and ‘deep’ understanding become subservient to the instrumental goal of passing an examination.

Teachers also reflected that the demands of content coverage meant that they were forced to cover content at the expense of being able to convey the meaning and relevance of the content (Mr. Hobbes) and lost time for building rapport with the students (Ms. Arkwright). As sociologist of education, Stephen Ball, explains:

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

“Performativity [...] is a new mode of state regulation which makes it possible to govern in an ‘advanced liberal’ way. It requires individual practitioners to organize themselves as a response to targets, indicators and evaluations. To set aside personal beliefs and commitments and live an existence of calculation.” (Ball, 2003, p.215).

Indeed, Mr. Hobbes reflected that hearing his students ask "is this in the test?" was, for him, “the most annoying and hurtful thing you can hear”.

The teachers talked passionately during the workshop discussions about their opposition to this ‘tick box’ culture and the tensions they experienced as a result of a clash between their own professional values and educational performativity. They felt that their own practice was regulated to such an extent that they experienced only small spaces in which to resist (e.g. to teach ‘for understanding’) and reflected with some sadness that the discourse was inculcated into students to such an extent that many students’ identity performances conform in that they adopt an instrumental approach to learning and resist teachers’ attempts to teach ‘around’ a topic. For instance, Mr. Okello shared a particularly poignant example of a boy in his class who, on learning that the topic they had just covered would not be “in the test”, erased all the text that he had just written in his work book. This student might be interpreted as exemplifying the workings of institutional power through the governance of the self (Rose, 1989), in which the subject comes to adopt the views and values of the system and becomes self-regulating (only focusing on what is required to pass the test). Although it could be argued that students who want to be taught ‘to the test’ are still learning science, the teachers felt that this culture inculcated narrow and unhelpful preconceptions among students as to what the ‘purpose’ and nature of science is (e.g. to pass examinations rather than intrinsic interest or active citizenship; science as just ‘facts’ rather than a practice or ‘habit of mind’) and what a science lesson ‘should’ look like. In particular, the teachers reported their exasperation that ‘tick box’ performativity works against students performing science identities, as the instrumental focus makes them “less curious”.

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

However, the teachers also recognised that they themselves were also implicated in the reproduction of the institutionally celebrated ‘tick box’ performance. Indeed, our observations revealed that ‘tick box’ performances were played out in particular moments within classrooms by both students and teachers – with both reproducing aspects of educational performativity. For instance, in Mr. Hobbes’s class students frequently focused on summative rather than formative assessment and often made public bids for recognition of their attainment through appealing to the teacher for merit points for having completed tasks (see also Ms. Dennis, who was often observed telling students that she would award merit points for “good answers”). Appealing to the students’ instrumental motivation (to earn merit points) was sometime used by some teachers as a behavioural strategy, enabling him/her to assert control and get the class on task when students’ attention was elsewhere. However, it could also be interpreted as working against the development of intrinsic interest and/or ‘deeper’ science learning given the instrumental focus. Moreover, in one of the discussion groups Ali reflected that this approach could disadvantage and de-motivate students who did not feel able to perform in this way:

“The only downside is, like, it’s the same people that gets like the ticks, because they’re like putting their hands up lots, but the other people don’t get a chance but because they don’t know the answer, they’re so shy, they don’t want to like put their hand up // some people do it, they’re like always like focussed, they go for the ticks, they go for the marks” (Ali, Y7 boy, Mr. Hobbes’s class).

As Mr. Hobbes reflected during a discussion of the Carlone et al. article at a project workshop, ‘tick box’ approaches cannot be simply dismissed or resisted – both on account of their substantial institutional power and because they can produce the required outcomes that are demanded by educational performativity – such as behavioural compliance and passing examinations. As Mr. Hobbes put it, “the Mr. Campbell approach does work for passing exams”. To a large extent, the teachers in our study epitomised Ball’s assessment, that:

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

Typically, at least in the UK, these struggles are currently highly individualized as teachers, as ethical subjects, find their values challenged or displaced by the terrors of performativity. [...] The struggles are often internalized and set the care of the self against duty to others. (Ball, 2003, p.216)

For instance, Mr. Hobbes articulated the identity performances that he *personally* valued in his classroom as being ‘open minded, not a right/ wrong answer, science as connected’ and emphasised that he wants his students to ‘think’, not just adopt a ‘tick box’ approach to learning – but he also recognised that the system works against him in being able to realise and foster alternative performances in the classroom in any sustained way. Mr. Hobbes explained that he tries to find ways to resist the ‘tick box’ performance when he can (“I always try to fight the system”), yet like his colleagues, he admitted that this can be exhausting and often impossible and can entail conflict with colleagues and students. For instance, when attempting to introduce a more contextualised teaching approach that drew on students’ funds of knowledge, Mr. Hobbes recounted the “hostility” that he encountered from his fellow science teachers. As Rose writes, such technologies and practices impact on ‘our subjective existence and our relations one with another’ (Rose, 1989, p.ix) and research points to the negative psychological, emotional and social effects that educational performativity can entail for teachers (Smyth et al., 2000 – cited by Ball, 2003). In this respect, we suggest that it is perhaps unsurprising that statistics point to high levels of attrition among urban science teachers in the UK (Manning, 2016).

‘Doing the right thing’: behavioural compliance

The second main celebrated identity performance that we identified was behavioural compliance. This performance was both symbolically valued (i.e. it was demanded and celebrated/ sanctioned by teachers and students) and was also highly prevalent (e.g. a lot of classroom time was devoted to managing student behaviour). For instance, when asked what they think their teacher values in

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

students, Y10 girls in a discussion group from Ms. Dennis's class replied "I think behaviour". Of course, behavioural compliance is not particular to science lessons, but is a common concern within the wider educational literature (e.g. Rogers, 2015). However, here we are particularly interested in the implications of these performances for students' performances of scientific identities.

A number of the teachers had students (but particularly boys) in their classes who regularly behaved in rowdy and disruptive ways, making teaching and learning challenging for all and rendering the regulation of behavioural compliance a constant and wearing task. For instance:

Ms. Dennis shouts at the class, they have exhausted the 20 minutes detentions now, if she writes up their name they will get a letter home and a curriculum detention. It doesn't seem to make a difference though, students are still being very noisy (Ms. Dennis, 9th Dec)

Tali plays with his pen it's an annoying noise. He is told to stop. He does not. Students around him tell him to stop, but he does not. Everyone looks at him, but still he does not stop (Ms. de Luca, 4th Feb).

We observed that behavioural compliance – particularly through performances of 'not shouting out' and 'putting your hand up / waiting to be asked to speak' - were valued and fostered by all the teachers. For instance, when asked what their teacher values in a student, three of the boys in the discussion group from Ms Randel's class replied being "quiet". To use an extended example from Mr. Hobbes class: one of the performances of behavioural compliance that was celebrated (i.e. compliance was rewarded and breaches were sanctioned) by Mr. Hobbes was 'not shouting out'. For instance:

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

Students are mostly talking and not working. A couple, like Dwayne seem to be looking at the board and trying to write answers. A boy calls out 'I done it!' Mr. Hobbes highlights to the class who is 'doing the right thing' and names students who are behaving: "Dwayne is doing the right thing. Ali is doing the right thing" (Mr. Hobbes, 14th Oct.)

Mr. Hobbes 'counts down' for quiet. Casey calls out "Mr. Hobbes, I've completed the task!" Mr. Hobbes says "no shouting out". Two minutes later, Mr. Hobbes says "OK I will ask people to stay behind who shout out" (11th Nov.)

Performances of 'not shouting out' were also regularly patrolled and reinforced by some of Mr. Hobbes's more science-keen students (notably Casey and Kaleem), as the following field notes illustrate:

Casey is getting upset and frustrated with everyone being noisy. He calls out loudly "shush man!" Later in the lesson, Casey claps for quiet and shouts "stop messing about!" Another student retorts "we're not!" Casey shouts again to the class "can you be quiet!" Again, later in the lesson, Kaleem shouts loudly at top of his voice, "shush! Can you just shush? We are going to be late for lunch" (18th Nov.)

In every observation of Mr. Hobbes's class we saw a number of boys (led by Qadir and his friends) who regularly resisted their teacher's celebrated identity performances of behavioural compliance, by shouting loudly and making public claims to visibility within the class, not least as part of their performance of muscular intellect (which we discuss in detail, below). These performances were not always sanctioned by the teacher or other students and enabled these students to gain voice and power in the classroom. In this respect, we interpret performances of shouting out as both transgressive of dominant class norms but also as dominant practices, in that they both reflect and generate status, visibility and hence power for the students performing them.

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

Ball (2003) argues that performativity requires educational managers and teachers to become what Foucault terms ‘technicians of behaviour’, in that they are required ‘to produce bodies that are docile and capable’ (Foucault 1979a: 294). The high stakes of behavioural compliance for teachers (for instance, feeling that their own performance, as teachers, would be judged by the standard of their classroom discipline) are further exemplified by the finding that teachers often cite concerns about behaviour and control as reasons for leaving the profession (Aloe et al., 2014). Yet as Carlone et al. (2014) warn, students’ performances of ‘good behaviour’ should not be conflated with their performance of ‘good science’ (Carlone et al., 2014, p.865). Indeed, Varelas, Kane & Wylie (2011) discuss how a ‘pedagogy of control’ that emphasises the regulation of student behaviour can negatively affect students’ capacity to ‘think outside the box’ and do robust scientific work.

Indeed, students whom we observed consistently performing behavioural compliance were not necessarily those whom we observed and/or who self-identified as performing a science identity. For instance Dwayne, a 12 year old, Black British working-class boy in Mr. Hobbes’ class, was consistently quiet and well-behaved in class. He was usually observed to be paying attention, listening to the teacher or had his head down completing the tasks that have been set. He often put up his hand to answer questions. When he was chosen to give an answer, it tended to be appropriately scientific and ‘correct’, but he also preferred to give his answers to Mr. Hobbes one-to-one, rather than publically in front of the whole class:

Dwayne puts up his hand, he calls Mr. Hobbes over and gives him a long scientific explanation to the question on the board (11th Nov.)

Dwayne gives a long answer to the next question –he explains that the number of atoms stays the same even though the substance can get bigger or smaller, but he speaks very quietly. Mr. Hobbes praises him and repeats his answer to the class (12th Jan.)

Despite his scientific competence, in the discussion group, Dwayne explained that he did not see himself as scientific or as having a science identity. Nor was he recognised as being scientific by other students. Rather, Dwayne described himself (and was regarded by others) as performing a ‘good student’ identity. Dwayne’s performance of behavioural compliance (‘being quiet’ in class) was also described by other students as being at odds with dominant performances of science, which – as we discuss next - were aligned with the performance of ‘muscular intellect’, involving confident and loud public contributions. As Jana reflected in a discussion group:

“I don’t know if Dwayne is good [at science] because he's always quiet, but he does the work and his book is normally full of sums” (Jana, Y7 girls, Mr. Hobbes’s class).

In other words, we suggest that while performances of behavioural compliance are celebrated within most classrooms (and will be necessary to some extent to enable teaching and learning to take place), didactic versions of behavioural compliance that prioritise more ‘passive’ student behaviours may sit in tension with more ‘active’ performances of science and indeed, with dominant, popular notions of what it means to perform scientifically, which as discussed next, tend to be organised around public displays of ‘muscular intellect’.

Doing science through ‘muscular intellect’: ‘Being right, being brainy and being macho’

As identified by other research studies, science is popularly aligned with ‘cleverness’ and ‘braininess’ (e.g. Archer & DeWitt, 2016). Accordingly, we observed a celebrated performance across all of the classrooms in which ‘doing science’ was dominantly aligned with performances of ‘brainy’ identity. In the discussion groups, when students were asked who in their class is a ‘science person’, across all schools and age groups, without exception students identified peers who they perceived to be ‘brainy’ and ‘smart’ (“They’re really like smart”; “like he’s got a lot of knowledge about Science”; “they’re very smart”; “I think they’re always ahead of our lessons, so

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

they know what's going on and sometimes it takes us quite a while to catch up"; "they always get the questions right"). As one of the Y9 boys from Ms Arkwright's class explained:

"To be known as one of the smart people in the class, you've just got to have general knowledge and like you've just got to be the one that always put their hand up when Miss asks a question".

For instance, Kaleem - a Y7 boy in Mr. Hobbes's class - was universally recognised by his teacher and peers as being a 'science person' and exemplifying science identity due to his high attainment and being 'smart'. Indeed, students in all four discussion groups at this school identified Kaleem as a science person:

"Kaleem, he's really smart [...] He mostly has his hand up for every question". (Girls discussion group)

Those students who were identified by their peers as being 'science people' concurred with these views. For instance, Kaleem agreed with his peer's descriptions of him and Mubid and Aalim, (boys from Mr. Hobbes and Ms Randel's classes, respectively) who were similarly named by other students as a science person, concurred "I see myself as like good at Science" (Mubid) and "Yeah, I think, like, because of the exams, I got quite a high score on that and like I'm quite high in most subjects, I guess" (Aalim).

On the whole, students felt that their teachers also recognised science people by virtue of their high attainment. For instance, when asked who they thought their teacher considers to be a science person, the Y10 girls from Ms Dennis' class replied "the people who are good at it". The exception to this were the students in Ms Arkwright's class, who asserted that "I think if you would ask Miss, she would name the whole class" and "she'd be really impartial" (Harrison). Teachers also described aligning attainment with science identity, as Ms Smith put it, "I probably expect my top set to be more science-y than my lower set".

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

Interestingly, when asked who is a science person in their class, only one discussion group (out the thirteen conducted) initially identified a girl (this group was a predominantly female group from Mr. Sharma's class). For instance, the students from Ms Randel's class identified three boys (explaining that "they get good grades" and "just like they have an answer or a point behind everything and usually they're right about it", Rohan). The boys from Ms Arkwright's class also only named male students until prompted by the interviewer as to whether there were any girls who might be science-y. The girls group from Ms Arkwright's class did name a girl as a science person, but this was only after they had identified a boy first. We suggest that this pattern reflects a wider dominant association of science with masculinity (Harding, 1998) and a tendency to see boys as being more 'natural' scientists (Carlone, 2003). Moreover, as we now discuss, we suggest that it also speaks to the symbolic value that is attached to performances of science through 'muscular intellect'.

Muscular intellect. Performances of muscular intellect involve confident, arrogant assertions and displays of knowledge and 'intelligence' – akin to 'pushing others around intellectually' – and have been noted particularly among some high-achieving middle-class boys (see Mac An Ghail, 1994; Redman & Mac an Ghail, 1997; Francis et al., 2010) and have been proposed as a dominant masculine performance of science identity (Carlone et al., 2015; Archer et al., 2014). We interpreted some of the most dominant and widely recognised performances of 'braininess' in science classes as being achieved through performances of 'muscular intellect'. As the boys from Ms Arkwright's class explained, in these performances "confidence is the key" and involve "flaunting their, like, knowledge". For instance:

Mr. Hobbes shushes the class and explains the next task. They have to use the keywords provided on the board to help them answer a comprehension task about synthesis and decomposition. Qadir calls out aggressively over other boys to answer // Qadir is invited to answer, says "iron and oxygen make rust". He continues to call out the answers loudly

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

beyond his 'turn' (when other students are invited to answer the next questions). //

Qadir gets up and goes over to bellow the answer at another boy (12th Jan)

In the discussion groups, students also conveyed their recognition of these behaviours, although as exemplified by the following Y8 girls from Mr. Okello's class, not all students valued or liked such performances:

Sharifa: They say all these big words, you know.

Leonore: They need to show off.

Sharifa: Yeah, well, they show off too much, there's a limit, isn't it? //

Leonore: Yeah, you have to show off to someone, so if you don't show off, then people will just think that, oh, you're quiet, like this girl, she's - //

Sharifa: [They] show off too much and then people, they feel bad about themselves, 'cause they think that like, well, they're trying to like say that you're dumb [...] But then no, they act like, they're like superior and high bred and all this, better than anyone else.

As Sharifa explains, students like herself and her girlfriends, experienced performances of muscular intellect as a form of "showing off" that is both elitist ("they're like superior and high bred") and belittling to other students ("they feel bad about themselves ... they're trying to like say that you're dumb"). As also hinted at by Sharifa's reference to "big words", we observed that performances of muscular intellect in science classes were closely intertwined with performances of 'talking science', that is 'doing science through the medium of language' (Lemke, 1990, p.ix), such as the adept use of scientific terminology and concepts. Such performances were widely recognised by teachers and students as authentic ways of performing scientifically. For instance:

Mika tells the rest of the class to be quiet and listen to Miss. He explains how you can calculate the power in the lightbulb using the equation (Ms Dennis, 9th December)

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

As a practice of power, we interpret performances of muscular intellect through ‘talking science’, as problematic and exclusionary of other students in that - following Lemke (1990) - such performances reinforce and perpetuate the ‘mystique of science’. As illustrated by Sharifa’s quote above, these narrow representations of science can alienate other students and can mean that those students who are unwilling or unable to produce such performances are rendered unintelligible as ‘good science students’.

We also observed that it was predominantly boys who used performances of muscular intellect to assert themselves within science classes. For instance, boys were more likely to assert themselves through ‘competitive’ performances of muscular intellect, which we read as attempts to generate status, power and ‘voice’, as typified by the following extract:

Shadin congratulates himself publically for getting the answer right, saying loudly (ostensibly to himself, but loudly, so others can hear), “metal chloride - genius! Yeah, I’m a genius!” (18th Nov).

Across the classes, we observed that boys were far more likely to compete with one another to get answers ‘right’ and to perform this ‘success’ ostentatiously to other boys – which we interpreted as examples of muscular intellect. For instance:

Mr. Hobbes goes through the answers to the questions on the board. The boys all cheer when they get an answer right // A group of boys at the front of the class (Kaleem and friends) compete with one another to give Mr. Hobbes the ‘right’ answers (11th Nov.)

These performances of muscular intellect carried significant symbolic ‘weight’ in that they were bound up with strong emotions (e.g. they were desired by some and disliked, even feared by others) and were hotly contested. For instance, we observed frequent occasions when students (but particularly boys) engaged in the public derision of students who ‘get it wrong’ when attempting to answer questions. For instance:

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

Mr. Hobbes asks the class, ‘in order to make pasta what two things do I need?’ Salma says ‘the pasta?’ Qadir insults her for getting the answer ‘wrong’ // Qadir offers an answer to a question but Mr. Hobbes explains that his answer is incorrect. Qadir plays to the class, saying “oh, I could have sworn it’s a mixture, a cake mixture”. Other students deride him, saying “come on, man” (18th Nov.)

Mubid asks, “Sir, what does permanent mean? And what does temporary mean?”. A boy at the front calls out to him “Oh my God! you don't know what temporary means!” Casey turns round and tells him “temporary means it don't last for ever. Permanent means it lasts for ever.” (8th Dec.)

On these occasions, students who could not offer a ‘correct’ answer were rendered unintelligible as science subjects because the performance of muscular intellect demands ‘being right’.

Unsurprisingly therefore, recognised performances of science identity were difficult to attain for students who did not often get the answers ‘right’ and those who did not want to risk public humiliation.

Indeed, students across the discussion groups described how they lacked the confidence to put their hand up to answer a question in class because of their fear of getting the answer ‘wrong’:

“I find that if a teacher comes up and asks a question, if they ask it directly at me, I have an answer but I'm not confident whether it is actually the right answer, so I wouldn't normally put my hand up” (Rohan, Y9 boys group, Ms Randel's class)

We suggest that these performances can be understood as technologies of power, in that those who were able to produce authentic performances of muscular intellect were able to be recognised as scientific. However, those who could not or did not want to perform muscular intellect experienced more trouble in being recognised as ‘science people’.

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

We noted that the symbolic power of ‘muscular intellect’ (as a dominant performance of science identity) posed a challenge for the intelligibility of quiet students, but particularly girls, as ‘science people’. For instance, students across the different classes and schools felt that most girls tended to be less vocal within science lessons – even when they possessed high levels of science ‘knowledge’ and interest:

“Like there's this girl, Wendy, in our class, it's like the quiet people usually have a better knowledge, but they don't share the knowledge with the class, yeah // [“Boys, yeah, they are much more loud”, Taheem]. The women are much quieter and sit at the back, so they don't get chosen most of the time” (Rohan, Y9 boys, Ms Randel's class)

“I think that the girls on my table, they're all quite smart and like clever and they could answer questions but they don't and like they stick to their books ... cos they're shy.”

Ewan, Y9 boys, Ms Arkwright's class)

However, as noted above, girls were rarely identified as ‘science people’ by their peers. We suggest that this is because while particular girls may be recognised as ‘brainy’ (“quite smart and like clever”) the absence of a performance of muscular intellect can interfere with their perceived embodiment of science identity. Our observations also seemed to bear out the students' views. For instance, in Mr. Hobbes's and Mr. Sharma's classes it was noticeable that girls seemed to lack confidence, compared to the boys and appeared unable or unwilling to perform muscular intellect. For example, we noted that whereas boys were more likely to congratulate themselves loudly and publically for their science ‘prowess’ (as illustrated by Shadin's exclamation above of “genius!”), girls tended to offer their answers more modestly and shyly, claiming ‘I'm not sure’ or ‘I forgot’ when asked to repeat an answer for the class. Moreover, girls appeared to occupy an ‘impossible’ position, in that those who *did* perform aspects of muscular intellect, such as confidently speaking out in class, asserting their knowledge and talking science, were usually ‘explained away’ by other students as exceptions to the norm:

“I think that the boys take part more and it’s just Boudica from the girls. The rest of the girls just, I don’t know, they stay quiet I guess” (Zakia, Y9 girl, Ms. Arkwright’s class)

Discussion & Conclusion

In this paper, we sought to identify the celebrated identity performances in nine urban secondary science classrooms, paying attention to how these are reproduced and/or contested among and between students and teachers. Our analyses contribute to existing work by providing evidence from a UK context and by adding to understanding of how context matters in complex ways. As per previous studies, we found that the values and practices of individual teachers play an important part in delineating which identity performances are/ can be celebrated within a particular classroom. However, our analyses also extend further, drawing attention to how the agency and personal values of teachers (and students) may be conflicted and compromised (in terms of which performances are valued and recognised in practice) due to their being ‘captured’ by the discourse of educational performativity.

We thus aim to build upon existing work on this topic by illuminating how it is not just individual teachers who establish celebrated identity performances, but that wider educational ideological policy practices (notably educational performativity) also play a key role. We showed how teachers may be complexly located *vis a vis* these celebrated performances, for instance, resisting or criticising aspects of them yet also feeling compelled to reproduce them and constrained in the extent to which they can exert their own agency to resist and enact alternatives. Moreover, we also found that students, too, can be implicated in the reproduction of celebrated discourses, for instance, playing into the reproduction of ‘tick box’ approaches and reinforcing the dominance of performances of muscular intellect (and the marginalisation of other students that this performance entails).

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

We highlighted how at a personal level, teachers reported valuing intellectual engagement, social and co-operative behaviours and self-directed learning in their students. We also noted that, on the whole, students broadly concurred with these values. However, as we discussed, teachers found it harder to foster these ideals in practice, as they are resisted and challenged by wider institutional and policy discourses (notably the demand for educational performativity in English schools) and as they are negotiated and resisted ‘in the moment’ across the multiple relations of power that are played out and produced within and between teachers and students in the classrooms.

We identified how three dominant discourses - educational performativity, behavioural compliance and muscular intellect - all shaped who and what is valued as being in/appropriate and in/authentic and delineated the range of possibilities available for students to perform a recognised science identity. Two of these were identified as dominant ways of ‘doing teaching and learning’ within schools, namely ‘tick box’ approaches (educational performativity) and behavioural compliance. The third performance we identified (‘muscular intellect’) was a dominant performance of science. Extrapolating from our findings, we suggest that the three dominant identity performances noted in the nine classrooms can be interpreted as all entailing potentially negative consequences for science engagement because – as articulated by the teachers - they close down opportunities for students to develop interest, intrinsic motivation and ‘scientific’ practices (such as curiosity), and/or reinforce narrow views of what, and who, can be read as scientific, thus potentially restricting the breadth of students who might be able to perform (and be recognised by others as performing) a science identity.

We interpret our findings as showing that ‘celebrated’ identity performances can be understood as produced through multiple, interwoven layers of policy, identity and practice. These performances are strongly framed by the prevailing educational policy climate (which in

the UK demands teachers and students to submit to educational performativity around ‘tick box’ learning and behavioural compliance) and by dominant constructions of science (as aligned with masculinity).

Extending beyond the data reported in this paper, we hypothesise that the dominance of these three discourses may entail different implications for different students’ potential participation in science. That is, students who do not value instrumental approaches to learning, who do not submit to behavioural compliance, but who perform more agentic versions of ‘voice’ and those who do not, or cannot, perform muscular intellect, may face especially difficult challenges to being able to produce themselves, and be read as, intelligible science subjects. The wider literature suggest that it is often students from historically under-represented backgrounds (such as the African American urban youth in Emdin’s, 2010, research and the African American girls discussed by Brickhouse et al., 2000, and Tan et al., 2013) who tend to experience such tensions between their own identities and the dominant norms and values within prototypical science classrooms. As such, we interpret our findings in light of Carlone et al.’s observation of “the difficulty of prototypical school science in sustaining and buttressing nonmainstream students’ meaningful science trajectories” (Carlone et al., 2014: p863).

We thus support calls for more to be done to support *science teachers* to enact more progressive and equitable teaching approaches (that can resist educational performativity and prototypical approaches to science education) and to support and value *students’* enactments of a wider range of personally meaningful science identities (e.g. Tan & Calabrese Barton, 2012), beyond those which are currently dominantly celebrated within prototypical science classrooms.

Luehmann (2007) argues that teacher education programs are failing to produce teachers able to enact reform-based teaching. In response, Luehmann suggests that such programs need to create scaffolding and ‘safe spaces’ for teachers to test out and develop their reform-based teaching identities and provide more opportunities for teachers to be recognised and validated in

their reform-based approaches. This, Luehmann argues, is important for helping bolster teachers' identities and resilience, to enable them to enact reform-based teaching that 'goes against the grain' of mainstream teaching. Based on our findings, we suggest that within teacher preparation and professional development programs, a useful part of this scaffolding - to help teachers enact more inclusive and equity-minded identities and teaching - could be supporting teachers to identify and reflect on the range of celebrated identity performances that permeate teaching and learning and consider how these fit together (or not) and their implications for teaching and learning.

We thus call for educational policy-makers to urgently consider integrating equity approaches – and spaces for reflection around equity and inclusion - more seriously and substantially within initial teacher education (ITE), such that 'teaching science' is understood as not just a cognitive or technical exercise or training, but as an identity-based process, in which teacher and student identity performances are enacted (valued, de-valued), made and re-made in and through the performance of 'learning science'. In the UK, identity, equity and diversity topics remain a small and marginalised aspect of most ITE. Yet without a solid conceptual grounding, why should we expect science teachers to be equipped with the required understanding and resources to enact equitable practice that can engage with the complexity of power relations and identities in the classroom?

Of course, this can be challenging to achieve within the high stakes climate of the current education system. However, as exemplified by Ms Wolf (in Carlone et al.'s study) – some teachers are able to enact more inclusive practices which can support all students to feel that they can perform science. Drawing on our teachers' experiences, we suggest that a key challenge lies in changing teachers' practice in classes that are preparing students for high stakes national examinations, where institutional audit – and the views and concerns of other teachers and

students – may heighten surveillance and concerns about potentially ‘non-conformist’ teaching approaches.

Finally, we believe that there is value in challenging the dominant culture of science, in which science and ways of being/doing science are aligned with masculinity and specifically, performances of muscular intellect. But how might this be achieved in practice? As we argue elsewhere (Archer et al., under review), one avenue might be to borrow from and extend Butler’s notion of ‘queering’ to science education. While Butler proposed this concept within the context of gender and sexuality, we believe that there is value in extending the concept to the present context, due to its core concern with challenging binaries and disrupting dominant notion of who/what is valued and ‘counts’. That is, the notion of ‘queering’ fundamentally seeks to both critique dominant values *and* disrupt and trouble who/what constitutes as an authentic identity performance. It involves re-evaluation of a topic from the perspective of the Other, placing the experiences, values and identity performances of the marginalised/ excluded in the centre stage. In the context of science education, this could mean reflecting on who/what counts as being a ‘good science student’ from the perspective of the Other, questioning dominant norms and values and disrupting taken-for-granted assumptions about who/what counts as science, science students and science teaching. We suggest that the concept of ‘queering’ might thus be a useful theoretical tool for helping teachers to identify, interrogate and reflect on celebrated performances, asking: who/what is normalised, how, why and with what implications? Who is excluded/ denied? In this way, the concept of ‘queering’ might help science educators to more effectively critique and move away from celebrations of tick box learning, behavioural compliance and muscular intellect. This approach echoes calls by science educators such as Elmesky and colleagues, who advocate for ‘creating spaces inside and outside of science classrooms that value student discourses, goals, and ways of being’ (Elmesky, Olitsky & Tobin, 2006, p.767). Yet the notion of ‘queering’ also moves beyond this approach, providing a way of

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

understanding, challenging and critiquing dominant educational policy and the dominant norms and values which currently configure prototypical science education.

We thus call on science education to engage critically with dominant, celebrated performances of doing science and to support teachers to diversify the range of identity performances that are recognised as legitimate ways of doing and being in science. A more democratic approach could involve engaging both teachers and students in the co-creation of which norms and values should be celebrated within science classrooms in order to be inclusive and equitable (e.g. Basu et al., 2011). A critical engagement with power and identity would lie at the heart of such a process, enabling teachers and students to recognise and challenge oppressive power relations and to understand how practices of power are implicated in constructing dominant ways of 'being, doing, becoming and belonging' (Grace, 2004, p.2, cited in Ford, 2004, p.1). In short, we look forward to a future in which science education might entail more collaborative and participatory classrooms (Ford, 2004), in which both students and teachers can thrive.

References

- American Association of University Women (AAUW). (2010). *AAUW annual report*. Washington, D.C.: AAUW.
- Adamuti-Trache, M., & Andres, L. (2008). Embarking on and persisting in scientific fields of study: Cultural capital, gender, and curriculum along the science pipeline. *International Journal of Science Education*, 30(12), 1557-1584.
- Allred, P., & Burman, E. (2005). Analysing children's accounts using discourse analysis. In S. M. Greene & D.M. Hogan (Eds.), *Researching children's experience: Approaches and methods*. London: Sage.

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

Anthias, F. (2001). New hybridities, old concepts: The limits of 'culture'. *Ethnic and Racial Studies*, 24(4), 619-641.

Archer, L. (2008). The Impossibility of Minority Ethnic Educational 'Success'? An Examination of the Discourses of Teachers and Pupils in British Secondary Schools. *European Educational Research Journal*, 7(1): <http://dx.doi.org/10.2304/eej.2008.7.1.89>

Archer, L., Dawson E., DeWitt, J., Seakins, A. and Wong, B. (2015). Science capital: a conceptual, methodological, and empirical argument for extending Bourdieusian notions of capital beyond the arts. *Journal of Research in Science Teaching*, 52(7): 922-948. buff.ly/1LNleLK.

Archer, L. & DeWitt, J. (2016) *Understanding Young People's Science Aspirations*. London, Routledge.

Archer, L., Dawson, E., DeWitt, J., Godec, S., King, H., Mau, A. & Nomikou, E. (under review) Can the subaltern speak science? An intersectional analysis of performances of 'talking science through muscular intellect' by 'subaltern' students in an urban secondary science classroom

Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B. & Wong, B. (2010). "Doing" Science Versus "Being" a Scientist: Examining 10/11-Year-Old Schoolchildren's Constructions of Science Through the Lens of Identity. *Science Education*, 94(4): 617-639.

Archer, L., Dewitt, J. and Willis, B. (2014). Adolescent boys' science aspirations: Masculinity, capital and power. *Journal of Research in Science Teaching*, 51(1):1-30.

Archer, L. & Francis, B. (2007) *Understanding Minority Ethnic Achievement: the role of race, class, gender and 'success'*. London, Routledge.

Atwater, M.M. (2000) Females in science education: White is the norm and class, language, lifestyle and religion are nonissues. *Journal of Research in Science Teaching*, 37(4), 386-387

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

- Atwater, M. M., & Simpson, R. D. (1984). Cognitive and affective variables affecting black freshmen in science and engineering at a predominately white university. *School Science and Mathematics*, 84(2), 100-112
- Baker, D. (1998). Equity issues in science education. In B. J. Fraser & K. G. Tobin (Eds.), *International handbook of science education* (pp. 869 – 896). Boston: Kluwer.
- Ball, S. J. (2003) The teacher's soul and the terrors of performativity. *Journal of Education Policy*, Volume 18, Issue 2, pages 215-228
- Basu, S.J., Calabrese Barton, A., & Tan, E. (eds) (2011) *Democratic Science Teaching*. Rotterdam, Sense Publishers.
- Bourdieu, P. (2010). *Sociology is a Martial Art*. New York: New Press.
- Brickhouse, N.W., & Potter, J. T. (2001). Young women's scientific identity formation in an urban context. *Journal of Research in Science Teaching*, 38(8), 965-980.
- Brickhouse, N.W., Lowery, P. & Schultz, L. (2000) What kind of girl does science? The construction of school science identities. *Journal of Research in Science Teaching*, 37, 441-458.
- Brown, B.A., Reveles, J.M. & Kelly, G.J. (2005) Scientific literacy and discursive identity: A theoretical framework for understanding science learning. *Science Education*, 89(5), p.779-802.
- Burman, E., & Parker, I. (Eds.). (1993). *Discourse analytic research: Repertoires and readings of texts in action*. London: Routledge.
- Butler, J. (1990). *Gender trouble*. New York & London: Routledge.
- Butler, J. (1993). *Bodies that matter: On the discursive limits of sex*. London: Routledge.

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

Calabrese Barton, A. Kang, H., Tan, E., O'Neill, T.B., Bautista-Guerra, J. & Brecklin, C. (2013)

Crafting a future in science: tracing middle-school girls' identity work over time and space.

American Educational Research Journal, 50(1): 37-75.

Calabrese Barton, A., & Brickhouse, N. W. (2006). Engaging girls in science. In C. Skelton, B.

Francis & L. Smulyan (Eds.), *Handbook of gender and education* (pp. 221-235). Thousand Oaks: Sage.

Calabrese Barton, A., & Tan, E. (2010). We Be Burnin'! Agency, identity, and science learning.

Journal of the Learning Sciences, 19(2), 187-229.

Carlone, H. B. (2004). The cultural production of science in reform-based physics: Girls' access,

participation, and resistance. *Journal of Research in Science Teaching*, 41(4), 392-414.

Carlone, H. B. (2003). (Re)producing good science students: Girls' participation in high school

physics. *Journal of Women and Minorities in Science and Engineering*, 9(1), 17-34.

Carlone, H.B., Scott, C.M. & Lowder, C. (2014) Becoming (Less) Scientific: A longitudinal study

of students' identity work from elementary to middle school science. *Journal of Research in Science*

Teaching, 51(7): 836-869.

Carlone, H. B., Haun-Frank, J., & Webb, A. (2011). Assessing equity beyond knowledge- and

skills-based outcomes: A comparative ethnography of two fourth-grade reform-based science

classrooms. *Journal of Research in Science Teaching*, 48(5), 459-485.

Connell, R. (1989) Cool guys, swots and wimps: the interplay of masculinity and education.

Oxford Review of Education, 15: 291-303.

Durant, J. (1993). What is Scientific Literacy? In J. Durant & J. Gregory (Eds.), *Science and culture*

in Europe. London: Science Museum.

Edley, N. and Wetherell, M. (1995) *Men in Perspective: practice, power and identity*. London, Prentice

Hall, Harvester-Wheatsheaf.

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

Elmesky, R., Olitsky, S., & Tobin, K. (2006) Forum: structure, agency, and the development of students' identities as learners. *Cultural Studies in Science Education*, 1, 767-789.

Emdin, C. (2010) Affiliation and alientation: hip-hop, rap, and urban science education. *Journal of Curriculum Studies*, 42(1), 1-25.

Ford, T. (2004). Queering education from the ground up: Challenges and opportunities for Educators. *Canadian Online Journal of Queer Studies in Education*, 1(1).

<http://jqstudies.oise.utoronto.ca/journal/viwearticle.php?id=5>.

Foucault, M. (1977) *Discipline and Punish: the birth of the prison*. New York, Knopf Doubleday Publishing Group.

Gonsalves, A., Rahm, J., & Carvalho, A. (2013) “We could think of things that could be science”: girls' re-figuring of science in an out-of-school-time club. *Journal of Research in Science Teaching*, 50: 1068-1097.

Gore, J.M. (1995) On the Continuity of Power Relations in Pedagogy, *International Studies in Sociology of Education*, 5:2, 165-188.

Gramsci, A. (1971) *Selections from the Prison Notebooks*. London, Lawrence & Wishart.

Hall, S. (1990). Cultural identity and diaspora. In J. Rutherford (Ed.), *Identity: Community, culture, difference* (pp. 392-403). London: Lawrence & Wishart.

Harding, S. (1998). Women, science, and society. *Science*, 281(5383), 1599–600.

House of Lords, Select Committee on Science and Technology. (2012). *Higher education in science, technology, engineering and mathematics (STEM) subjects*. London: The Stationery Office Limited.

Jackson, P.A. & Seiler, G. (2013) Science identity trajectories of latecomers to science in college. *Journal of Research in Science Teaching*, 50(7), 826-857.

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

- King, H., Nomikou, E., Archer, L. & Regan, E. (2015). Teachers' Understanding and Operationalization of 'Science Capital'. *International Journal of Science Education*, 37(18): 2987-3014.
- Lemke, J. L. (1990). *Talking science: Language, learning, and values*. Westport: Ablex Pub. Corp.
- Mac an Ghail, M. (1994). *The Making of Men*. Buckingham: Open University Press.
- Luehmann, A.L. (2007) Identity development as a lens to science teacher preparation. *Science Education*, 91(5), 822-839.
- Malone, K. R., & Barabino, G. (2009). Narrations of race in STEM research settings: Identity formation and its discontents. *Science Education*, 93, 485-510.
- Manning, A. (2016) Urban Science Teachers: Exploring how their views and experiences can influence decisions to remain in post or not. Unpublished PhD thesis, King's College London.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Newbury Park: Sage.
- Mutegi, J. (2013) "Life's first need is for us to be realistic" and other reasons for examining the sociocultural construction of race in science's performance of African American students. *Journal of Research in Science Teaching*, 50(1), 82-103.
- Nasir, N-S. and Hand, V. (2008) From the Court to the Classroom: Opportunities for Engagement, Learning, and Identity in Basketball and Classroom Mathematics. *Journal of Learning Sciences*, 17: 143–179.
- Olitsky, S. & Weathers, J. (2005) Working with students as researchers: Ethical issues of a participatory process. *Forum: Qualitative Social Research*, 6(1), Art. 38, <http://nbn-resolving.de/urn:nbn:de:0114-fqs0501383>.
- Ong, M. (2005). Body projects of young women of color in physics: Intersections of gender, race, and science. *Social Problems*, 52, 593-617.

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

Redman P. & Mac an Ghail, M. (1997). Educating Peter: The making of a History Man, in D.L.Steinberg, D. Epstein, and R. Robertson (eds) *Border Patrols: Policing the boundaries of heterosexuality*. London, Cassell.

Rogers, B. (2015) *Classroom Behaviour* (4th Edition), London, Sage.

Russell, M. L., & Atwater, M. M. (2005). Traveling the road to success: A discourse on persistence throughout the science pipeline with African American students at a predominantly white institution. *Journal of Research in Science Teaching*, 42(6), 691-715.

Smith, E. (2010a). Do we need more scientists? A long-term view of patterns of participation in UK undergraduate science programmes. *Cambridge Journal of Education*, 40(3), 281-298.

Smith, E. (2010b). Is there a crisis in school science education in the UK? *Educational Review*, 62(2), 189-202.

Smith, E. (2011). Women into science and engineering? Gendered participation in higher education STEM subjects. *British Educational Research Journal*, 37(6), 993-1014.

Tan, E. & Calabrese Barton, A. (2012) *Empowering Science and Mathematics Education in Urban Schools*. Chicago, University of Chicago Press.

Tan, E., Calabrese Barton, A., Kang, H., & O'Neill, T. (2013) Desiring a career in STEM-related fields: how middle-school girls articulate and negotiate between their narrated and embodied identities in considering a STEM trajectory. *Journal of Research in Science Teaching*, 50: 1143-1179.

US President's Council of Advisors on Science and Technology. (2010). *Report to the President and Congress - Designing a digital future: Federally funded research and development in networking and information technology*. Washington, D.C.: Executive Office of the President – President's Council of Advisors on Science and Technology

CELEBRATED IDENTITY PERFORMANCES IN SCIENCE CLASSROOMS

Varelas, M. Kane, J.M., & Wylie, C.D. (2011) Young African American children's representations of self, science and school: making sense of difference. *Science Education* 95(5): 824-851.

Wilkinson, S., & Kitzinger, C. (Eds.). (1995). *Feminism and discourse: Psychological perspectives*.

London: Sage.

Zipin, L. (2009) Dark funds of knowledge, deep funds of pedagogy: exploring boundaries

between lifeworlds and schools. *Discourse: Studies in the Cultural Politics of Education*, 30(3): 317-331.

ⁱ As part of the wider project analysis, we also searched the data to identify 'impossible' (subjugated/ denied) identity performances. These are reported elsewhere (Archer et al., under review).