A Research Evaluation of the Francis Crick Institute Education Outreach Programme

Prepared by

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We would also like to thank the EOP team for providing us with deep insight into their working lives and for opportunities to see at first-hand how the EOP works. Thanks especially must go to Dr Clare Davy, Education Manager at the Crick, who first commissioned this work and stayed the course with us.

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Contents

1. Introduction to the Research Evaluation

1.1 Overview

This document presents the findings of a research evaluation of the Francis Crick Institute's 'Education Outreach Programme' (EOP). The EOP is organised as an intervention for 'sustained change in young people's aspirations for a science or STEM career, and for them to feel that the Crick is for them'. It comprises a broad programme of age-appropriate activities such as practical science workshops in schools, work experience and mentoring, and professional development for teachers, targeted at state schools in the London borough of Camden. Our evaluation report is based on a broad consultation of the Camden schools' community and Camden schools' stakeholders. It has been designed to identify experiences and perspectives on the EOP; its potential impacts; and ways within which such impacts might be further extended and enhanced. Moreover, our report offers a critical analysis of the efficacy of the EOP as a model for science engagement, aspiration raising and cultural/professional change within school communities.

1.2 The team

The research team led by Professor Richard Watermeyer (University of Bristol), has involved Professor Catherine Montgomery (Durham University), Professor Tom Crick (Swansea University), Dr Cathryn Knight (University of Bristol), and Dr Ceri Brown (University of Bath) with support from Mar Borras (University of Bristol). The team boasts special expertise in the sociology of education with specific reference to the schooling experience of disadvantaged learners as specific to science/STEM contexts. The research team are highly experienced in leading longitudinal, multi-method and complex research and evaluation studies and in the specific domain of science education and engagement.

Executive Summary

2. Executive Summary

- Our consultation of the Camden school community reveals that the EOP is highly regarded and seen as a valuable if not essential aspect of support and enrichment for Camden schools' science teaching. It is especially valued in the context of allowing young learners sight and experience of the world of scientists, and in supporting schools with resources and teachers with content knowledge they otherwise lack. Camden school staff are especially positive about their experience of interacting with the EOP.
- In line with a national trend, Camden primary schools are seen to be under resourced in teaching science. Additionally, primary teachers (as subject generalists) were identified, by their students, for lacking the same level of scientific expertise as the EOP team.
- Demand for the EOP considerably outstrips supply. School staff repeatedly advocated for increased interaction with the EOP while recognizing the size of the EOP team and its limitations in delivering more. A strong case was made by the Camden school community for further investment and increasing the size and response capacity of the EOP team.
- A positive impact of the EOP was reported across pupils' 'aspirations', 'confidence' and 'attainment' as science learners, with the most positive impact reported on female pupils' aspirations as science learners. However, learners themselves consider the impact of their experience of the EOP in more modest terms and as relates mainly to their changed understanding of scientists, in the form of the EOP team. The relational contribution of the EOP team is considerable in reframing learners' negative assumptions of science and scientists though is less potent in improving proclivity for science. It is unclear quite the extent to which the EOP is changing mindsets about future imaginaries of work. Many of the learners we consulted had already established future work imaginaries that were non-science based. While the EOP experience had helped to debunk misassumptions made by learners related to what scientist are like, we detected little sense that the EOP had in any substantive way made them reimagine their educational and occupational futures. In part, this may be as a result of such imaginaries being whilst clearly articulated only vaguely conceptualized. The role of the EOP thus at this nascent stage is important for placing if nothing else the seed of possibility in learners' minds and in providing them direct experience of scientific careers so often out of reach – especially where the quality of careers advice in schools and a greater reliance on schools in the provision of careers advice is problematic (*cf*. Watermeyer, Morton and Collins 2016)
- There is sound evidence of the EOP making a contribution to learners forging a connection with science and thus generating science capital – in informal and non-educationally specific ways such as family and birthday outings to the Crick – which requires ongoing scaffolding in the secondary school context where risk of learner disengagement is high.

Executive Summary

- Early introduction to the Crick through the EOP helps to normalise what might be for some a daunting encounter and positions the Crick as open-door to, and even a hub of the community. The physical grandeur of the Crick is not, however, lost on learners and is a core aspect of what makes their visits so memorable.
- The Crick is a frontier space for learning about science, with learners introduced to and becoming acquainted with alternative spatial and material modalities of science learning.
- Our data suggests that the Crick has had an influence on cultural and professional change within school communities, encouraging new directions in professional development for teachers and directing engagement with science in schools. The Crick's contribution to teachers' capacity building may be especially welcomed, given that many of the accounts of the quality of school-based science learning provided by learners were less than flattering, and spoke explicitly of limitations of teachers' content knowledge and pedagogical skill in delivering the science curriculum.
- The EOP is recognized for having aspects of informality but is distinct in the context of what is commonly recognized and termed 'informal learning', where despite the necessary experimental and experiential qualities of science learning undertaken in the Crick laboratory, school visits are well structured and follow an organisational structure that does not deviate too far from the organisational logic of the classroom experience. The greatest difference perhaps is in the context of what is pedagogically possible in being either resource rich or deprived, and the related opportunities, therefore, for more autonomous forms of learning.
- Attitudes for science teaching and learning in Camden schools appear from our survey data to be largely positive. When reflecting on their own practice, the majority of our survey respondents agreed that they enjoy teaching science (87%) and feel confident teaching science (85%). 93% of our survey respondents reported that the pupils they teach enjoy science.

3. Rapid review of the literature

There exists a cornucopia of evidence confirming the mutually ameliorative effects of scientists (and the wider academic community) interacting with schools, school teachers and school pupils; principally in a pedagogical milieu and in relation to engagement, enhancement and enrichment of the taught curriculum, habitually in science, technology, engineering and mathematics (STEM) subject domains (Clark et al. 2016; Gamse et al. 2016; Kressly et al. 2009, Spencer & Dawes 2009; Traphagen & Traill 2014; Ward 2015). Such evidence has accumulated with a significant history of STEM engagement with young learners and a near universal and inter-related policy foci, observable within the educational strategy of the vast majority of national governments across the world, on STEM education, STEM skills and the apotheosizing of STEM-based knowledge economies (DfE 2010; HMT/DfES/DTI 2004; Hoyles et al. 2011; Kuenzi 2008; OECD 2010; Royal Society 2010; US National Science and Technology Council 2013). Analogously, scientific and higher education sectors in the UK especially have found themselves increasingly compelled to respond to 'public' demands for greater transparency, accountability, openness (Moriarty 2011; Stilgoe & Wilsdon 2009; Wilsdon & Willis 2004) and a willingness to operate not just at the edge of but across the formal education and labour market continuum (Watermeyer, Morton & Collins 2016).

STEM engagement as a broad set of extra-curricular activities or 'out-of-school time activities' (Dabney et al. 2012) is discussed for its contribution in stimulating and maintaining learners' interest, aspiration, self-concept and self-efficacy in STEM subjects; in supporting equal participation in STEM regardless of variation in learners' social profile; and in securing a talent pipeline for STEM through improved articulation between formal education and employment opportunities and needs (Archer et al. 2013; Hampden-Thompson & Bennett 2011; Osborne, Simon & Collins 2012). STEM engagement activities tend to be thus characterized as practical activities that connect STEM to real life contexts; that link taught content to careers in STEM; that make explicit the relationship between and across STEM subjects; and which support teachers particularly in scaffolding learners at key subject transitions and decision points (Straw & MacLeod 2013). An argument for STEM engagement, is, therefore, unsurprisingly amplified by concerns of homogenisation (CaSE 2014; National Academy of Sciences 2011; OECD 2008), specifically imbalance in the social profile of learner constituencies, especially at further and higher education levels and in more prestigious STEM subject domains (Smith & White 2011), that might be resolved and/or avoided by early intervention and/or forms of positive disruption (Mostache et al. 2013; Tsui 2007; Xu 2015). However, the case for STEM engagement is weakened by evidence of divergence in terms of what is understood by STEM in educational terms (Wong, Dillon & King 2016) and how this impedes a policy for growing and sustained participation in

STEM; how informal and external 'educators' are only one part of a motivational ecosystem for learners in STEM that includes other 'significant persons' (Sjaastad 2011) such as family members and peers (Nugent et al. 2015); and how students' aspirations in STEM may be resistant to change (Archer, DeWitt & Dillon 2014).

As one iteration of STEM engagement, scientists are co-opted into school-based settings, often as subject ambassadors and aspirational role models (Gartland 2015; Morganroth et al. 2015; Weber 2011) and/or 'instructional bridges' (Lee & Fradd 1998) to support teachers in stimulating and scaffolding young learners' interest, enthusiasm and sense of entitlement in STEM subject disciplines. Concurrently they are deployed to help demythologise and interrupt many commonly perpetuated yet erroneous beliefs – particularly related to STEM occupations – that contribute to the alleged recurrence of socially mediated disadvantage, marginalisation and non-participation in STEM domains (Constan & Spicer 2015; Archer et al. 2012). As such, they are provided an opportunity with which to fulfill a professional obligation of engaging non-academic audiences and in learning how better to manage such two-way interactions (Bell 2013; NCCPE 2010; Wellcome Trust 2013). Their pedagogical challenge, however, is to seed and nurture a sense of self-confidence and self-efficacy among learners of every type and description that might confirm the latter's self-actualisation as legitimate members of a STEM learning community. Such an intercession may be especially valuable to those denied an equality of opportunity as STEM learners or those lacking the kinds of 'science capital' (Archer et al. 2015) necessary for participating without inhibition or risk of discrimination in formal STEM learning contexts.

While a focus on STEM engagement in schools continues to exist as a cornerstone of public policy much in the way of its organisation is problematic. This is due mainly to a dominant yet weak organisational paradigm of multiple discrete project-based activities, interventions and initiatives (Greany et al. 2014). These, whilst legitimate catalysts of change, provoke change in rather short-term, cursory and/or unconnected ways and mirror weaknesses identifiable across other forms of engagement activity implemented by those working within the higher education sector (Burchell 2015). Consequently, whilst evidence pertaining to the positive contribution of scientists to STEM engagement is plentiful, understanding of how STEM engagement – in and with schools especially – might occur in a more sustained, systematic and therefore, potentially more effectual way is rather less copious (see also DfE 2004).

The Francis Crick Institute's EOP, provides a valuable opportunity to study the potential of what we consider to be a holistic model of STEM engagement that is organised around continuous co-operation with and support of schools within a localised and integrated education ecosystem. The EOP makes an especially interesting case study given the extent of its ambition to open its

doors and make science relevant and exciting not only for Camden schools but the wider Camden community. Its aim thus appears to exceed the one-off engagement of young learners that typifies so many engagement initiatives by focusing instead on building an engaged *community*. Our evaluation thus seeks to probe the success of the EOP in mobilising the various stakeholders whose contribution to young learners' scientific engagement is integral to their sustained and growing interest. It accordingly considers the EOP in the context of upskilling teachers (primary teachers especially) in content knowledge and pedagogical repertoires; of reaching out and including families within their children's learning experiences and journeys (both formal and informal); and in being a resource-rich local laboratory accessible to all.

4. Methodology

4.1 Overview

We undertook a mixed method approach to the research evaluation and the generation of both qualitative and quantitative datasets. We focused on: (i) teacher/school research; (ii) pupil research; (iii) EOP team perspectives. Fieldwork consisted of:

- 10 focus groups with Camden school children reflecting on their experiences of the Crick during primary school (2 in person and 8 undertaken online)[1]
- an online survey consisting of scaled and open-text questions distributed to Camden (primary and secondary) teachers (generating 94 responses)
- 18 semi-structured interviews with science leads, heads-of-science, science teachers and headteachers
- 5 semi-structured interviews with the EOP team

4.2 Analysis

We have applied an inductive approach in the identification and problematisation of the EOP as an 'impact ecosystem' our analysis is guided (and data coded) by a threefold focus on:

- Primary school children wanting to be scientists/work at places like the Crick
- Confident and well-resourced schoolteachers providing opportunities in practical science and/or work-related learning
- Young people (their families) and teachers feeling that the Crick is for them

In broad terms, we have sought to identify, isolate and map from the data, causal factors or what we refer to as 'impact triggers' that have contributed to or culminated in positive and potentially not so positive effects from participating in the EOP in the specific contexts of young children's future occupational aspirations; teachers' professionalisation and pedagogical capacity building; cultural/community ownership.

We have also analysed data from the perspective of impact-generation as an ongoing, incremental and diffuse process, and impact taking different forms over different periods of time. We suggest that in most cases the kinds of impact derived from the EOP, given its relatively short lifespan is nascent or juvenile – with most impact 'emerging'. A common misconception is that

[1] *As a consequence of the interruption caused by the COVID-19 pandemic, some of the interviews exploring primary school experiences of the EOP, were undertaken with Year 7 pupils, and as reflections on their previous experience of the EOP in Year 6.*

impact generates automatically and at speed. Most substantive and sustainable impacts, conversely – especially those related to culture or attitudinal change – generate over longer periods of time.

In the simplest of terms our analysis has sought to identify from the EOP the various conditions and contexts; the triggers, levers and inhibitors; and the interrelationships between different impact pathways (and personnel) that contribute to improved awareness, aspirations, experiences and skills among learners in science; enriched curriculum and enhanced pedagogy in Camden schools; and greater knowledge of STEM career pathways and opportunities. Moreover, we have sought to establish what factors contribute to a sense of 'cultural' and 'community' ownership of the Crick as an open and accessible space. Ultimately, we have sought through our analysis to establish what (and where – recognising the significance of space and place to the success of engagement) works best and what could work better, across the EOP's varied suite of activities.

4.3 Ensuring Ethical Integrity

The ethical integrity of the research was ensured via initial submission of all research plans for scrutiny by a university Research Ethics Committee. In communication with participating schools and stakeholders, it was made make clear the aims and objectives of the research and the rights of all participants, such as for instance the voluntary nature of their participation and right to withdraw at any stage. The research team adhered to the ethical guidelines for educational research established by the British Educational Research Association (2011) and ensured that the wellbeing and welfare of all participants was safeguarded through all phases of the research process and beyond. All data collected from the project has been kept confidentially and securely and in compliance with the University of Bristol's protocol on data management and governance. The identities of all research participants have been protected and anonymised.

4.4 Limitations

Our analysis of teachers' perceptions is time specific and accordingly provides a snap-shot of opinion. Analysis is also of course based on selective data *i.e.* perspectives drawn from teachers who agreed to be interviewed or responded to our survey. We are consequently provided with an overall understanding of the perceptions of teachers who engaged with the EOP. However, we cannot claim (and do not try to claim) that the data is representative of all teachers who engaged with The Crick.

5. Findings and Analysis

a. Quantitative Results

i. Survey of Camden School Teachers and Leaders

An online survey was undertaken which aimed to gather the views of primary and secondary school teachers who had worked with The Crick. The respondents were contacted via a distribution list provided to the research team by The Crick. Schools were asked to distribute the survey to the staff in the school that had worked with The Crick. In total, 94 teachers responded to the survey (*see Participant Demographics Infographic for full demographic information*).

The survey was designed by the research team and administered via the Qualtrics online survey tool. The survey asked demographic questions about the participants, followed by a number of closed ended questions about their perceptions of the EOP. Finally, open ended questions gathered more in-depth perceptions about the EOP and suggestions for improvements.

Prior to distribution the questionnaire was piloted on a subsample of the population who commented upon the structure and readability of the survey. Based on these recommendations, adaptions were made before the survey was distributed to the wider population.

Likert and slider-scale questions were used. Prior to analysis, for ease of interpretation, five-point Likert scales (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree) were recoded into 'agree', 'neither agree or disagree' and 'disagree' variables. Quantitative data was analysed using SPSS. Descriptive statistics were employed to define overall trends in the population. Chi-square (X^2) tests were used to understand if there were any significant differences between participant demographic groups.

<u>Results</u>

The following pages show the key descriptive results from the survey. These show that respondents were, overall, incredibly positive about their experience of interacting with the EOP. 'Key Findings 1' shows the positive impact that The Crick has had on both teachers' and pupils' interaction with science and science teaching. Nevertheless, respondents agreed that they would benefit from training on teaching science and teaching science careers (Key Findings 2).

Findings & Analysis

Respondents reported a positive impact on the wider community. Slightly less agreement than in other responses corresponded to whether The Crick 'helps to bring teachers from different schools together' (64.9% agreed). Therefore, this may be a focus for future improvement.

'Key Findings 2' shows respondents' perceptions of the impact of The Crick on their pupils' 'aspirations', 'confidence' and 'attainment' as science learners. A positive impact was reported across all areas with the most positive impact reported on female pupils' aspirations as science learners.

When reflecting on their own practice, the majority of respondents agreed that they enjoy teaching science (87%) and feel confident teaching science (85%). A lower percentage of teachers agreed that science in their school is well resourced (65.9%). Importantly 93% of teachers reported that the pupils they teach enjoy science. Only 34.9% of teachers agreed that the pupils they teach 'engage in science activities outside of school' and therefore, this may be a possible direction for future outreach work.

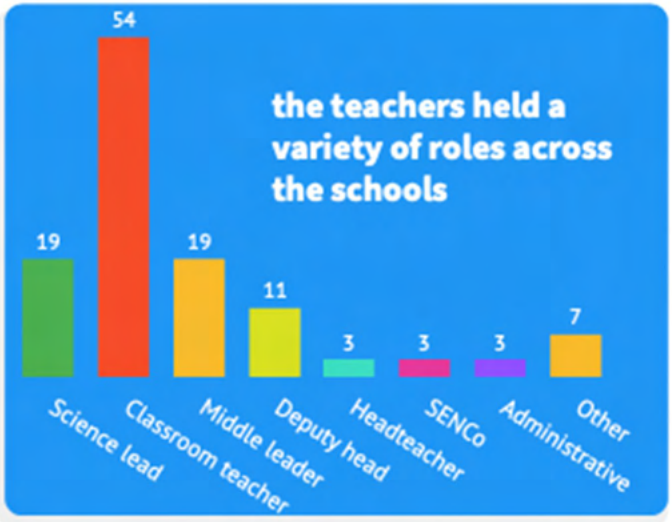
Teacher Survey

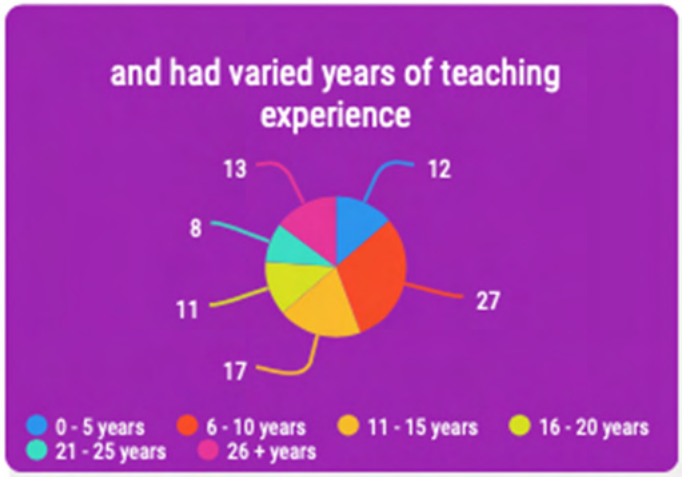
Participant Demographics

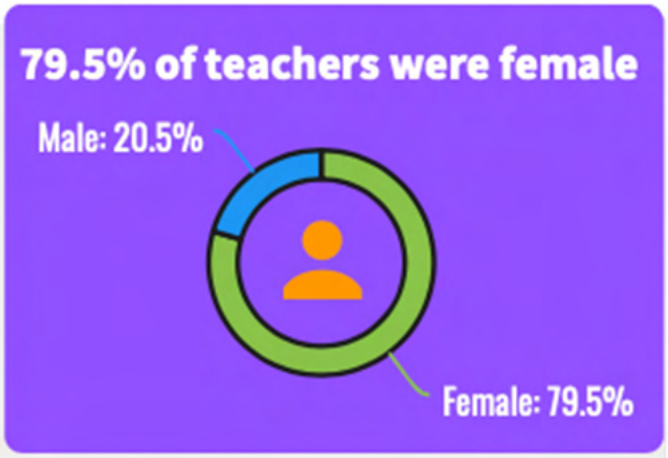
94

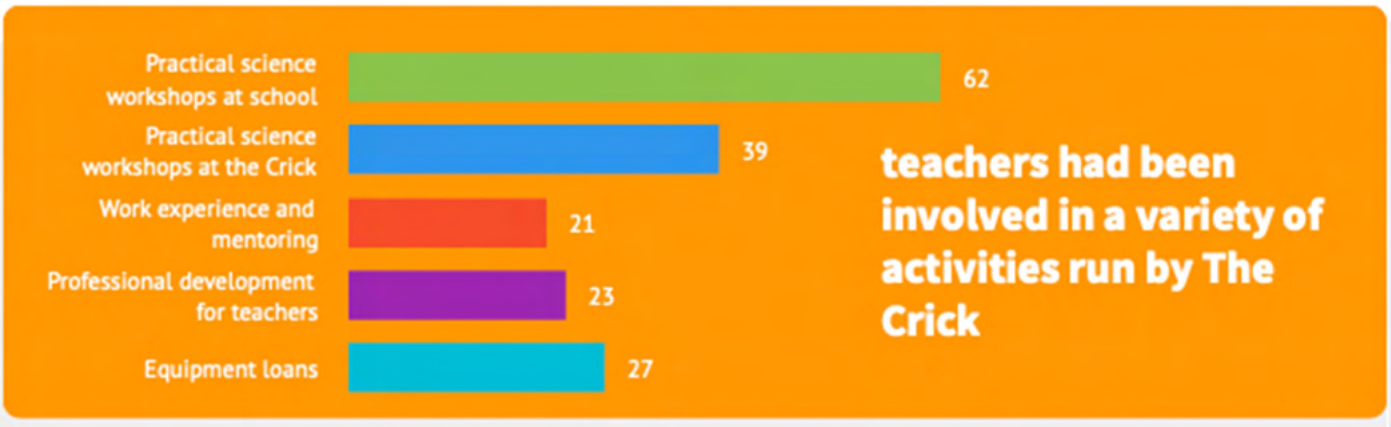
teachers completed the survey

44% Primary | 55% Secondary









Teacher Survey

Participant Perceptions

93% Agreed

"the pupils I teach enjoy science"

"The pupils I teach engage in science activities outside of school (e.g. visit science museums)"

85% of teachers agreed that they "feel confident teaching science"

87% of teachers agreed that they "enjoy teaching science"

85%

of teachers agreed that they "have a good understanding of the work of science and scientists"

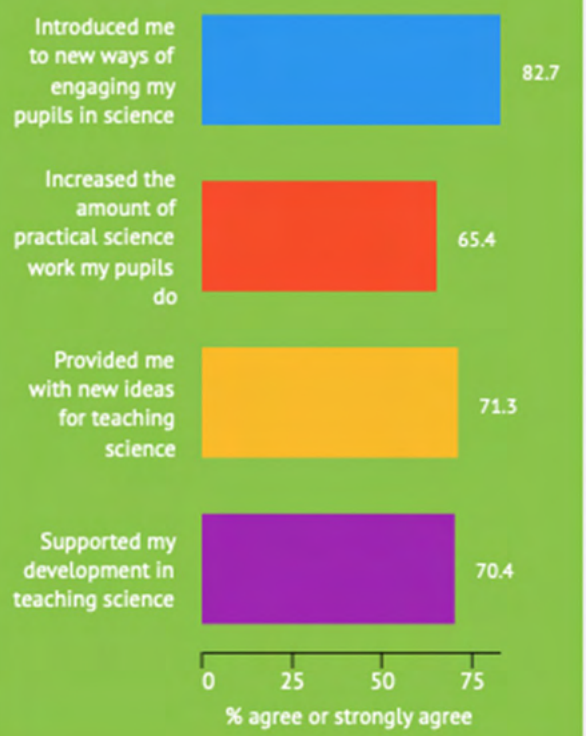
65.9% Agreed

"In my school, science teaching is well resourced"

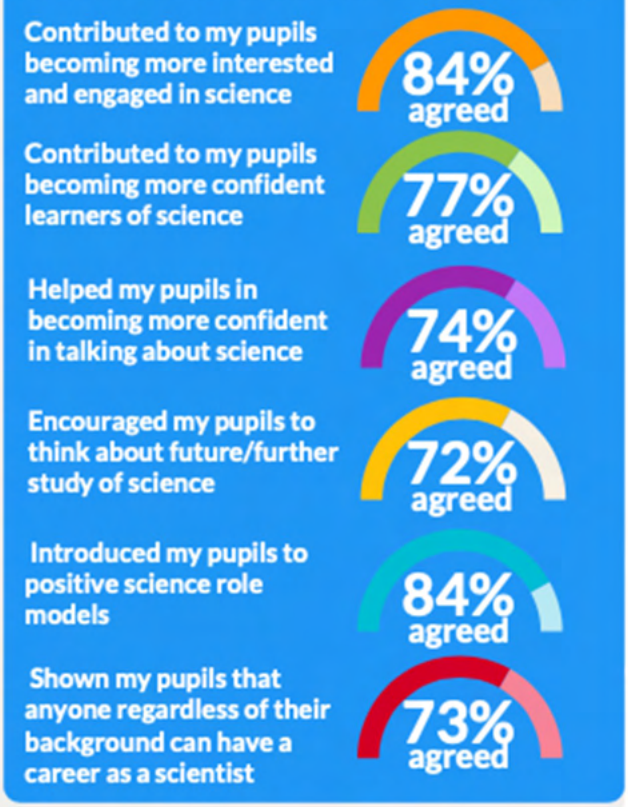
Teacher Survey

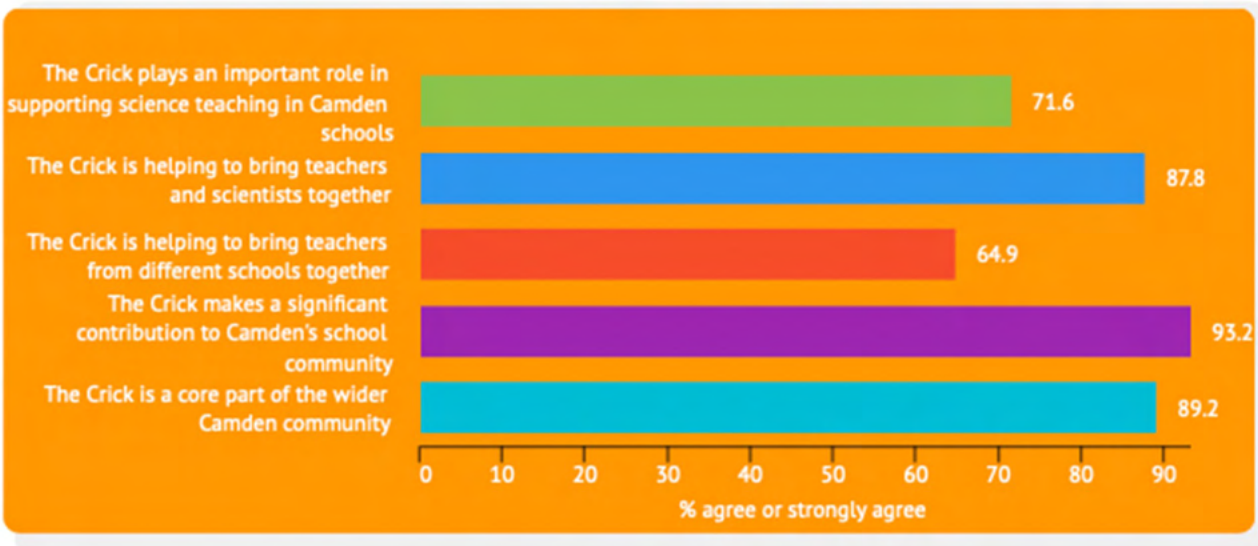
Key Findings 1

The teachers agreed that the Francis Crick Institute has...



The teachers also agreed that the Francis Crick Institute has...

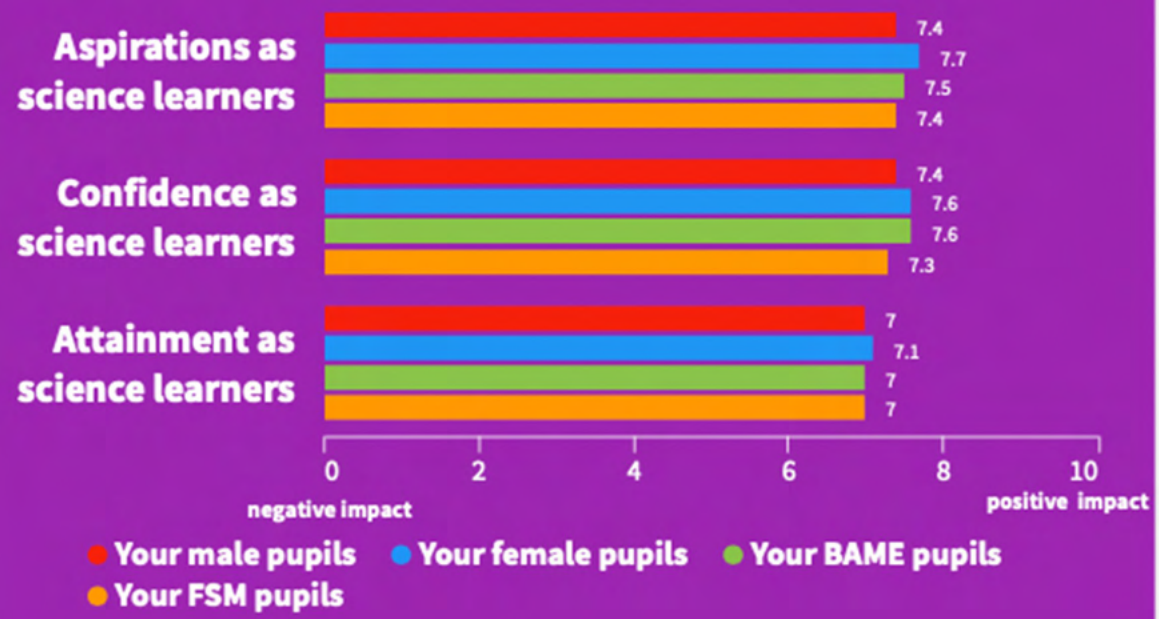




Teacher Survey

Key Findings 2

On a scale of 0 (negative impact) to 10 (positive impact) how has The Francis Crick Institute's Education Outreach Programme had an impact on...



Teacher Survey

Quotes from Teachers

"The Crick is an inspiring place for students to visit and provides key work experience placements we wouldn't otherwise have access to."

"Everyone we have met from the Crick have been great. The children love working with the scientists!"

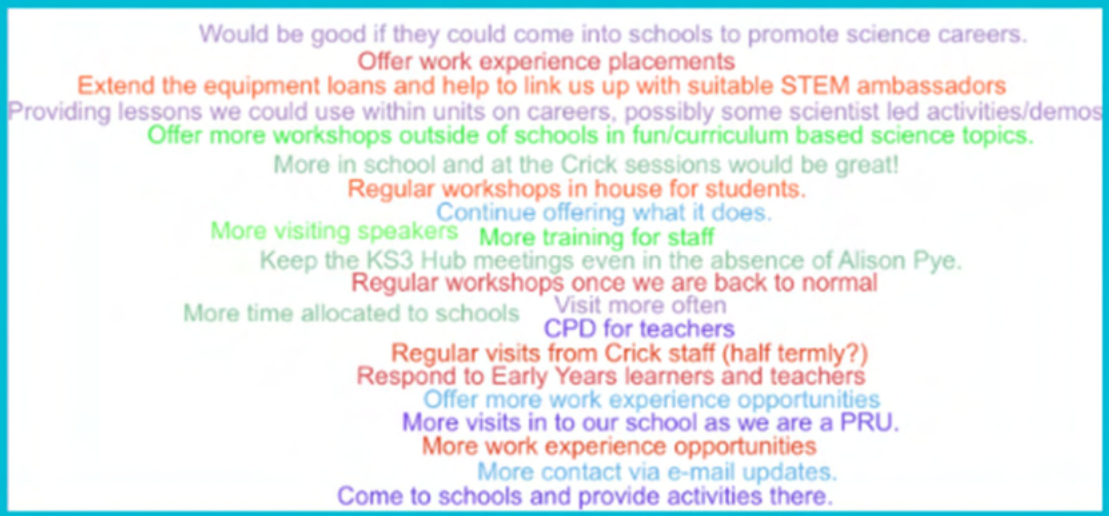
"The support that The Crick have provided us over the years have been exceptional. Our students have greatly benefited from their work."

"I cannot speak highly enough of the team and the support they show to our school and other schools in the borough."

Keep up the good work and keep making the experiments stimulating and enjoyable for young people."

"I felt very well supported by the Crick - every CPD session I would be inspired to think beyond the pandemic "

Is there anything more The Crick can do to engage Camden schools??

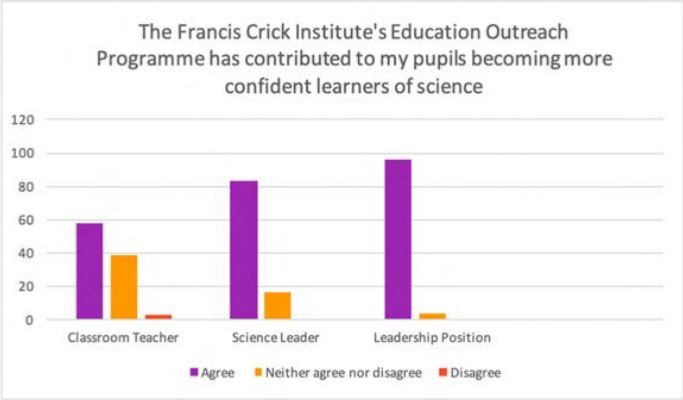


Differences Between Teacher Roles

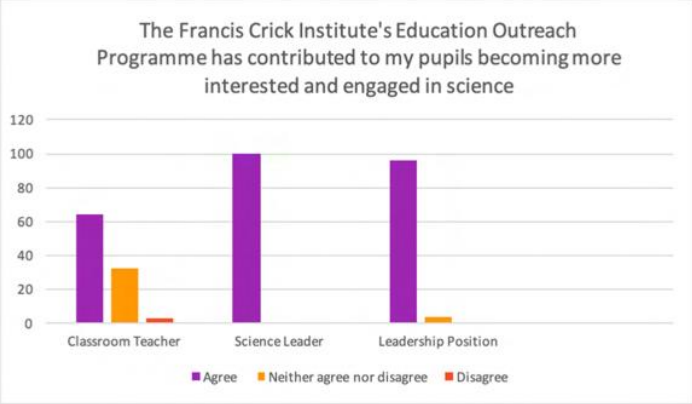
Chi-Square tests (X^2) were conducted to look for significant difference between those who reported that they were 'classroom teachers' (n= 37), 'science leads' (n= 13) and held a 'leadership position' (n=32) *(for the sake of this analysis those that reported that they held more than one of these roles were coded as the highest leadership position they held e.g., those that said they were a classroom teacher and a middle leader were coded as 'leadership position').* The following significant differences were found between these groups:

- Classroom teachers were significantly less likely to agree that The Crick has provided insight into their pupils' learning needs (28.1% agreed). Those in a leadership position were significantly more likely to agree (64% agreed) *($X^2(4) = 9.67, p = 0.05$).*
- Those in leadership positions were significantly more likely to agree that The Crick had contributed to pupils becoming more interested and engaged in science (96.2% agreed) whereas classroom teachers were significantly less likely to agree (64.5% agreed) *($X^2(4) = 12.95, p = 0.01$).*
- Those in leadership positions were significantly more likely to agree that The Crick had contributed to pupils becoming more confident learners of science (96.2% agreed) whereas classroom teachers were significantly less likely to agree (58.1% agreed) *($X^2(4) = 12.06\ p = 0.02$).*

Findings & Analysis



Those in leadership positions were more likely to agree that The Crick had contributed to pupils becoming more confident learners of science whereas classroom teachers were less likely to agree.



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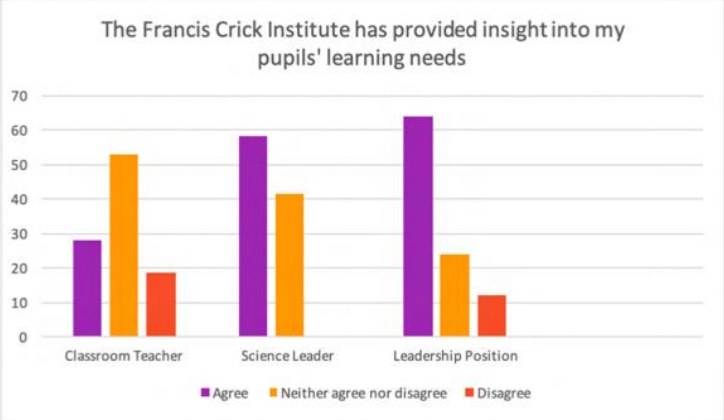


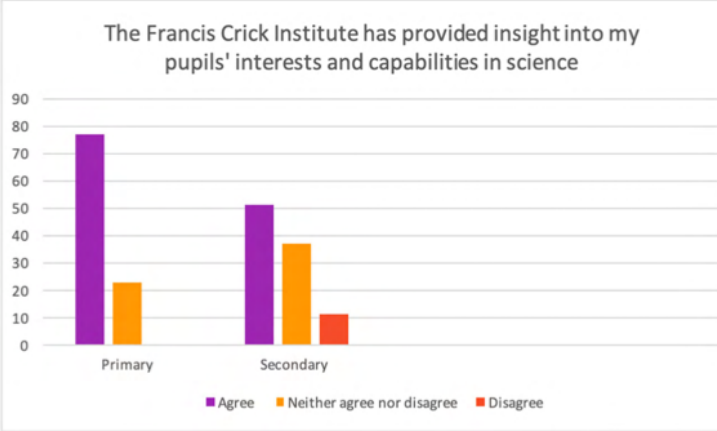
Classroom teachers are less likely to agree that The Crick has provided insight into their pupils learning needs. Those in a leadership position are more likely to agree.

Differences between Primary and Secondary Teachers

Chi-Square tests (X^2) were conducted to look for significant difference between those who reported that they were primary school teachers (n= 36) and secondary school teachers (n=45). The following significant differences were found between the two cohorts:

- Primary school teachers were significantly more likely to agree that The Francis Crick Institute has provided insight into their pupils' interests and capabilities in science (94.3% agreed) than secondary school teachers (71% agreed) *($X^2(2) = 6.99, p = 0.03$).*
- Primary school teachers were significantly more likely to agree that The Francis Crick Institute has supported their development in teaching science (94.3% agreed) than secondary school teachers (71% agreed) *($X^2(2) = 6.68, p = 0.04$).*
- Primary school teachers were significantly more likely to agree that The Francis Crick Institute's Education Outreach Programme has introduced (my) pupils to positive science role models (97.2% agreed) than secondary school teachers (66.7% agreed) *($X^2(2) = 12.19, p = 0.002$).*
- Primary school teachers were significantly more likely to agree that The Francis Crick Institute's Education Outreach Programme has led to a positive change in my pupils' perception of scientists (72.2% agreed) than secondary school teachers (32.3% agreed) *($X^2(2) = 12.61, p = 0.002$).*
- Primary school teachers were significantly more likely to agree that The Francis Crick Institute plays an important role in supporting science teaching in Camden schools (100% agreed) than secondary school teachers (88.6% agreed) *($X^2(2) = 4.24, p = 0.04$).*
- Primary school teachers were significantly more likely to agree that The Francis Crick Institute is helping to bring teachers and scientists together (97.1% agreed) than secondary school teachers (77.1% agreed) *($X^2(2) = 6.29, p = 0.01$).*
- Primary school teachers were significantly more likely to agree that The Francis Crick Institute is a core part of the wider Camden community (97.1% agreed) than secondary school teachers (80% agreed) *($X^2(2) = 5.08, p = 0.02$).*

Findings & Analysis



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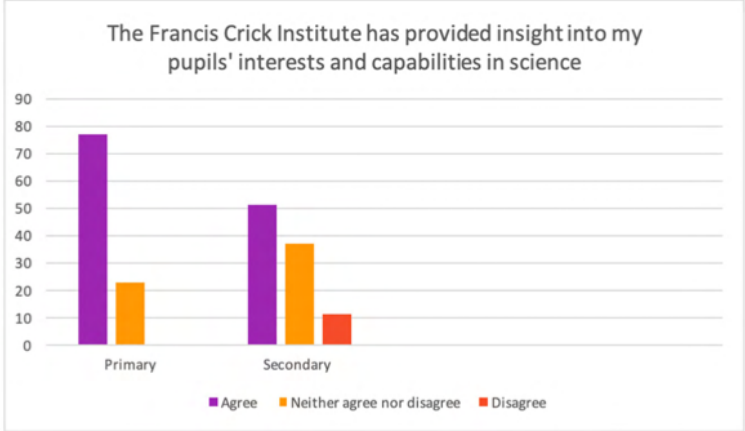

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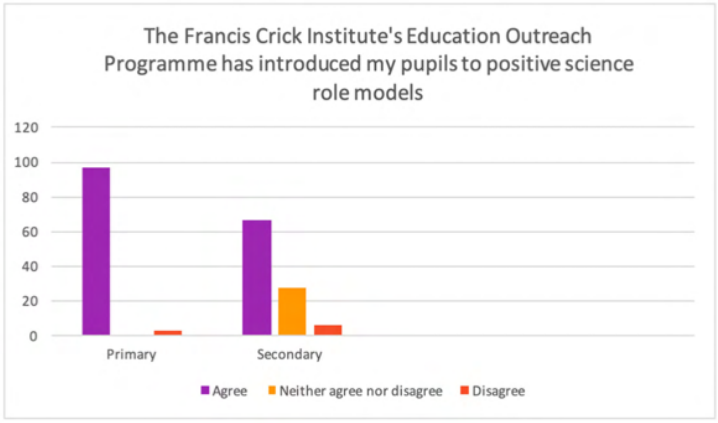
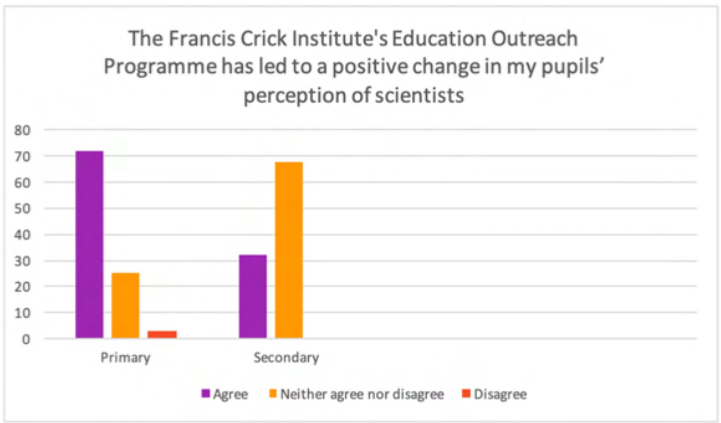


Primary school teachers were significanly more likely to agree that The Francis Crick Institute's Education Outreach Programme has introduced my pupils to positive science role models.



Primary school teachers were significanly more likely to agree that The Francis Crick Institute's Education Outreach Programme has led to a positive change in my pupils' perception of scientists.

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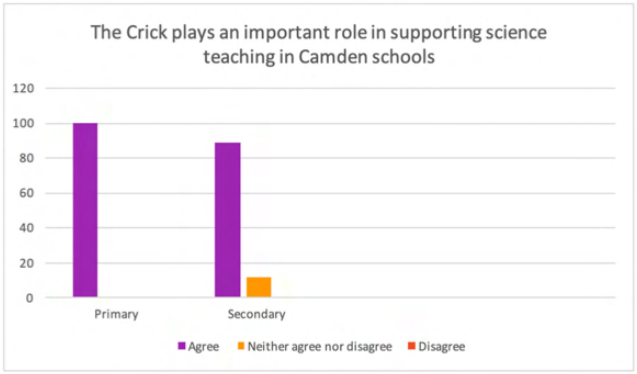
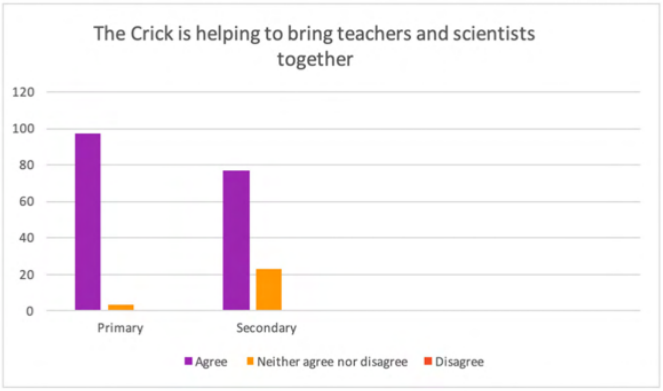
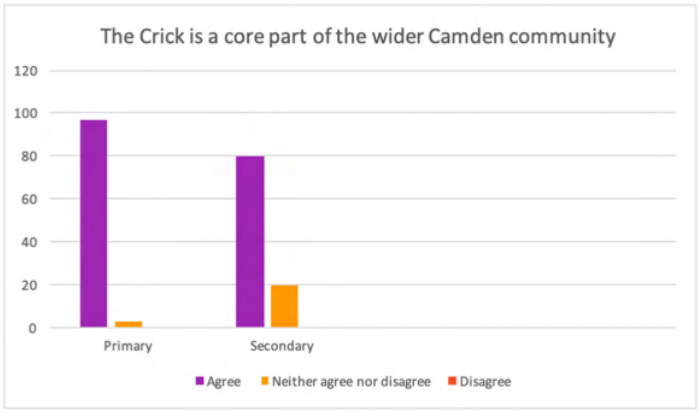


Primary school teachers were significanly more likely to agree that The Crick plays an important role in supporting science teaching in Camden schools.

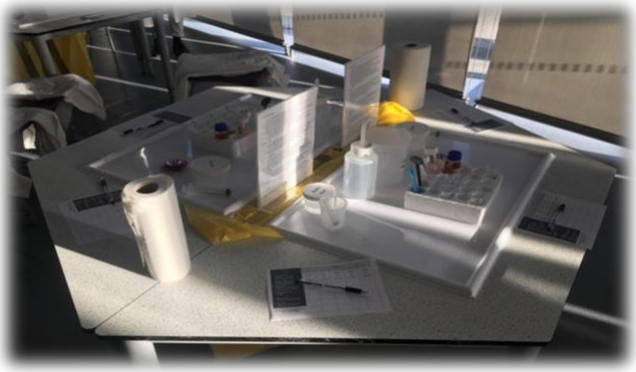


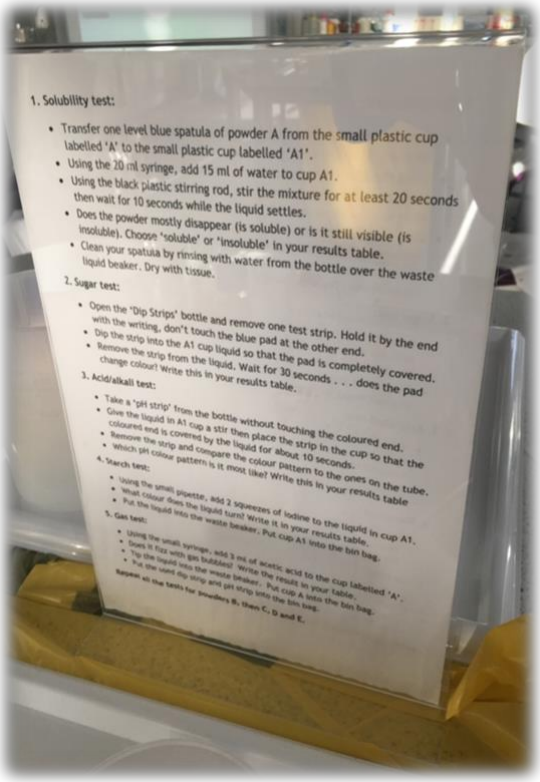
Primary school teachers were significanly more likely to agree that The Crick is helping to bring teachers and scientists together.



Primary school teachers were significanly more likely to agree that The Crick is a core part of the wider Camden community.

Findings & Analysis





b. Qualitative Results

In this section we present findings generated from our qualitative data collection: focus groups with Camden learners; interviews with schoolteachers and leaders.

i. Camden Learners – Focus Groups

Two focus groups were conducted in person (in addition to *n*=2 in-person interviews with school leaders) in Camden, prior to the onset of the pandemic. Multiple focus groups that had been booked in with a variety of Camden primary schools were subsequently abandoned due to enforced closure. During the various lockdown periods and thereafter at points of gradual re-opening, our contact with school staff and ability to conduct any form of schools-based research was severely curtailed. In reviewing the feasibility and ethics of continuation– prioritising, especially the welfare of our research participants during a period of severe organisational disruption and stress – the decision was taken to place this and other aspects of the project into hibernation. It is worth noting that the research team's own capacity was challenged at this stage with four members of the team contracting COVID-19. Self-evidently much of the work of the EOP team was also suspended with school closures.

In late 2020 and before the second national lockdown, spying what might be a narrow window of opportunity with schools reopened, we sought to recommence our schools-based research. Working with the Crick team, we were able to conduct (*n*=8) online focus groups with children in Year 7, in two Camden secondary schools. These children were drawn from *n*=15+ Camden primary schools, as illustrated in Table 1. While the method of conducting the focus groups online was new to the research team, a corpus of evidence related to learners' perspectives of their EOP experience was generated, with, we should add, the generous support of science leads in both schools who were present in all sessions.

The focus groups revealed that despite the time lapse since their interactions with the EOP team, participants were able to clearly recall and reflect with some detail upon their experience. This delay actually enabled the research team to better determine the longer-term impact of the Crick's EOP on Camden's young learners. Where a prolonged hiatus separating an initial visit and our consultation may have lessened learners' potential enthusiasm or impaired their recall of the EOP we found, in the online focus groups, that the passing of time had scarcely diminished their memory of events or their enthusiasm:

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"We were learning about electricity and used these wires to connect different components together to make the light shine. That's what we did."

Focus group participants were uniformly positive about their experience, and especially enthusiastic in describing their interactions with the EOP team and their impressions of the Crick as – as it seemed to them – a unique learning space.

Overview of Focus Group Findings

Focus group participants spoke to many aspects – relational, spatial, material, cultural – of effective/affective science engagement with young people in describing their interactions with the Crick. The EOP experience was seen perhaps first and foremost as redefining the teaching and learning space and as a pathway to new learning content and experiences. The Crick was represented as a frontier space with novel spatial and material arrangements for learners to become engaged. Through participatory, collective immersion with new science artefacts (mostly unavailable in a school context) complemented by the Crick's spatial and material uniqueness, FG participants described their exposure to new forms of association that helped to spark their scientific imagination and interest. The centrality of playing as learning (Dewey 1932; Piaget 1929; Vygotsky 1929) with scientific artefacts and object-based role-play were recalled by FG participants indicating the importance of the material nature of the EOP in making durable associations and deep meaning for students. For instance:

"I remember in year five we went to the Francis Crick Institute to experience gases oxygen and carbon dioxide."

"They had the chemicals zone, and they were ready to start practice and experiments, they had all the scientific equipment that we needed to get ready for research."

"There was one where we had like five black powders and If you put pressure on it, or touched it turned solid and we had to guess which one was the right powder."

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There was a strong sense from the focus groups that learners' identification of/with the EOP team, and the ways with which they identified and made comparison with their teachers was also transformational to their nascent perspectives of science, science learning, and of course, scientists. However, the manner of their identifications could be seen as producing a status divide, with the EOP team celebrated for helping learners understand and enjoy science in ways that teachers don't, or as is suggested, *can't*, with the taught contribution of the latter therefore devalued. On various occasions, FG participants described the EOP team as being not only scientifically but pedagogically superior to their teachers. Much of this thinking appears related to a perception of the EOP team creating a more permissive, tolerant and relaxed learning environment – with learners' mistakes not censured (as appears reported in their schools) but embraced as a valuable part of the learning experience, and by extension scientific method. We would note, however, from our own direct observations of a school visit to the Crick, that Camden learners are nonetheless well marshalled by the EOP team and guided by behaviour expectations and lab etiquette made explicit to them from the outset and throughout to which they largely adhere to. The pedagogical function – or be that custodian role – of the EOP team is not, therefore, quite so distinct from that of learners' teachers, even if their repertoire differs. This partial role symmetry we would argue facilitates the instructional fluency of the EOP team – providing some form of platform and precedent for learners in an otherwise unfamiliar setting – and the potential to ultimately value-add rather than detract from their school-based experience of formal curriculum. In fact, we might argue that the success of the schools' visit to the Crick, is owed to it being not too dissimilar in structure than the school day. While there can be no denying the spatial and material exoticism of the Crick for learners, the school visit in many ways follows the structure of a typical school day. There is also a clear formality to proceedings, which from our observations, learners appear to buy in to and actually benefit from. Learners appear to understand and appreciate that their visit to the Crick is not just about having fun – though the fun element of their visit is clearly important. It is not just 'edutainment' and not quite what many onlookers would consider to be 'informal' learning. In fact, the schools' visit is in very many ways formal, and necessarily so; the laboratory is not a place for misadventure. Instead, the EOP is about learners being trusted and consequently empowered to act and behave as responsible scientists, following the example provided by the EOP team, whose strong facilitation is key in making the day not only a memorable experience but in helping young learners establish a scientific memory, even consciousness.

The valued-added dimension of the EOP to science learning, identified through focus group accounts, may thus be best understood in terms of the EOP team as embodying and thus personalising and relativising science to learners in positive ways that their teachers cannot – especially where deprived of the same kinds of tools and resources. They feature as a conduit to

informal learning encounters that are immersive, experiential and playful; where learners are afforded a fuller and possibly even more equal opportunity of 'doing' science that is less readily available or even unavailable in school settings:

"At the workshop of science everyone can participate and everything."

"Because when we learn science at schools is just talking about it not like doing it."

"It's cool because you do the experiment then you see the results and you learn why did it happen, what did happen."

Table 1. Focus Group Sample

Camden Primary Schools Represented by FG Participants	
Argyle	Richard Cobden
Christchurch	St Aloysius
Christopher Hudson	St George
Fleet	St Michael's
Kingsgate	St Patrick
Mary Kilburn	Rhyl
Netley	Richard Cobden
Rhyl	

Detailed Analysis

Extent of learner engagement

In the focus groups we sought to understand both the extent of learners' formal engagement with science and their enthusiasm for science as a formal subject and as differentiated by male/female gender assignment.

We found in the testimony provided by focus group participants evidence of limited in-class engagement with science in Camden primary school settings and significant variation in attitudes towards science learning. For instance, when asked the intentionally broad and open question, "What do you think about your science lessons when you were at primary school?", respondents answered, *"We didn't do that much science"* or *"We did science but it was hardly science"* or *"We did hardly any science"*.

Among our sample of n=49 focus group participants, *n*=33 stated *liking* science; *n*=10 that they *didn't like* science; with just the one participant claiming *indifference*. Of those respondents that stated liking science, over half of participants, *n*=12 were female. In the context of those who stated that they didn't like science, the gender split between male and female participants was exactly even. When asked whether they would consider a career as a scientist only *n*=8 participants responded positively; four of these were female. Some among the group did, however nominate science, or rather, STEM related jobs, for instance, "I want to be an engineer" and *"I want to be an architect"*. Others were more ambivalent, *"I'm not sure"*; *"I don't really know"*. Some others were firm in what they didn't want to do: *"I don't want to go to university"*. Additionally, while many of our focus group participants spoke of liking science, many described themselves as having low competency, "*I'm so-so at it*", others were especially honest in proclaiming, "*I'm bad at it*". One participant disclosed that "*In primary I was good at it but in secondary it got harder*", suggesting a need either for ongoing extra-school support or an increased investment in preparing learners in primary school for secondary science learning.

Science learning in schools as resource-limited

Within the focus groups we asked participants to compare the Crick with their school setting, an unreasonable comparison to make given the significance of the Crick as an internationally leading and world-renowned scientific institution, yet necessary in helping to identify resource needs for learners' science engagement and what pedagogical tools and materials might better enable schoolteachers for such purpose.

Our participants were habitually direct in what they perceived as material and cultural differences between their school and the Crick and a dichotomy of the Crick as resource rich and

their schools as resource-limited if not by comparison, starved. These differences were evidenced in their description of the Crick's physical architecture – the building and lab space – yet also in reference to the Crick's education team, and an overall sense of enchantment that starkly contrasts with a deprecatory account of their school and teachers. Of course, much of participants' enamour with the Crick may be attributed to the novelty of the school visit, a break with the routine of everyday school-life, and experience of a learning space and learning interactions, particularly with the Crick team, that are less predictable and formulaic, and unconfined to the prescriptions of the archetypal teacher-student relationship. Furthermore, there can be no escaping that the Crick is a very impressive if potentially intimidating. Our focus group participants, however, seem oblivious to any such concern – instead seemingly embracing the opportunity to spend a day at the Crick and away from school – and recall no sense of being inhibited by the Crick's physical grandeur – a behaviour we found confirmed first-hand with observation of one school's visit to the Crick.

In their observations of how the Crick team and their teachers differ, our participants spoke of their former primary school teachers in complimentary terms yet of them being hamstrung by a lack of resources impairing the extent of formal science learning:

"They are different, very different, because science teachers were good but they didn't have all that equipment. You can do loads with equipment."

"I think that the science teachers could have more equipment to do proper science lessons. So that we can, like, learn more science."

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Another focus group participant, spoke of their former primary school positively yet described a lack of 'tools', 'tools' that were for instance used – efficiently – in the context of the Crick's circuitry session and which underpins (and energizes) hand's-on and experiential learning:

"You can do loads with equipment"

"In our school it was good but we didn't have so many tools. But in the Francis Crick Institute, there were a lot of tools and they were really fast. They were really nice to put together and a lot were really easy to construct together and put together."

Conversely, for some of our participants, the experience of science learning at primary school had been far more limited and restricted – as might reflect a low-resource setting – to didactic and transmissional pedagogy:

"It was different because in our school, we simply looked at the whiteboard to see how to do it."

They also describe primary teachers as subject generalists and intimate a lack of science expertise contributing to a more incremental and perhaps pedestrian approach to formal science learning:

"We didn't have science teachers, we just had, like one teacher who taught every lesson. We had to do it step by step by step."

Relational Dynamics

They seemed professional. Very experienced.

Focus group participants spoke of the ease of their interactions with the Crick's team, of the latter being personable yet no less professional, able to establish clear parameters in terms of conduct, what was expected of

participants yet what wouldn't be tolerated, and at the same a dialogical, non-judgemental and non-punitive learning environment:

"When someone made a mistake, for example, someone dropped something they would say. "It's okay, we all make mistakes". They were all nice."

This contrasted to accounts provided of their primary school teachers, who were characterised as being more authoritarian (and we would infer protective of limited resources):

"Our primary teachers were too strict sometimes and they were a bit over the top when we did experiments."

Conversely at the Crick, participants recount their license to operate and affordances of learner autonomy and greater pedagogical freedom, bringing science 'closer' to them:

"They made science closer and fun to us compared to our teachers. The teachers are more like you have to do this. And scientists are more you do what you can."

Limitations of the Camden School Community

Overall, if the Crick experience showcased to FG participants what science learning could be like – and the value of having scientific specialists scaffolding, and equipment for participatory learning – it simultaneously revealed the limitations of science education provision in Camden primary schools and what is not possible:

". . . in the Crick it's really easy because there's a lot of different scientists around to help us."

"It interested me because in the Francis Crick Institute, we used different tools for the experiments we did. Well, we can't do them in classes or in our school, presumably. I mean, in the Crick its really easy because there's a lot of different scientists around to help us."

One participant spoke directly to a lack of school funding for science teaching, denying learners opportunities for not only science experiments and therefore participatory forms of learning, but also variation of learning activities:

"Yes, very, very different, because the school doesn't have the money to get the specific equipment and you can't really do much if you don't have the equipment. Whereas in the Crick there was much more equipment and a lot more things to do. We could do more things in one day."

Other participants alluded to the quality of role-playing – as a key aspect of experiential science learning – that in the context of the Crick experience was undergirded by the availability of 'professional' equipment, under-resourced in schools:

There was very limited scientific equipment in my classroom like, they had a couple of burners and some little pots and that was about it. Whereas in the Crick it was great to be able to work with professional equipment.

"We didn't really have the scientific equipment back then, like we used a long wire and we used it to conduct electricity through it, but it wasn't very fun for us. But when we went to Francis Crick Institute we had access to much more equipment and it was a lot more fun."

The value of being *'able to work with professional equipment'* we would suggest is furthermore key in terms of learners' self-efficacy as science learners and, we would go so far to say, in enhancing not only their engagement in science learning but self-investment as science learners.

A reflection of schools as resource starved was also addressed by some of our FG participants who spoke of the physical differences distinguishing their primary school experience from their experience of the Crick:

"So, in my school we didn't have that much light like in the Crick. You could see there was a lot of glass around it, but we didn't have that much light at our school."

"My school was old and rusty, and the Crick institute looked more modern."

The Crick was also spoken of in the focus groups as a place of return and of the EOP having reached out and connected with, if only by proxy, participants' parents – and thus we would claim the wider Camden schools' community:

"I told my dad and my mom. And they were very interested about the magnet thing and they wanted me to show it to them. So, I showed them on a YouTube video."

It was also spoken of as place revisited not only as a scientific institution but as a space variously used by its local community:

"I went there for one of my friend's birthday and also with my family".

Impacts of the EOP

While FG participants were uniformly upbeat about their experience of the EOP, they were not quite so unanimous in reflecting upon its educational impact. When asked whether their experience of the EOP had resulted in change to their classroom learning, one participant responded, with little hesitation: *"Not really. I think it was just more fun to go somewhere else"*. Other participants were similarly muted and/or agnostic of the change-effect of their EOP experience: *"It hasn't made me any more interested in science or any less"*. The more obvious or immediate value of the Crick, according to these pupils was as an interruption from the norm; the prescriptions, routinizations and predictability of school learning. For others, the impact of their EOP experience was in confirming and consolidating a pre-existing interest in and enjoyment of science: *"Before I went to the Crick I already liked science, but going there showed me how fun science can be"*. These accounts accordingly show modest yet no less relevant

impacts of the EOP as a positive interruption to formal schooling of science. They provide an honest and economic declaration of what the EOP achieves, that sidesteps the hyperbole common to the frequent (over)claiming of science engagement's educational effects.

As evaluators we are forced to critically ask, what are the impact parameters of the EOP? What more could it possibly achieve in terms of fostering learner engagement? Even as a repeated experience, for the majority of Camden learners, their exposure to the Crick is and remains limited. Yet ostensibly, this is a necessary condition. It is ostensibly the novelty and inconstancy of the EOP experience that provides its potential to engage and enrich learners in ways the school cannot no matter how ephemeral. The novelty and relative brevity of the experience of course, therefore, means that the impact on learners of the EOP, may be more subtle and contained than necessarily groundbreaking and rooted more in a fuller appreciation of science than a *volte face* in attitudes to science learning. We found some instance in the focus groups of learners' acknowledging the influence of the EOP experience on their critical thinking:

> *"When we went to the Crick we felt more interested about science and how different points of view affect one topic."*

Fuller appreciation of science and scientists is no small measure of achievement, at least where enhanced exposure through the EOP helps to erode stereotypes, bias and misassumptions. The success of the EOP thus hinges on the relational dynamic forged between Camden learners and the EOP team, and the extent to which the former are able to visualize science and what scientists do in ways that confound narrow expectations and crucially that are fun:

> *"When I talked to the scientists, they showed me, like, how much more fun they have than what I thought. I thought it was a bit boring. Like, you go to work, you look at some substances, you see what they do and you are done. But it's actually much more fun than that. You get to actually do like a lot more it is not just doing a few tests on something is a lot more than that."*

The success of the EOP in terms of changing Camden learners' perceptions of scientists, rests not only with a perception of EOP activities as fun but the EOP team in communicating the human side of science and the social qualities of scientists:

"I thought scientists would be extremely serious, but instead they're super, super kind."

"Yeah, I agree. I thought they would take everything seriously. But then when we went to the Crick, it was super fun. And they would spend a lot of time with us."

Some of the success of the EOP may be attributed to another negative binary with schools, or rather schoolteachers. While FG participants discussed how their science learning in schools tended, unlike the Crick, to be resource deprived, they also contrasted their teachers as scientifically inexpert with the EOP team as scientifically authoritative, and therefore the latter as more credible and by implication deserving of attention:

"I think the Crick Institute scientists . . . I think they knew what they're doing. I think they have more knowledge about science. And our own teachers teaching us about science. I think they don't really know what they're doing."

"I thought it was important because since they have lots of information about it, and we know it's true, since they're scientists. I thought I would listen to them more."

One FG participants was particularly scathing of – or be that astute to – the limited science knowledge and expertise of their former primary teacher who *"just had no clue of what she was doing*". Others had a similar view:

"The teacher doesn't really explain that much. Like it's really confusing because they teach about like different subjects each lesson… the scientists they explain or help."

"The teachers don't know as much as scientists."

"In our primary school our teachers were nice but the scientists have more experience and knowledge."

The impact of primary teachers as scientifically inexpert was also discussed in relation to the greater capacity of the EOP team to confidently field questions and unambiguously explain scientific concepts to Camden learners:

"When we asked about something that we didn't know, they would explain it really well to us so that we knew what it was. While at primary school, I feel we kind of struggled because the teachers couldn't explain it to us, which made us like kind of clueless."

Section Conclusion

The focus groups provide a mixed picture of the EOP especially as relates to its impact on learners. Dealing with this first, we find a view of the EOP not quite so much as a radical change intervention as consolidating or else enhancing learners' enthusiasm for science. The more substantive values-impact of the EOP is in debunking assumptions made by young learners of scientists – and we might add by extension, science – in being dull. Throughout the focus groups the EOP team were routinely and animatedly discussed for being approachable and fun, yet no less professional. Their scientific expertise was well observed by learners and contrasted with their schoolteachers who are perceived to be found wanting. Change in value estimation is also noted in the way with which focus group participants described the physical and material wealth of science learning at the Crick, which is sharply contrasted with schools as resource deprived and reported in some instances as being in comparative disrepair. A link may, therefore, be made between resource abundance and learners attributing greater significance to their science learning. However, there is no indication from the focus groups that the EOP experience has in any substantive or sustained way, changed views of science as a subject or future career choice. The positive impacts of the EOP are for our focus group participants much more modest and contained, despite strong recognition of the Crick. The EOP may be interpreted thus as a process of scaffolding, stabilising rather than necessarily disrupting learner attitudes towards, and proclivity for science.

Finally, the focus groups portray the EOP as a formal experience, in a formal setting, yet benefitting from aspects of informality that are related primarily to learners being provided a

space with which to be more autonomous than they might in a schools setting and without the threat of censure from teachers. The EOP is thus a break from school, but also in many respects and despite the exoticism of the Crick's setting, offers a not entirely dissimilar structure that has an explicit logic identifiable and familiar to young learners.

Findings & Analysis

i. Teacher interviews

Introduction

The interview data with teachers at both primary and secondary level enabled us to build a picture of the attitudinal trends and the contextual detail which surrounds educators' engagement with the Crick. The interviews enhanced our lines of questioning from the survey and helped to capture the complexity of stakeholders' experiences and responses to the EOP and breadth and depth in an understanding of its various influences. The following section presents a thematic analysis of the interview data, drawing out the impact that the Crick EOP has had on teachers in Camden. Themes around STEM engagement, communities, professional change, vision and directions provided by the Crick are presented and then followed by an interpretive section which draws out recommendations for potential improvements based on the interview data.

Theme 1: Science/STEM engagement

"They enjoyed that sense of wonder and they were very motivated and inspired".

Engagement with The Crick

The initial theme that was extracted from the data was the positive impact of the EOP on learners' engagement with The Crick: "*It is exciting to see the children so engaged in what they were doing".* This was mirrored across both the trips to The Crick: "*It does everything that they need to do and a lot of the things that we can't do as you sit in the classroom*", and the outreach work delivered in the classroom:

"But every single time they go into a classroom, it's really relevant to what they're doing, it's fun, it's engaging, the children often tell me how much they love it when they come in and the staff look forward to having them".

The teachers reported that this engagement with science also extended past the students' interactions with the Crick:

"I think that the children, when they come back, they are usually quite motivated or after workshop in school they're quite motivated in their learning. For example, after we've used the microscopes with the Crick, they

often ask to use microscopes in school […] so it does show, you know, they want to take their learning forward and keep getting these kinds of activities."

Teachers also commended their interactions with The Crick as an institution stating that "*They are really professional, welcoming, inclusive and exciting"* and "*It's convenient, it's friendly, it's easy".*

Engagement with the subject

As well highlighting the positive impact on student's engagement with The Crick, the teachers also commented upon the benefits for students engaging with STEM:

"It is so helpful to have people who actually use these types of inquiry skills in their day-to-day jobs, talking to the children about how to make those links and make those connections between different subjects within the sciences and also in the rest of the STEM subjects".

"The fact that they see scientists coming in and hear the language they use and see the experiments that work".

In particular, a key theme was the benefits of the practical engagement with the subject:

"I would say it is practical, it's hands on, it's fun, it's educational, it's directly linked to the curriculum. It's flexible in the way that it sorts of allow the children to explore their ideas to some degree, but then obviously very well planned and structured so that they got what they need".

It was noted that the science taught in school can be very theory based, whereas the provision offered through the EOP allows application of the theory to practical examples. Teachers commended the planning and thought that as gone in to making the activities accessible for the different age groups: "*very well planned and structured so that they got what they need".*

Theme 2: "Real life" science

"Bringing learning to life"

A recurring theme that emerged throughout the course of the interviews was the connection that The Crick activities offer to real life. The word "*meaningful*" was commonly used to describe the activities and engagement.

Of importance to the teachers was that their students are given the opportunity to understand the real-world application of the science they are learning. For example, one teacher commented that

"It's sometimes difficult for children to realise that this kind of research actually does happen and it's for a purpose […] if you have a bottle of shampoo, it's going to have gone through this process […] so it's making those links to real life. Real world for them is important". Another example was provided: "it isn't just learning about solid-state liquids and gases […] it's about what do you do with them".

One teacher described the science learning in the school curriculum as "*abstract"* and that the EOP "*has really helped to make it more concrete".* The relevance of the material was commonly mentioned as it applies not only to the curriculum but is also relevant to the real world:

"This is something that happens really in the world and it's relevant. And this is how it impacts on your life. And you can be part of that in the future."

This application to real life also led to teachers commenting that the students were able to recognise that 'real-life science' is happening in in their neighbourhood and students have the potential to be involved with it in the future:

"They live in central London and to have the understanding that this is an opportunity they can take forward. You know, you've got an awareness of the role of scientists, it opens the possibility of children to want to take the sciences on further and get involved".

Theme 3: Aspiration Raising

"It has shown [the students] how you can turn something that you enjoy learning about into a job".

A key aim of The Francis Crick Institute EOP is to expand children's future aspirations. The teachers interviewed were keen to comment upon how engagement with the EOP has achieved this. They attributed the EOP with changes to their students' perspectives on science, and in turn raised aspirations in science learning:

"I think the issues that we face in this school is that I suppose children from certain backgrounds, maybe they don't see themselves in buildings like the Francis Crick. They operate maybe in a very different world to what is going on their doorstep, if you know what I mean. And we want to show them that, you know, there's a real opportunity here and there's opportunities".

This idea of raising aspirations was two-fold. Firstly, teachers commented upon how the EOP was raising students' aspirations in their learning of science at school, and secondly, they discussed how aspirations were being raised for students' future careers in STEM. This is summarised by one teacher who stated:

"I think the Crick is doing two things. It's motivating and exciting students around ideas and understanding, but it's also being really practical in terms of looking at how we grow scientists by observing how they're developing their thinking scientifically skills and then deepening their knowledge through content."

Along with encouraging students to raise students' aspirations in science learning in the classroom, teachers were also keen to explore how the EOP has impacted students' future career aspirations as scientists:

"What has transpired over the last few years is they just don't feel like they're intelligent enough to become scientists. And I think that's probably due to the fact that they've got this preconceived idea of what a scientist is. And having people coming in, they're scientists, but they're not these amazing planetary gods they're just normal people that the children relate to and talk to. So, it's so important to have that real life figure of scientists going to school"

Theme 4: Role Models

A further theme to emerge from the interview data was how The Crick has provided positive science role models for the students. One teacher discussed the importance of students having a *"relatable figure"* stating that if *"they don't have that real life scientist involvement, they can't ever see kind of long-term potential for themselves in that role. And that's why I feel so strongly about scientists coming in."*

This theme of role models was discussed in relation to both gender and sociodemographic background.

Gender

The teachers interviewed mentioned how their experience with the EOP had helped to challenge gender stereotypes around science by having female scientist role models.

> *"I think it was valuable for the girls as well, to see other female scientists, because sometimes, you know, things like science and math, some girls kind of think, or maybe it's a subject the boys are engaged with or interested in. So, I think for the girls, it was really important for them to be able to see that they can do it, too. And there was the female scientist and it's important for them."*

> *"I think it raises aspirations and it also supports encouraging children, particularly the girls, which I know there's still an imbalance between girls' and boys' engagement and their attainment in science as well. I think it encourages people who might not necessarily always consider science or being a scientist as an option. It makes them see it from a different perspective".*

Sociodemographic background

The teachers also commented upon the demographic factors of their students, and how interaction with the EOP had shown the students what people from similar backgrounds have been able to achieve working in STEM.

> *"it's this sort of science aspiration because they see scientists who are from similar backgrounds to them and come in and run the workshops"*

"Really positive, diverse role models for the children to see that it's not a white man with frizzy hair and white lab coat"

"Is it important to see people at work […] be exposed to other jobs and coming out and seeing people going and doing a job, which is something very different to what their parents might be doing"

Professional development for teachers

Teachers had a strong sense of the value of the Crick in terms of professional development, gaining of confidence and development of enthusiasm. There were a range of positive learning benefits for teachers themselves in engaging with the Crick team.

In particular, the level of specialisation and knowledge of science provided by the Crick was very positively evaluated, perhaps due to the more generalist profile of the majority of primary teachers.

"I suppose it's really informative and sometimes our primary teachers generally are... well... Are generalists, so we don't specialize in anything? So, it's sort of good to have someone who's a specialist, I suppose, coming."

It was notable that teachers picked up on the specialist knowledge of the EOP team from the Crick and this had a positive impact on their own engagement with developing stronger science knowledge. Teachers reported an increased engagement with expertise and 'knowing' in science and they viewed engagement with the Crick as improving their skills and knowledge of new areas of science. There were also signposted how practical resources, provided by the Crick, contributed to raising the profile of STEM in classroom settings. The physical resources used by the Crick team also generated enthusiasm amongst the teachers to try something new. One teacher said:

"It just creates a buzz more than anything."

Teachers' observations and involvement in the ways the Crick team work in terms of their speed and efficiency with experiments and investigations was also a source of developing stronger science knowledge. The activities delivered by the Crick seemed to offer new perspectives and teaching possibilities to the teachers interviewed.

"I'd say that they have developed stronger science knowledge and also ideas of ways to work scientifically within a short period of time. You know, you can

do a useful investigation within a time limited period. And I think that has a wider impact, to certainly train the teachers, but also within the workshops, the teachers are there so they can see how the projects and the people coming to work and then adapt those and build on them as well."

There was a sense from the interview data that the teachers felt the Crick team were also aiming to engage them with new perspectives of both science and pedagogy and that the EOP was as much for their benefit as Camden's schoolchildren. The 'authentic' environment which the Crick team represented and promoted with teachers and children was seen to facilitate a community of engagement with tangible impact on teaching in Camden schools.

"So, for me, it's kind of seeing things happening in an authentic environment with career professionals. So, I know from the interactions we've had, I've been able to draw on their expertise, but I can really see the children engaging with that. So, it sort of ups the level of everything and education as well. You know, I learned from those scientists and that feeds back into my teaching"

Teachers reported other pedagogical impacts such as the critical distance and reflexive space afforded by the EOP that was felt to provide a window onto the behaviour of their students in different learning or problem-solving contexts, affording insight into individual learning routines and methods of knowledge and skills acquisition not so easily observed in the ordinary passage of classroom teaching.

There was a very strong sense of gratitude and appreciation communicated in the course of our conversations with Camden schoolteachers, in respect of the professional development opportunities and supported provided by the Crick.

"I think it's the best thing I've ever done in my teaching career. Link up with them."

"Thank you for the hard work and dedication. I honestly don't think they realise just how much they do and how much they've helped to support staff like myself . . . And it's just so amazing to have somebody there that you trust and that, you know, just wants to help and support you is invaluable. So, I'm just really grateful"

Findings & Analysis

A science direction

A recurrent theme in our interviews with teachers was the contribution the EOP makes in building an educational vision for science teaching. The EOP was seen as facilitating a more coherent and explicit vision for how science should be taught in Camden schools. Our teachers also reported increased confidence in leading science in their schools and that working with the EOP team had enabled a much stronger sense of how science curriculum can be developed and shaped.

> *"I genuinely feel like we've got a science vision now, where if you'd asked me a year and a half ago, I just would have been completely at a loss at what to say"*

> *"They've helped us develop an entire vision and supported the development of our curriculum within our school"*

> *"I'm more confident as a science leader now and I have a stronger science vision. And I also know where I want to go in our school, and I want our children to go and kind of have a fun and goal of what I would like"*

Type of relationship with the Crick

Teachers attributed a symbolic value to the EOP that exceeds the value extracted from individual points of engagement. The EOP was in such terms understood as a community interface – belonging to the local community – through which Camden schoolchildren were helped (inspired and empowered) not so much to imagine as to anticipate their future selves as scientists.

> *"It's great that it's part of a community resource that it is seeing itself as a community resource doing this outreach work. It's great for our children to see that this is a future that they could go into. And it is real life and it's really happening science as well. So. I think it's great and keep doing it would be my message to them"*

Interaction with the EOP was also described by those we interviewed as having stimulated ideas and impetus for other enrichment and engagement ideas, linked with and spurring interactions with other teachers. The EOP was consequently described for having snowballed other forms of extra-curricular activity and facilitating a sharing space with other teachers in their network. Such developments are important in signposting the value of the EOP beyond direct interaction with its programme of activities, and demonstrate the ripple effects of EOP participation across Camden's community of teachers. The EOP in such terms may be seen to operate almost as a

relational broker of good practice fostering a stronger sense of connectivity and belonging across and within the Camden schools' community, of which the Crick is a prominent participant:

> *"It's just making the connections isn't it? So rather than just being another piece of information about another random place, we feel very much part of that"*

Moreover, the teachers we interviewed perceived their relationship with the Crick as a long-term partnership that would sustain into the future:

> *"It's like a partnership. You want somebody to develop with your school and have a really long term, longstanding partnership with, not somebody that's going to pretend for an hour and then leave and you never see them again".*

Overall, there was a strong sense from the teachers we spoke to of how various interactions with the EOP had consolidated the Crick's role in the Camden (schools) community. Teachers consistently articulated the symbolic value of the Crick within their professional networks and as uncoupled from specific activities, showcasing the breadth of its influence and impact.

Organisation and communication

The teachers we interviewed emphasised the fluency of their interactions from the EOP team and the team's general responsiveness to their needs. Communicating with the EOP team was described as being easy and fast, with the team always on hand to help. A lack of red tape and bureaucracy in engaging with the EOP was viewed as pivotal to the success of its schools' interactions, drawing teachers in and engendering a sense of community:

> *"In terms of what the Crick has offered, it's just absolutely amazing. So, they've surpassed everything. They kind of give us so much support in terms of workshops in school, support from the outside of the school. I emailed them in the past before because I had queries or questions and they always get back to me. So, In terms of that kind of outreach program. It's like education for myself, but also for the kids. I feel really lucky that we've got them."*

> *"I had a colleague at work who had been, I think, searching for a workshop for her class. And stumbled across the Crick's educational outreach program. And she said, oh, this could be of interest to you. And I emailed them, and they were amazing. They came back with like.... We can come in and do a whole week with you if that is what you want. And since then, I feel like they've*

totally taken us under their wing. So, we're constantly being offered support from them."

"They have just been phenomenal in terms of the support"

"It does feel accessible."

Some conclusions to draw out:

- The EOP has engendered a sense of community and belonging for Camden teachers and and made them feel supported and part of an initiative. This has led to a stronger vision for science teaching and its leadership within Camden schools.
- Professional development offered through the EOP is very well received. Teachers express feeling very much a part of a professional community and being enriched by the Crick's material resources and added specialist knowledge. Their teaching practice is supported and enhanced by the EOP.
- The value of the EOP is not confined to its programme of activities but its influence in energising and coalescing a community of pedagogical practice within the Camden schools community.

Potential improvements

Our interviews also provided useful insights into how the EOP, despite its myriad successes and strengths might be further improved. Suggestions for further enhancing the EOP, presented here in turn, constitute:

- greater staff resourcing of the EOP team, facilitating a more generous provision of time to schools and learners
- better articulation and alignment and potentially even fuller co-operation in curriculum development involving the EOP team and schools
- maximising reach (to non-traditional learner cohorts)
- parental engagement

1. Time and resourcing

The vast majority of comments pivoted around the hope of all teachers interviewed to be able to spend more time engaged with the Crick and the EOP specifically. These engagements can be divided in three types:

- More regular interactions with the Francis Crick Institute. These include both visits to the institute and scientists going to schools. One recurrent recommendation made by teachers was to increase the size of the EOP team so that it might be able to accommodate demand for a more extensive programme of activities.

Our interviewees related increased interactions – once a term – with the Crick to better relativising and enlivening the taught curriculum:

> *"We would like more regular trips to the Crick. I mean, it would be nice for every year group to get a chance and maybe once a half term or once a term. I know this is just what we would dream of doing and if we could then have it really linked to what we're teaching in class and the curriculum. That would be an amazing thing for us."*

Interviewees reflected upon staff and thus capacity limitations of the EOP team and the difficulty of their managing a surplus of demand from a myriad of schools. A demand for increased schools' interaction might only therefore be accommodated, interviewees argued, with an investment of personnel and a larger EOP team better positioned to cater for Camden's schools' needs and a more substantial offering:

> *"I've spoken to the Crick about it, and they quite rightly say we've got a lot of schools and if we could, we would. They're working with so many schools that to be fair, they have to manage their time in that way. It would be great if their outreach team could be slightly bigger, so that they could do more, more regular sessions. But what they do is great. I would just love a little bit more."*

An issue of schools being resource deprived – an oft repeated theme in the focus groups – was also discussed by interviewees, who spoke of being able to exploit the locality of the Crick and its wealth of resources, and moreover, their preference for physically visiting the Crick as opposed to hosting the EOP team within school:

> *"The other thing that we lack in the school is really the science facilities. So, we're a primary school, we don't have a lab, or we don't have tons of resources for science. So, to be able to go to that lab at the bottom of Francis Crick is a great plus for us. So, we would prefer actually to come to Francis Crick to do science there than actually to do workshops in the school . . . going to the Crick is not far from us. It makes a big difference to children. It is exciting. And they have got a facility that we don't have."*

More training for teachers. While our interviewees advocated for increased exposure of Camden learners to the EOP programme, they also discussed the benefits of increased access the EOP's professional training and pedagogical capacity building for teaching and support staff:

> *"I think it would be beneficial to have some more time with our teachers and support staff helping them to become more familiar with developing inquiry skills for our children – so ways to approach their skills in different contexts. I think our staff would really benefit from that."*

2. Curriculum co-operation and co-design

While interviewees discussed what they saw as the added value of the EOP to their delivery of the taught curriculum, they also advocated for increased synergy between schoolteachers and the EOP team so as to better align Camden schools and the Crick's taught content.

> *"It would be good at some point to sit down with people who are organizing the curriculum or the activities of the Crick and match it to our curriculum, really, that would be more useful for us to be able to look at... So we are teaching this at this point, is there anything you can do to help us with it and to link that way".*

A more collaborative relationship would also, it was claimed by some, require the EOP to become more responsive and/or reactive to schools demands and by extension less proactive in setting an agenda for science engagement:

> *"If I'm honest, the only tiny thing that I would suggest would be sometimes it would be better if they could link some of the works that they do in school directly with the curriculum. So, in year six, we have a really gorgeous workshop based around using microscopes and things like that and the children absolutely love it. But I thought, oh, it'd be better if we could have linked it to one of our science objectives".*

In recommending the Crick, our interviewees also observed how the success of the EOP team is based on a firm understanding and knowledge both of the primary curriculum and of primary learners' diverse needs that exceed the standard engagement offering:

> *"I think that the Crick have a good awareness of what actually primary level children need. They have a really good understanding of our curriculum. They're quite happy to work with the school ethos. And I think some of other*

STEM engagement maybe have not as good understanding of what actually is needed in a primary school and then how to accommodate these children, the children's needs".

"Their pitch is really good. They know what coverage needs to be in there. They know how to adapt for different children's needs within a session, things like that. Because I think you can often feel like... In a setting quite often with other outreach, they know the content really well, but aren't necessarily that well equipped to deliver it."

3. Maximising reach

As a means of capturing and extending the positive impacts of the EOP, interviewees advocated for the recording of EOP sessions. Digital records of EOP activities might be used for purposes of consolidation, revision and/or as powerful means of 'catching-up' learners:

"I mean, I think that having that available for a number of reasons would be good. For students to watch again at home to consolidate understanding at the end of a topic, but also maybe for revision or for students who join the school late or who have missed a lot of school or for any reason. I think that would be an enormous amount of work."

In maximizing the reach of the EOP, interviewees also suggested that the EOP team should further differentiate their audience and stakeholder community and target a wider demographic and specific marginalised or non-traditional (science learner) constituencies, including for instance children who are home-schooled; female learners; economically disadvantaged learners; and even gifted learners. It was suggested that the EOP activities might be reconfigured as a community engagement event, involving young learners with their parents – and thus also educating parents on future educational pathways and opportunities for their children, they may likely be ignorant of:

"Another area that I work in is with families who elect to home educate. And I'm wondering whether that might be kind of a community-based outreach that they could offer us, maybe some like termly events for children who are home-schooled."

"If there's any way to identify either white working class or ethnic minority students in some of our larger groups to come in and do a special project, maybe in the early spring, around Christmas time, late autumn or January

time at the Crick to... Based on high achievement in science and with the notion that their parents may or may not see science as a pathway for them or I don't know. I mean, I don't know how that might be done, but that could be another way of encouraging young people from these backgrounds to see that there's a range of possibilities for them to keep involved in science."

A project-based approach to outreach with specific sub-groups was advocated much as the EOP in more general terms, on the basis of necessarily extended and more regular interactions:

"If I'm thinking about any improvements, it could be that we're focusing on certain groups of children that could be involved in the project on a slightly more regular basis. So, if we're thinking about… I don't know, just girls being involved in it or disadvantaged children or children with gifts and talented."

4. Parental Engagement

The final recommendation, made by interviewees, for improving the Crick's EOP offering, and we would suggest role and recognition within the Camden community, concerned a fuller investment in parental engagement – understanding more clearly parents' perspectives on their offering and what more could be done to entice them and their children to the Crick, outwith school:

"I think as a school we have a strong community and we have obviously a lot of engagement with parents. I don't think our parents are massively engaged with Francis Crick if I'm honest. I know they do get some newsletters and things from them on that, but I haven't asked the parents how engaged they are. I know as a School our parents are very engaged with the school and they are involved in the school community. I don't know really how engaged our parents are with the Crick".

Final comments

These interviews have been crucial in enabling us to identify details of the impact of the EOP, considering this against the various conditions and contexts of teachers working in Camden schools. We have considered the interrelationships between different impact pathways (and personnel) that contribute to improved awareness, aspirations, experiences and skills among learners in science; enriched curriculum and enhanced pedagogy in Camden schools. This contributes to developing greater knowledge of STEM career pathways and opportunities. The data has demonstrated that the EOP contributes to a sense of 'cultural' and 'community'

ownership of the Crick as an open and accessible space. This analysis will help the Crick to consider what works best and what could work better, across the EOP's varied suite of activities. The detailed nature of the data recognises the significance of space and place to the success of the Crick's science engagement.

Staff Perspectives on the EOP

Introduction

Further to our consultation with the Camden schools' community, we sought to understand how the EOP functions from the perspective of its core team and from within the Crick, and moreover, ascertain the immediate and longer-term impacts of the COVID-19 pandemic from 'the coalface'. We undertook a day's long interviewing with four members of the EOP delivery team and the Crick's, Director of Public Engagement. Each interview lasted approximately 45 minutes, some stretching to almost an hour.

Discussion of the interviews falls into six main thematic sections dealt with sequentially and followed with an overall chapter conclusion:

- The uniqueness of the EOP and its overachieving
- The impact of the pandemic: online public engagement
- Accessibility: special schools
- In-person dialogue
- Camden schools without the EOP
- Future forms of collaboration and funding

i. The uniqueness of the EOP and its overachieving

Interviews with the EOP team further confirmed much of what we had already ascertained through our broad consultation of the Camden schools' community related to the success of the EOP, and how in many ways it overachieves. Such overachievement is rationalised on the basis of what is a small team of five engagement professionals/science educators continuously interacting across the entirety of the Camden schools' community:

> *"We're working with every single school in Camden, we're pretty much reaching every year group. We're not reaching every student but I think it's an amazing achievement to have those relationships with every school to have those activities and providing opportunities to students is an amazing achievement, among a team of five. Sixty schools, twenty thousand students, and it's every year."*

Both the breadth of the EOP offering, its personal delivery, and the permanence of its accessibility are factors which in our opinion make the EOP highly unique in a field of science communication and schools' outreach that lacks variety and differentiation:

"Ours is more personal. We're going in and we're dealing with individual classes, every single time, and you will get an experience that's your thirty kids . . . Without building concrete building blocks of support for the teachers then it becomes very much a throwaway offer. It becomes, "Yeah we had the Crick in, they were alright. So what? It's a one-off thing". Well, actually it's not a one-off thing and actually we can help you with some many other things".

The accessibility of the EOP is in our opinion a defining feature that sets it apart. Unlike much of a commercial science communication and schools outreach industry that charges for services and products, the EOP offering is free. Consequently, every child within Camden has access to the EOP, and thus a world-class, world-leading science institution:

"Wonderful outreach occurs in lots of places, but we are the only core funded people that I'm aware of. No school has to pay for the services that we provide and so no child will be turned away because of lack of resource."

An ability to interface and impact so many schools, with such a small team, requires, of course, logistical precision:

"The logistics have been worked out really well. When we go to a school we try and see all the year groups on one day. So that means logistically we can reach a lot of people in a short space of time with only a team of five".

Logistical success also however was attributed by our interviewees to highly effective leadership of the EOP from the Crick's Education Manager, and a consultative and bottom-up model of strategy building, which allows all members of the EOP team to have their say:

"She's got a strategic outlook on all of these sort of things which is pretty comprehensive and impressive but she's also including us on what our strategy should be and how we should fulfil it. We're all getting an opportunity to input into what is happening on the ground".

Despite the obvious quality of the EOP's leadership and the cohesiveness, dedication and abundant enthusiasm of its team, the tasks of the EOP remains considerable, are numerous and

exceed pedagogical responsibilities. There is a danger, therefore, of the EOP team becoming, if it is not already, overly stretched and in need therefore of further human resourcing. One of our interviewees, for instance, stated:

> *"The issue for us as a team is the level of demand. There are so many projects we'd like to do. And we all teach as well and we have to contribute to boring lab jobs, like making sure everything is well-stocked. We set up for our workshops ourselves. I think we're pulled in many directions."*

Unchecked and unacknowledged work intensification can be damaging to staff morale and moreover staff wellbeing, no matter the extent of staff commitment to work. While we were hugely impressed with the energy and enthusiasm of the EOP team as a tight-knit and collegial unit, we would recommend that expectations of what the EOP can achieve, especially in future, remain realistic and that workloads are proportionate and well justified according to resource.

ii. The impact of the pandemic: *online* public engagement

The impact of the pandemic on the EOP cannot not be underestimated. With 'lockdown' mandated by the UK government in early 2020 all in-person schools' provision of the EOP necessarily ceased, while some members of the team retrained to assist the Crick's role as a COVID-19 testing facility. Just before and during this time, the EOP welcomed two new team members, whose onboarding was for obvious reasons challenging, yet nevertheless successful. When lockdown lifted, the EOP team faced, as all school educators, the challenge of adjusting to social distancing measures and other virus-containment measures within schools, impacting their creative freedom within classroom contexts and limiting the impact of their pedagogical approach. They were forced to accept and adapt to limited classroom mobility and a stationary (didactic) role at the front of classrooms; an obligation of wearing facemasks; the challenges of working within classroom bubbles; and the need to continuously sanitise kits.

The pandemic was also articulated as a period of time, where despite schools being physically closed, demand for the EOP failed to diminish. In fact, the pandemic was attributed to an uplift in demand for the EOP, in tandem it would seem with the Camden schools' community being most stretched in terms of resource. Consequently, our interviewees described how they exceeded a remit of delivering science education and sought more widely to support schools during crisis conditions:

"We've gone beyond delivering the science education, we supported digital devices for local schools and also convened conversations around what do our schools and teachers really need."

There is evidently huge potential for the EOP to extend its Camden remit and good justification too based upon the level of demand, however, this would depend not only on an investment in blended schools' engagement but increased human capacity. While the Crick is almost unique among research institutions – and certainly in comparison to universities – for the extent of its dedicated staffing for public engagement and the degree to which their specialist expertise is acknowledged[2], with five members of permanent staff among the EOP alone, there can be no escaping the intensity of demand in already servicing approximately 19,000 Camden learners. There should also be no underestimation of the labour and potential cost of adapting existing in-person engagement methods for digital delivery. These are obvious contingencies for any kind of scalability, yet could be successfully justified on the basis not only of the proven efficacy of the programme but the underpinning (and essential) support provided by the Crick's institutional leadership:

"At the Crick, public engagement is so well supported from the top. We have a relatively large team, a relatively large budget and freedom. Our expertise is respected by the top pEOPle. Most pEOPle at the Crick value the work we do and value our expertise."

While the pandemic was a cause of significant disruption for the EOP it was also a period of adaption and creative experimentation; an opportunity to play with new ideas and new methodologies, ordinarily for reasons we will later discuss, off-limits. While some of these 'innovations' served as a rapid – and consequently, sometimes less refined – response to schools' and learners' needs, they were seen to offer a blueprint and precedent for original thinking. For instance, one of our interviewees commented:

"A number of our staff ended up recording from home, their own careers videos, snapshots about themselves: how did they get where they are, which are up online and used in schools."

[2] See Watermeyer and Rowe (2021) for how public engagement expertise in universities is routinely unacknowledged and dismissed: https://www.tandfonline.com/doi/abs/10.1080/03075079.2021.1888078

This kind of online platformisation of the EOP in such terms might not only increase the footprint of the EOP and its penetration into learning communities beyond Camden but might also provide a vehicle to facilitating, and importantly, *maintaining* the 'personalisation' and 'accessibility' of science and science personalities (as embodied within the EOP team) beyond in-person encounters. Moreover, by platformising (aspects of) the Crick's engagement offering, there is prospect for better 'signposting' of the EOP, allowing other organisations to learn from and model their own engagement practice on it. Such 'signposting' is viewed as another element of scaling-up the EOP yet beyond the Crick and as a type of creative-commons, and therefore as unconstrained by an issue of human resource local to the Crick:

"Signposting is something we are keen to develop a little bit more. Because we are not protective of our work. We don't have the capacity to achieve what we want to achieve on our own so if we can signpost to other people then it's extending that experience and extending the impact."

In such context, it is also worth mentioning that uptake by other organisations of the EOP methodology was recognised by our interviewees as symbolic of the programme's achievements; imitation as the sincerest form of flattery:

"What does success really look like? Other institutes adopting our model. That would be the gold star for us for success."

In terms of other online experimentations, our interviewees discussed the success of an online 'discovery week' in attracting significant numbers, part of which may be rationalised by schools' initial scrambling for online activities to compensate for their physical closure. Notwithstanding, success in reaching such a sizable audience should not be dismissed, not least where such digital engagement was made from a stationary start:

"We had new activities, new quizzes all online on our website and that was really successful. And for an organisation that didn't really interact with anyone online we had well over 7000 individual households joining us during the week."

Experimentation by the EOP team with digital technologies, had it was suggested, provided a basis for a blended model of public engagement that incorporates both in-person and digitally facilitated methods:

> *"We trialed a few things online. We did online work experience. We did online science shows. We did online teacher CPD . . . I'm not sure how much of those we will continue with but it's good to know that there is that option. And we're now as a public engagement team focusing much more on online engagement."*

The experience of delivering online education outreach was identified by our interviewees as a means not only for continuity in the delivery of the EOP to Camden schools during the pandemic, but also as a means for scalability and in responding to demand for the EOP from outside of Camden, from across, London, the UK and even internationally. However, our interviewees discussed the challenges of hybridised forms of delivery, or in other words in-person and on-line engagement, occurring synchronously. Hybridised schools' engagement was considered to be problematic given that the success of most engagement is attributed to the quality of the dialogical process, which might arguably be diluted and compromised by a split focus in managing in-person and online participants. Moreover, the complexity and difficulty of orchestrating hybridised dialogue might further accentuate among youth participants, whose needs for dialogical scaffolding may not be adequately accommodated where the attention of engagement professionals is split.

One other aspect of the EOP programme, continuous professional development (CPD) for teachers, was also discussed by one of our interviewees for not being well suited to online platformisation. While online CPD might be considered beneficial to teachers as busy professionals with congested workloads, enabling them to access training at points of greatest convenience and of their own choosing, a transition from in-person to online CPD was interpreted by one of our interviewees as a cause of drop-off among teacher participants. This was rationalised on the basis that it denied teachers' buy-out for a full day, and we might thus also speculate, cause CPD to become an investment of personal (and non-work contracted) time.

> *"Some of the feedback from the primary leads was that when it was on Zoom it felt optional because then they didn't have to prearrange cover for someone*

to come for the whole day. And so suddenly it was, "Oh I'm going to come" and then suddenly "Oh no I can't because something has come up."

Notwithstanding these caveats, there is good reason for further deliberation of how aspects of the EOP programme might benefit from blended delivery, which might include for instance online work experience. There is also need to consider the EOP and wider Camden schools' community operating presently at a time of COVID recovery, where educational communities are reintegrating and readapting to previous methods. It was noted for instance, albeit anecdotally, by one of our interviewees that the pandemic had resulted in observable behavioural change among schoolchildren, a finding collaborated elsewhere on the socio-emotional impacts of school closures[3].

iii. Accessibility: Special schools

Digitalisation in the delivery of the EOP would, it was also felt, enhance greater accessibility to its offering, especially for learners with special needs and thus further improve the diversity of its audience (recognising of course, the preexisting diversity of the Camden schools' community):

"There are two primary purposes that we're looking at digital for the education team. One is to satisfy that demand from outside of and within Camden. And the other thing we are interested in is improving access for students with physical access needs or social access needs, particularly with the work experience programme, because that is the one programme where we are more selective. We're going to look to see whether online does increase diversity in that programme."

Children with special needs and certainly the special schools the EOP already interacts with, are recognised for being a priority community. Regrettably, they are also a part of the wider Camden schools' community, for whom EOP interaction with has been difficult and tailed off during the pandemic. Interviewees, however, were unanimous in describing the richness and deep personal satisfaction gained from working with children with special needs; a cohort of EOP beneficiaries it was felt that should be further prioritised. They also, however, reflected a lack of specialist skills in providing a more expansive offering to schoolchildren in Camden with special needs:

[3] https://www.iser.essex.ac.uk/files/projects/school-closures/SDQnote2021_final.pdf

"We want to be doing more and you could argue we should be doing more . . . That's a group we do something for but not enough for. And it would be great if we had more time and the specialist knowledge . . . to adapt what we're doing or make something new for that specialist knowledge."

The EOP was also, in the context of education outreach to *special* schools, reflected upon as an equaliser of opportunity; levelling a field of access for all children to be engaged in science, regardless of socio-economic status and/or physical and cognitive needs:

"For me I think it's equity. That those children are always set aside. They've been identified as being different quite early on it their lives. And it may be a positive thing as they are getting the one-to-one support they need but still there is this, "You're different", and they're in a major campus with other children but they're behind a fence. For me, what I love about our programme is the equity of it all. That every Camden state school has access to the same Crick science workshops to the same equipment, all the CPD which is free. We don't discriminate regardless of the post code that you live in, or how lofty your parents may be, or what your ability is as defined by someone else. So, for me [for SEN kids] it's just that, you're getting the same thing as everyone else."

iv. In-person dialogue

In-person dialogue remains at the absolute core of the EOP offering that is taken every year to every student in Camden; an extraordinary undertaking. In such terms having a 'smaller'[4] remit of engaging 'just' with the Camden schools' community is seen to work in the EOP's favour in facilitating young learners' positive associations with science and the Crick, through the EOP team as a known Camden constituent:

"Having a smaller remit of just seeing Camden students has worked in our favour up until now. To see every student ever year. You talk to anyone else and they say, "You're trying to do what"? But the continuity of that is extremely important. To go into a school and they go, "Oh, it's 'David'", three years after. Even after COVID they'll go, "It's 'David' from the Crick". And you

[4] We firmly recognise the EOP as no 'small' undertaking, and that 'just' working with the Camden schools' community requires a huge logistical effort for what is still a small team of only five permanent staff.

go, "Great you're making associations with (a) something that's local for you that we're providing for you and your community and (b) it's made an impression and they're actually remembering it and that can only be a positive thing."

The (relative) regularity of the EOP team's interactions with the Camden schools' community appears to us as crucial to their personalising science and in establishing a fluency of association with the Crick as a scientific institution at the heart of the borough. As visible, known and clearly popular members of the Camden schools' community, the EOP team are reflected upon for achieving almost celebrity status:

"The Education team are almost celebrities in Camden. When we do family events, the families come and they say we did this workshop with 'Sam'. The Education team not only have these relationships with schools but they have individual relationships. They are part of the Camden community."

As highly visible and recognised members of the Camden schools' community, the EOP team are also able to exceed what can be an often reductive aspiration of 'science capital' accumulation among learners. Interviewees' reflected on their position in fostering a more holistic ambition of social agency among learners:

"For me public engagement isn't just about developing science capital, it's about addressing inequities ultimately in our society, in our health systems, in our education systems. That's why I do the work I do. So wonderful that we help inspire children into science but more importantly for children to have a sense of their own agency."

The EOP team is, however, challenged in terms of how it mediates simultaneous representations of science and Camden's local community. While the EOP team provides an opportunity for the Crick to be both 'in' and 'of' Camden, it is partially challenged in the context of its social composition and being a team, that as predominantly white (and female)[5], is not quite so reflective of Camden's heterogeneous and ethnically diverse community as it be or might like to

[5] A prevailing characteristic of the wider UK community of public engagement professionals.

be. This said, the EOP benefits from one member of its small team being a person of colour, who provides by way, enhanced social symmetry with the Camden's schools' community, an attribute public engagement habitually lacks. Social symmetry of this kind is important in terms of the credibility of the democratic aims of public engagement and therefore learners being able to visualise themselves as scientists by means of associated identity with those who are and who look like them:

> *I know anecdotally that my former colleague and I – she's a Black woman and I identify as an Asian woman – we've been told on a couple of occasions by teachers, "It's wonderful to see not only female scientists but women of colour. People who look like they can come from their communities as opposed to just seeing White people which matches their stereotypes of what scientists are".*

v. Camden Schools *without* the EOP

The embeddedness of the EOP within the Camden schools' community and its contribution to so many school-aged learners (and their families), has resulted in it being a resource that schools would struggle without. This was a sentiment we picked up not only in our consultation with school heads, science leads and teachers but among the EOP team themselves who understood their role as integral to curriculum delivery and more precisely as plugging gaps in Camden schools' science provision. At the same time, however, dependency from Camden schools on the EOP as a partner of curriculum delivery, is seen as a constraint to altering and evolving the programme:

> *"Speaking to teachers about areas of the curriculum that they want support delivering. Whether it is that practical science, whether its scientific careers where they don't have the expertise or resources . . . It's not enough to be curriculum linked. I think you need to fill gaps. That is the bit of the curriculum that the Crick delivers and we are so integrated now into science education within Camden that it would be hugely problematic if we changed our programme . . . To do anything new or original is difficult because we can't really take anything away. For some schools the Crick delivers that part of the curriculum."*

vi. Future forms of collaboration and funding

The successes of the EOP are manifold and we hope to have made these explicit within our reporting. Sustaining such success is of course, as for any organisation, a key objective and we were keen within our conversations with EOP team members to identify ways with them of how they might increase their impact. Most of our conversation focused on an extension of reach, taking the EOP to new and potentially different audiences. Some of this might be achieved as we have already discussed through digital means and through 'signalling' to other educational outreach providers. But a strategy of wider reach would surely also, as our interviewees described, depend on collaboration with other organisations. However, identification of the right kinds of organisations to partner with, in extending the reach of the EOP was recognised as key. Our interviewees accordingly reflected that collaboration might not be so much with other science organisations but instead local community organisations, and these being a focus for future partnership:

> *"In order to reach those different audiences, first of all identify those different audiences, well you're not going to be working with science organisations to reach them. I look at our community officer, that's how you reach the hard-to-reach people. It's not, "Oh, we're a lovely science organisation, come in", because they won't. So, it's using the networks that they already have and trying to use those networks to reach those students. So, it may be youth centres, it may be local sport centres, it may be who knows what, and that's perhaps something we should focus on more."*

Despite the Crick's physical location and it being within proximity of major globally leading universities, partnership with universities was not viewed as a particularly useful way of extending the EOP's reach. In fact, our conversations with EOP team members revealed a sense of dissonance between the aim of the EOP and the widening participation agendas of most universities which are motivated by albeit socially conscious, student recruitment, and reinforcement of an idea of higher education as the only route to science (careers):

> *"Working with universities is not so much on the agenda as there is a link to be made with widening participation: "but widening participation for what? For the university route – but yes it's not just the only one."*

Finally, while we identify and recommend a need for increased funding of the EOP as a part of the Crick's central budget and in recognition of its manifold achievements and the needs to sustain these, we might also recommend further exploration of external funding sources. This may not be particularly straightforward in the current funding context, especially where investment in public engagement is weak, however, we are aware from our interviewees of the potential of attracting external funding – "whether philanthropic grants, trusts and foundations we could speak to" – in supporting the Crick's EOP as a national, and potentially, international exemplar of science schools outreach:

Section Conclusion

Our interviews with members of the EOP team, confirm much of our initial findings apropos the significant success of the programme and its major impact on the Camden schools' community. This further and penultimate chapter of our report makes further explicit the unique selling point (USP) of the EOP and what makes it distinct from other forms of schools' engagement and outreach. The USP of the EOP relates to having a permanent team of dedicated engagement and educational outreach specialists, interacting in an ongoing way with the entirety of a local schools' community and them offering a variety of services that exceed, standard one-off schools-based interventions, and an interaction *just* with learners. This USP extends to the EOP being freely available to all Camden school children at no charge, and the Crick building itself being an accessible part of the community.

The success of the EOP extends to the pandemic and the perseverance and ingenuity of its team in devising new ways of interacting with the Camden schools' community in the milieu of school closure. While the pandemic conditions were clearly challenging to the EOP team, they also provided a unique opportunity to experiment with models of delivery and specifically the use of digital technologies in platformising aspects of the EOP. Online engagement is discussed for its potential in the scalability of the EOP, where demand greatly exceeds the Camden borough. Blended engagement is identified as one pathway towards increased reach of the EOP, however hybridised forms of engagement are questioned in terms of diluting the dialogical basis of the EOP which underpins its success. In-person engagement, or more specifically, in-person dialogue is emphasised as a key condition of the EOP's success and what makes the EOP team so integral to the Camden schools' community.

Collaboration with other external organisations, and signaling to them, is also discussed as a means of directly and indirectly extending the reach of the EOP. However, such collaboration might not involve other science organisations, such as university partners, but local community organisations.

While the EOP benefits from its dedicated staff resource, there are concerns of the team being overstretched and the dangers of work intensification in managing massive demand for a mixed portfolio of activities within Camden and beyond. There is clear justification for further investment in the EOP team, which might be leveraged internally within the Crick but also via application to external funders.

Finally, concerns also exist in relation to social representation, and the EOP team operating as representatives of science, yet also for the purpose of building learners' sense of self-efficacy and entitlement, operating as representatives of the Camden community. The challenge thus at least partially remains of the EOP team being both *within* and *of* the Camden community.

Recommendations

6. Recommendations

- The centrality of the EOP offering to the Camden schools community cannot be underestimated, in the contexts especially of:
    - the EOP team as important role models challenging and breaking misassumptions among young learners of scientists;
    - in embedding a scientific memory among learners serving as an important reference point in formal science lessons and also in seeding self-efficacy (among those whose 'science capital' is less developed and whose risk of science disengagement is most acute)
    - in providing a resource-rich learning environment, where learners become accustomed to the spatial and material modalities of doing science – and in short become exposed to explicitly experiential forms of science learning
    - in providing teachers (primary teachers especially) with enhanced subject knowledge and alternative pedagogical repertoires
    - in mobilising an inclusive educational ecosystem for science learning that goes beyond the parameters of the school

  However, perhaps the biggest challenge for the EOP programme is its level of staff resourcing and the fact that demand from schools significantly outstrips what the EOP team can reasonably deliver. The EOP team therefore requires an investment in personnel that will allow the Crick to not only continue to support the Camden 'schools' community and wider Camden community, but also potentially expand on this provision (including digital provision). Dedicated support for parental engagement is we would argue key and much more could be done to bring parents closer to the Crick and not just as organized through the school as gatekeeper. So too, is there strong evidence that schoolteachers would benefit with closer and more prolonged interactions with the EOP team for purposes of their own professional development and in the amelioration of curriculum. In the latter context, especially, there is significant value to be gained from a closer and more collaborative relationship between the EOP and schools in terms of curriculum development and for the purpose of improved alignment and articulation.
- The survey results suggested that more could be done to bring teachers from different schools together. Therefore, we recommend the Crick looks at how it could encourage teachers across the Camden school community to work together to share best practice in science learning and teaching.

Recommendations

- Teachers reported that they would benefit from more training related to teaching science and teaching science careers. We recommend a review of the CPD programme to ensure that teachers have access to high quality training in this area.
- Only 34.9% of teachers agreed that the pupils they teach engage in science activities outside of school. Therefore, we believe that more work could be done to encourage students to engage with the Crick outside of school.
- Teachers reported that they would like students to have access to more work experience placements in the Crick. We recommend that the Crick reviews how it can provide work experience placements to students, along with employability schemes and career outreach work.
- Finally, cognisant of the Crick's interaction with special schools, we strongly recommend that research be committed specifically to understand more fully the value proposition of the EOP to children with special needs and as distinct from a typical rationalisation of engagement as a catalyst of science capital.

7. Conclusion

It has been a privilege to have undertaken the evaluation of the EOP and to have had the opportunity to consult with the Camden schools' community, of which the Francis Crick Institute is so indelibly a member. While the COVID-19 pandemic massively challenged and changed our approach and capacity to undertake this study, we are confident that our findings offer a robust and honest appraisal. We are also in a way grateful to have had an opportunity to consider the EOP in the context of such unprecedented circumstances, in so much as the pandemic has further revealed to us the professionalism and (infectious) personality of the EOP team, the adaptiveness and resilience of the EOP model, and a platform from which to anticipate the future of the Crick's engagement of the Camden schools' community. There are clues within as how to scale up engagement and lessons pertaining to its digitalisation and hybridisation.

The EOP is uniquely valuable in so many ways and offers a blueprint of what works in schools' engagement, and public engagement more widely, that is as relevant to a time before the COVID-19 pandemic as it is now.

It confirms much of what is already known in terms for instance of:

- the value of (diverse) role models in enabling learners' future imaginaries and disrupting science (social) stereotypes
- of experiential and object-based learning as a powerful means of relativising abstract and complex knowledge, making connections to learners' personal worlds and building self-efficacy and sense of positive entitlement
- of schools engagement as a form of curriculum enrichment providing learners new ways to experience science and teachers and school leaders new ways to think about teaching and inspiring science

Yet the EOP, in our estimation goes further, in providing insight into authentic processes of levelling-up for learners that are not just linked to the greater acquisition of so-called 'science capital' (by those already endowed) but of learners, the most disadvantaged, marginalised and excluded, benefitting from an experience of science with wider social and personal benefits. The contribution of the EOP to those with emotional and behavioural difficulties and acute learning needs, for instance transcends reductionist impact claims of science engagement tied for instance to the consolidation of learner aptitudes. In this sense, the EOP has at root a profound social mission tied to the welfare of the Camden community, with schools at its heart. As such, the EOP reveals another dimension to the added-value of engagement.

Conclusion

Concurrently, the EOP also provides a rubric for thinking about engagement of schools that exceeds individual activities and whose impact seeps well beyond the satisfaction gained by learners or teachers from experiencing science in novel ways. It also reveals the Crick as an internationally recognised and celebrated science organization which is in every way a local, indeed anchor institution; a balance of focus and priority many universities (as similar organisations) fail to affect.

We might only anticipate further disequilibrium in terms of supply and demand for the EOP. Demand will surely grow further in Camden and needless to say exists in abundance across other London boroughs and across the UK and internationally. There are possibilities in terms of supplying this demand but ultimately, only so much that might be realistically achieved. In such terms, we would anticipate the further expansion of the EOP yet within Camden and as relates perhaps not only to its schools but wider social mission.

The EOP needs recognising as a treasured resource of the Crick and of Camden and as an international exemplar of school's engagement.

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