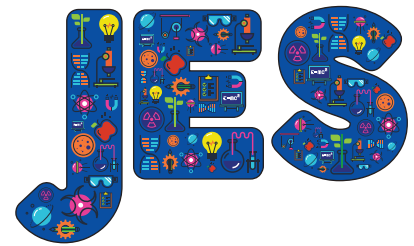# The SSERC Primary Cluster Programme in Science and Technology – Impact on teaching and learning

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Abstract

This paper considers the findings of a recent multi-method research project that assessed the impact of a national Career Long Professional Learning (CLPL) programme, which suggest that teacher CLPL, particular in science and technology education, is particularly effective when it adopts a collaborative mentoring approach deployed across school clusters. This model is underpinned by collaborative professional dialogue, action research and a focus on promoting teachers' confidence and expertise in science and technology using practical skills as a vehicle. We examine the model adopted by the programme, drawing on research evidence in the literature on effective professional learning for teachers and, in particular, apply Desimone's (2009) conceptual framework. The paper identifies key components of the programme responsible for its effectiveness and concludes by reflecting on the implications of the findings for tackling the challenge of promoting science literacy and attainment.

Surveys of >12000 pupils have shown, inter alia, that the programme encourages the preservation of positive pupil attitudes towards science.

Keywords: Professional learning, primary science and technology, teacher mentors, collaborative enquiry

Background

Publication of the TIMSS report (Martin *et al*, 2008) was something of a wake-up call to the education community in that Scotland's relative position was perceived to be weaker than had previously been the case. A series of recommendations followed on from the TIMSS report (Donaldson, 2010). In relation to the work discussed here, three of Donaldson's recommendations are particularly noteworthy:

❒ *Recommendation 33 – The balance of CPD[1] activities should continue to shift from set-piece events to more local, team-based approaches that centre around self-evaluation and professional collaboration and achieve an appropriate blend of tailored individual development and school improvement.*

❒ *Recommendation 34 – Teachers and schools should plan and evaluate CPD more directly on its intended impact on young people's progress and achievements.*

❒ *Recommendation 42 – Teachers should have access to high quality CPD for their subject and other specialist responsibilities.*

The need for high quality, effective professional development to support teachers of primary science and technology was further highlighted in a report (SEEAG, 2012), which concluded that the majority of primary teachers in Scotland lacked confidence in teaching about science.

In 2012, the Scottish Government invited SSERC to plan a professional development programme that would address some of the concerns about the quality of science provision in the primary sector. The SSERC Primary Cluster Programme in Science and Technology (PCP) was developed to pilot a systematised approach to CLPL that would offer *all* primary teachers opportunities, within an existing learning community, to raise their levels of confidence and expertise in science and technology, thus providing a better experience for, and engagement from, their pupils.

PCP aims to address the challenge of how to make available a programme of effective CLPL that offers opportunities to *all* primary teachers within specified communities to improve their levels of confidence and expertise. Within Local Authorities in Scotland, schools are usually associated in groups and, most frequently, these consist of

several primary schools and their associated secondary schools. Whilst the names of the local groups vary (e.g. Associated School Group, Learning Community, Cluster etc.), the groups of schools that have taken part in PCP are referred to as clusters. The first tranche of clusters joined the programme in September 2012.

Aims of PCP

Through PCP, SSERC seeks to:

❒ provide opportunities for every primary teacher within the selected school clusters to raise their levels of confidence and expertise in science and technology, thereby increasing pupil engagement in, attitude towards, understanding and knowledge of science and higher-order problem-solving skills;

❒ develop further the range of pedagogic and assessment skills of all primary teachers within the clusters in science and technology contexts;

❒ develop further the individual professional practice of participants;

❒ establish collegiality between schools within a cluster and, where appropriate, between clusters; and

❒ lead to greater engagement of learners and increased aspirations to pursue a career in science, technology or engineering.

Programme outline

Several months before participation in the programme, initial contact is made at a high level with a Local Authority (LA) and, at that point, the LA is invited to make a commitment in relation to its participation over a two-year period. There follows significant liaison between SSERC senior management and the Quality Improvement Officer (QIO), or equivalent, in the LA to discuss requirements for participation; such discussions include the need for any participating cluster to have science and technology on its cluster improvement plan. Since 2015/16, SSERC has additionally requested that a LA nominates a cluster whose schools have a significant proportion of pupils from areas of deprivation, as measured by the Scottish Index of Multiple Deprivation. Once nominated, SSERC personnel meet with the Cluster

Management Group (CMG) and QIO to agree the level of their support required. The CMG nominates mentors who must have a keen interest in science and technology, although they do not need to have a background therein. Each cluster selects several teachers who will assume the role of 'mentor'.

The role of a mentor, which is explored further in the next article, includes working with other mentors to assess the science and technology CLPL needs of teachers in their cluster and to design and implement a programme of experiential CLPL[2], tailored to address these identified needs.

Figure 1 portrays the sequence of activities that occur within PCP.

The PCP provides opportunities for CLPL at two levels:

❒ Mentors initially participate in immersive, experiential, residential CLPL (3 days' duration) to help raise their levels of confidence and expertise. During this phase, mentors are provided with resources (electronic and physical) and will continue to be able to access further advice and guidance from SSERC personnel; and

❒ Non-residential, experiential CLPL for all teachers in the cluster via programmes designed and organised by cluster mentors.

Mentors carry out a needs analysis of the CLPL required by teachers across the cluster, then design and start to implement a tailored programme of CLPL. Later in the implementation phase, mentors participate in a second, immersive, residential event (generally nine months after the first).

At this second residential mentor cluster, groups, *inter alia,* highlight the progress and impact of their work with teachers and pupils. During the following academic year, clusters are eligible to receive support through the Sustain and Extend Programme available through a financial contribution from the Primary Science Teaching Trust (PSTT).

Grants from the Edina Trust allow all schools that participate in PCP an opportunity to acquire classroom resources that complement the CLPL.

Thus, PCP provides:

- CLPL for mentors and teachers;
- resources for CLPL; and
- classroom resources.

Evaluation

The Robert Owen Centre at the University of Glasgow was commissioned to evaluate the effectiveness of the SSERC PCP. The findings from the final evaluation of the latest phase of the PCP have recently been made available (Lowden *et al*, 2019). The main aims of the evaluation were to:

- gauge the standard of the CLPL and satisfaction rates regarding the CLPL across the participating LAs;

- collect data on mentors' needs, aspirations and plans, and assess the impact from the perspective of mentors, teachers, Headteachers and other relevant key stakeholder groups;
- collect data from pupils to contribute to assessing the impact of the Programme; and
- use the emerging findings to inform and refine the development of the Programme and to feed into the knowledge exchange process with SSERC's LA members and other relevant professional bodies.

In the evaluation (Lowden *et al*, 2019), a range of research methods was used including:

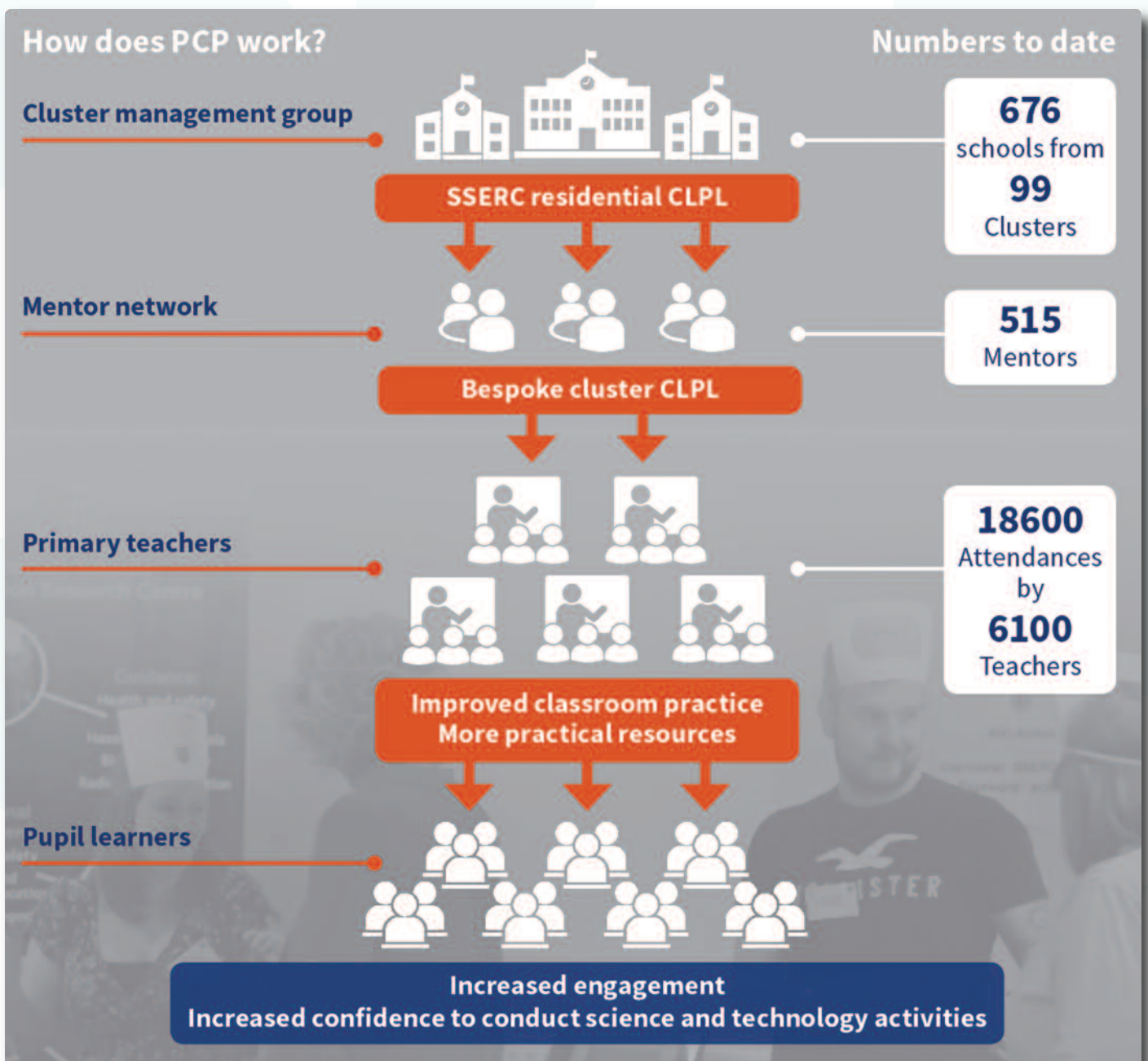- surveys of all teachers involved, teacher mentors, *all* Headteachers/senior management in involved clusters/LAs;

How does PCP work?

Numbers to date

| Cluster management group | SSERC residential CLPL | **676** schools from **99** Clusters |

| Mentor network | Bespoke cluster CLPL | **515** Mentors |

| Primary teachers | Improved classroom practice / More practical resources | **18600** Attendances by **6100** Teachers |

| Pupil learners | Increased engagement / Increased confidence to conduct science and technology activities | |

Figure 1. Overview of PCP with data on participation and level of involvement – April 2012-March 2019.

- focus groups with mentors;
- mentors' reflective diaries; and
- observation of SSERC and SSERC-approved CLPL events.

Results from the evaluation indicated that, by the end of the first phase (April 2012-March 2018), PCP had been successful in achieving the programme's aims. In addition, it was recognised that the Programme also empowered mentors to:

- adopt a collaborative action research model to inform practice and provide CLPL sessions;
- provide support and guidance between staff in school and across cluster schools; and
- facilitate a network that has shared ideas and expertise, and influence the direction of appropriate CLPL.

There was consensus across mentors, senior management and other teachers in the schools regarding the CLPL Programme's high level of impact. Almost all respondents in these groups agreed that the Programme had provided consistently high quality relevant CLPL that had had a positive impact across the range of evaluation criteria detailed above. Moreover, it was clear from the evaluation findings that the PCP was addressing key recommendations from Donaldson (Donaldson, 2010) by encouraging more locally based professional CPD, where teachers and schools planned CPD collaboratively to better meet the subject development needs of teachers and consequently enhance the progress and achievement of pupils.

The Scottish Government, as principal funders of PCP, were keen to gather evidence on whether there was impact on learners in the clusters, particularly regarding learners' self-efficacy, engagement and views on science. To meet this requirement, a strand of the evaluation focused on gathering pupil data and, from the autumn of 2015, both pre- and post-CLPL programme pupil surveys were conducted (P2–P7, ages 5-11). Baseline and follow-up surveys of pupils took place in the same year as teachers from their school were involved in the PCP CLPL. In the final three years of Phase 1, the evaluation collected baseline and follow-up questionnaires from almost 12,000 pupils.

Impact

There is substantial research literature and professional advice on what constitutes effective professional learning and development for teachers, and possible models for implementation to enhance effectiveness (see, for example, Joyce & Showers, 2002). Our approach, with teacher mentors supporting their cluster schools at its core, is grounded in research evidence and the wider literature (Duncombe & Armour, 2004; Smith & Nadelson, 2016). Hargreaves' (2005) research identified the value of mentoring and coaching in providing a 'critical friend' to support teachers' professional development.

We recognise that the PCP has, within its structure and *modus operandi*, a range of elements that are described in the literature as best practice. The delivery and ethos of PCP parallels the observations of Desimone (2009) in which she argues that '*there is an empirical research base to*
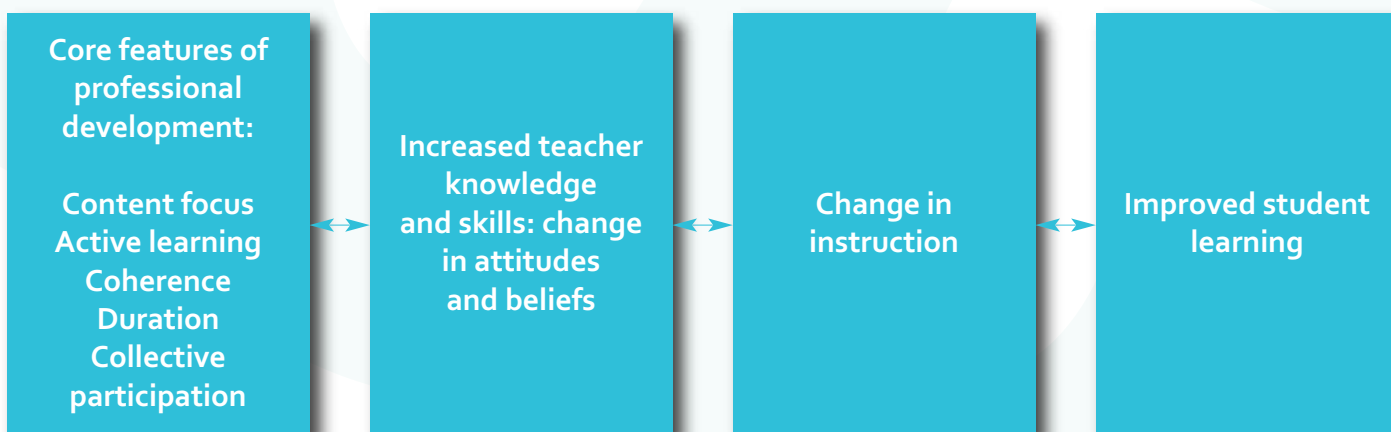
Figure 2. Proposed core conceptual framework for studying the effect of professional development on teachers and students (taken from Desimone, 2009).

support the identification of a core set of features of effective professional development' (Figure 2).

Our view is that the PCP displays most, if not all, of the elements for effective CLPL as described by Desimone (2008). It is appropriate, therefore, for us to consider 'improved students' learning'.

Reviewing the findings from the pupil survey, we conclude that the majority of pupils in the study are enthusiastic about school and about the subjects they study. After PE and ICT, science was ranked third most popular subject for all pupils. There was some evidence to suggest that, over a year, the enthusiasm of both P2 (ages 5/6) -P4 (ages 7/8), and P5 (ages 8/9) - P7 (ages 10/11) pupils towards school and all their subjects began to decrease. Pupil responses from the P5 - P7 group showed relatively positive attitudes towards science, with substantial numbers indicating their enthusiasm for science education in school and an interest in pursuing science beyond school. A majority of pupils in both the P2 - P4 and P5 - P7 cohorts enjoyed taking part in a range of science-related activities. *Doing experiments in class* and *Going to the science museum or science centre* were particularly popular across both groups. These findings indicate that learning science experientially may be fundamental in engaging young people with science and helping to maintain their enthusiasm for the subject. More than 70% of pupils were open to the idea of further involvement in science after completing school. Moreover, the data indicated that, in schools with higher PCP Headteacher impact ratings, the pupils were significantly less likely than their peers in schools with a lower Headteacher impact rating to see their attitudes and beliefs about science follow the general 'negative shift' over the evaluation period. This suggests that the SSERC CLPL may, in addition to supporting pupil enjoyment of science activities and confidence in conducting science tasks, also encourage the preservation of positive pupil attitudes towards science.

The future

This paper summarises PCP at the end of March 2018, when the programme had reached all 32 Local Authorities across Scotland. From April 2018, SSERC has been working with new clusters from across 13 LAs on Phase 2 of PCP. With ongoing support from PSTT, we have been able to put in

place a 2-year programme, which will allow for greater opportunity for further experiential professional learning.

The Scottish Government recently set out in its 'STEM Strategy' (Scottish Government, 2017) several challenges, including the need to ensure that:

- All learners experience relevant and engaging STEM learning, in both formal and informal learning settings, which equip them with skills and capability to be scientifically, technologically and mathematically literate citizens, fully involved in our society as it becomes increasingly reliant on science and technology, and informed and empowered to take decisions about their lives and society as a whole.

- There is equality of access, opportunity and outcomes in STEM learning and STEM experiences for everyone, regardless of gender, background or circumstance or geography.

- There is increased practitioner confidence in STEM learning in the early years, primary years and in community, learning and development settings and increased practitioner engagement in STEM professional learning opportunities.

- Through the development and delivery of a new and significantly enhanced professional learning package in relation to STEM, all early learning practitioners, primary and secondary teachers, technicians and community learning and development practitioners will have the opportunity to build their capacity to deliver effective STEM learning.

It is our belief that PCP and its associated workstreams are making a significant contribution to the Government's aspirations. However, meeting these aspirations as laid out in the Government's recent STEM Strategy will require additional significant investment. There are some 2000+ primary schools across Scotland and, in the period to the end of March 2019, the PCP has worked with 676 of them. The strengthened partnership between SSERC and PSTT will continue to deliver high quality CLPL opportunities, but the finite resource pool that is currently available will inevitably mean that the benefits of the PCP will not be felt by *all* primary schools in Scotland for several years to come.

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[1]The term Continuing Professional Development (CPD) has, in large part, been replaced by Career-Long Professional Learning (CLPL) and we will, unless quoting the work of others, use CLPL throughout.

[2]In this manuscript we use the term experiential to describe activities in which participants gain first-hand experience of, and confidence in, hands on, practical science and technology; participants also reflect on how such activities might be used in classroom settings.