The evaluation of the Stimulating Physics Network (SPN) Programme

Final report for
the Institute of Physics

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Executive summary

Background to the programme

The Stimulating Physics Network (SPN) programmes comprises of three related project strands: 1. Increasing Participation, 2. Improving Gender Balance and 3. Developing Teachers. The Increasing Participation project is working in partnership with a rolling cohort of 400 selected schools over two years to achieve an increase in participation in A level physics. The Improving Gender Balance project is trialling a series of intensive interventions in 24 schools aiming to improve significantly the number of girls progressing the A level physics. The Developing Teachers project is providing support, resources and professional development for physics teachers across England, including mentoring for early career teachers. This report covers the evaluation of the Increasing Participation and Developing Teachers programmes, which together offer a range of interventions to increase physics teaching capacity; create learning environments that recognise and seek to break down barriers to studying physics; and increase demand for A level and further-level study of physics from under-represented groups.

Elements of the programme have been introduced incrementally since 2009 (a three-year pilot ran from 2006 – 2009). Since 2009 schools with 'historically low progression to A level physics' have been invited to join the programme as 'partner schools' with a two-year package of support from a teaching and learning coach (TLC) and opportunities to attend a four-day summer school ('increasing participation'). Schools join at different points over the academic year. In the 2011/12 academic year one-to-one mentoring for early careers teachers (ECTs) was introduced and since April 2014 continuing professional development (CPD) workshops have been available for teachers from non-partner schools ('developing teachers'). When considering the impact of the programme, therefore, the evaluation considers the time dimension as well as differential inputs

Focus for this report

This final report focuses on findings on the extent to which there has been a change in: whole-school behaviour and attitude towards physics teaching and learning; pedagogy in the physics classroom, pupils' engagement, and progression to AS and A level physics in partner schools. The report also reports on early-career teachers' (ECT) experience of the SPN mentoring programme and the CPD experience of non-partner school teachers attending SPN events.

It presents evidence against three programme key performance indicators (KPIs): teachers report increased **pupil engagement** in physics lessons (KPI 6); heads of science/physics in SPN partner

schools report **positive impact** on departmental practice and culture (KPI 7), and engaged ECTs report **positive impact** on teaching practice (KPI 8).

Data collection

The following data has been collected and analysed for this report:

- **Online survey**: Two school online surveys – all partner schools from April 2012 (a baseline survey autumn 2014; follow-up survey autumn 2015). The final report largely focuses on responses from the second online survey but compares these to responses from the first survey where this is helpful. 105 schools responded to the autumn 2015 survey (137 individual responses).
- **Case-study schools** – an in-depth study of 10 partner schools (sample taken from full list of schools), including teacher and head of science department interviews (baseline visits in winter 2014 and follow-up telephone interviews with the head of science in winter 2015/16)
- **Telephone interviews**: Telephone interviews with 88 ECT mentees (2012/15 cohort) and 31 non-partner school CPD event participants.

Key performance indicators

This report provides evidence against three of the KPIs for the programme:

KPI	Annual target	March 2015	March 2016	Data evidence (for March 2016) – online survey wave 2
Teachers report increased pupil engagement in physics lessons (KPI 6)	75 %	80 %	89%	121 (89%) of survey respondents said they currently teach physics, of these 98 said they were implementing changes to their teaching practice as a result of taking part in the SPN programme *and* gave an answer to the 'pupil engagement' question. Of this 98, 87 respondents (89%) reported a positive impact on student engagement in physics lessons.
Heads of science/physics in SPN partner schools report positive impact on departmental	75 %	75 %	96%	Of the 56 heads of science/physics who answered the question, 25 (45%) said they had noticed a change in the whole school/department approach to physics education. Note that just one respondent said they had not noticed any change, the remaining 30 respondents said it was 'too early to say'. While this may appear to represent a drop in the number of department heads reporting whole school/department changes, the question

KPI	Annual target	March 2015	March 2016	Data evidence (for March 2016) – online survey wave 2
practice and culture (KPI7)				was asked in a different way this year with the addition of an initial 'have you noticed any changes?' question, rather than simply asking what changes have been noticed. If we calculate this as a percentage of those who gave a definite yes/no answer and disregard those who said it was too early to say, 96% (25 out of 26) can be said to have reported one or more changes. All of those who reported a whole school/department change indicated that SPN activities or support had made a definite contribution to the change(s).
Positive impact on teaching practice of engaged ECTs (KPI8)	80%	n/a	62%/90%*	Of those recorded as engaged, 48 (62%) mentees considered that the support from the mentor had had a positive impact on their teaching. *Of those mentees who reported a medium or high level of engagement with the programme, 38 out of 42 (90%)* considered that the support they had received had had a positive impact on their teaching.*

Key messages

Increasing participation

Whole-school behaviour and attitude towards physics teaching and learning

- The most frequently whole-school or department change cited by heads of science in the online survey was a general increase in colleague motivation and knowledge. Other frequently mentioned changes included greater use of practical work, improved confidence in teaching physics and improvements to the teaching of specific topics.
- There had been an enhancement in the status of physics reported in seven of the ten case-study partner schools, where SLT behaviour and attitude towards physics teaching and learning had improved. Of the seven schools, two had a challenging starting point, the profile of physics was already high in three and the remaining two were somewhere in between before becoming SPN partner schools. The positive change was mainly due to highly-valued TLC input and consequent improvement in pupil engagement.
- The circumstances preventing a positive change in the status of physics at two of three other case-study schools was that the department's involvement in the SPN programme had

stayed under the radar of the senior leadership team. The third school was focussed on exam grades rather than enhancing students understanding and had cut time and funding of A level physics teaching.

Pedagogy in the physics classroom

- The most frequently cited change to teaching practice that survey respondents said they had either already made or were planning to make was changes to the teaching of specific topics (e.g. energy, electricity and forces). Greater use of practical work in lessons, revisions to schemes of work and/or lesson plans, greater or improved use of demonstrations, and changes to the language/terminology used when teaching physics were also frequently mentioned changes to teaching practice that had been made or were being planned.
- When asked which SPN activities or forms of support were the greatest contributor to any changes made or planned, as was also the case in the 2014 survey, CPD workshops by the TLC at the school was the most frequently cited influence reported by survey respondents, followed by personal support from the TLC. Where survey respondents mentioned any additional support they would like this usually related to help with teaching specific topics.
- The heads of science in the case-study schools all reported a positive change in non-specialist teachers of physics' subject knowledge, subject- specific pedagogic skills, confidence and/or enthusiasm as a consequence of the TLCs having run CPD sessions and in some cases offering one-to-one support to the staff.
- Staff at all the case-study schools had made changes to their teaching practice due to SPN / TLC input. The main types of changes included: teaching in more a student led, activity / investigation based and hands on ways, including more practical demonstrations and experiments and relating physics ideas and concepts to the students' lived experience. These new ways of teaching were reported to have enhanced student engagement in and understanding of physics in a large majority of the case-study schools.

Pupils' engagement and attainment

- Survey respondents were asked to identify up to five criteria they might use to determine whether students are engaged in their physics learning and against each, to indicate the extent to which they believe their involvement with SPN has impacted on levels of engagement. Attainment or progress being on track was mentioned the most often as an engagement criterion followed by take-up of GCSE and/or A level physics and then pupils being obviously engaged with the work. This represents a slight shift since 2014 when respondents were more likely to mention take-up than attainment. Respondents' views on

the extent to which SPN activities or support had affected these engagement criteria were generally rather more positive this year than in the 2014 survey: most expressed the view that involvement in SPN had contributed to improvements in these engagement criteria to some extent. Although in 2014 attainment attracted a slightly higher number of 'no impact' responses than the other criteria, this was not the case in the current survey: the majority of those who listed attainment as an engagement criterion this time indicated that the impact of SPN had been relatively high.

- Whilst GCSE physics attainment had gone up in some of the case-study schools, heads of science were unable to establish a direct link between SPN input and student attainment, as there are a lot of variables influencing changes in attainment.

Progression to AS and A level physics

- Survey respondents were asked to describe any impact they had seen on student participation in GCSE or AS or A level physics as a result of their school's involvement n SPN. Many of those who answered the question said it was too early to say whether there had been any effect but several respondents said that interest in physics had increased (some specified that this was among girls) and one respondent said that attainment in physics had generally improved. Note that some respondents pointed out in their comments that is was difficult to assess how far SPN involvement had contributed to these changes and a couple of respondents mentioned that the new physics curriculum had meant it was difficult to confidently attribute changes to the SPN or other factors.

Developing teachers

Early-career teachers' experience of the mentoring programme

- The nature of the mentoring offer varied depending on the approach of the mentor and, to some extent, the needs of the ECT mentee: in the majority of cases the main focus of the mentoring relationship was on subject-specific pedagogy and most often contact with the mentor was as part of a group, either a face-to-face workshop or email group.
- Many mentees expressed satisfaction with the type and level of support they received whether it was group or one-to-one support. Generally there was a high level of enthusiasm for the mentoring programme if mentees were able to attend workshops and/ or were regularly sent ideas and resources to support teaching by their mentor.
- The approach of mentors varied - some were very proactive and others more reactive, waiting for the mentee to ask for specific help. Mentees were more likely to have engaged

with the programme and expressed satisfaction with the support received where the mentor had a proactive approach and was perceived as willing to follow-up any individual requests for help.

- Mentees' 'need' for support usually depended on the extent to which their school or PGCE provider offered a supportive environment (generally) and/ or there were other more experienced physics teachers to talk to in close proximity.
- Mentees, although largely very pleased to have some additional support from the IoP, sometimes felt that it was not clear what the 'mentoring' role offered that was different to the wider offer of subject-specific CPD such as the workshops and newsletters offered by IoP or by other organisations such as the unions or NQT mentors – this was most often the case where there was no, or very little, one-to-one contact with the IoP mentor. Where mentees were still in the early stages of their PGCE year they were less likely to ask for help, sometimes because they were just too busy or because were unclear what they could ask their mentor about.
- Largely where mentees 'engaged' with the programme they reported a positive impact on their teaching practice as a direct result of being involved in the SPN programme. However a few mentees currently in their PGCE year reported not engaging because they had not had any, or had very little, contact from their mentor.
- For some ECT mentees their mentor was a lifeline, supporting them through some difficult times during their NQT years.

Non-partner school teachers' experience of the SPN programme

- All the SPN link school and regional CPD event participants interviewed had gained or learned something valuable at the CPD event they had participated in.
- A very large majority of teachers had changed their physics teaching practice in one or more ways as a result of taking part in the SPN programme CPD events for non-partner schools.
- The changes to teaching practice had had a positive impact on pupils in terms of their level of engagement, understanding, identification with and/or attainment in physics having increased.

1 Introduction

1.1 Background

The Stimulating Physics Network (SPN) programmes comprises of three related project strands:

1. Increasing Participation
2. Improving Gender Balance
3. Developing Teachers

The Increasing Participation project is working in partnership with a rolling cohort of 400 selected schools over two years to achieve an increase in participation in A level physics. The Improving Gender Balance project is trialling a series of intensive interventions in 24 schools aiming to improve significantly the number of girls progressing the A level physics. The Developing Teachers project is providing support, resources and professional development for physics teachers across England, including mentoring for early career teachers. This report covers the evaluation of the Increasing Participation and Developing Teachers projects, which together offer a range of interventions to increase physics teaching capacity; create learning environments that recognise and seek to break down barriers to studying physics; and increase demand for A level and further-level study of physics from under-represented groups.

Elements of the programme have been introduced incrementally since 2009 (a three-year pilot ran from 2006 – 2009). Since 2009 schools with 'historically low progression to A level physics' have been invited to join the programme as 'partner schools' with a two-year package of support from a teaching and learning coach (TLC) and opportunities to attend a four-day summer school ('increasing participation'). Schools join at different points over the academic year. In 2011/12 one-to-one mentoring for early careers teachers (ECTs) was introduced and since April 2014 continuing professional development (CPD) workshops have been available for teachers from non-partner schools ('developing teachers'). When considering the impact of the programme, therefore, the evaluation considers the time dimension as well as differential inputs.

1.2 Evaluation approach and focus

A theory of change approach was used in the development of the research design. The approach included working with the programme team to:

- identify key aspects of programme implementation
- make explicit assumptions about the purpose and nature of the programme and how the use of the different interventions are expected to impact

- gain a shared understanding about what change is being brought about and the expected impact
- consider results within a wider context of policy development and strategy.

Following discussion with the programme team a theory of change logic model was developed for C1 and C3. The logic models outline:

- what the programmes hope to achieve within the defined timelines in terms of outputs, outcomes, impact
- the social and behavioural assumptions that underlie the development of the programme: processes; vision and strategy; implementation and delivery; and outcomes
- how constituent parts of the outputs and outcomes can be mapped to the expected impact and define causal links
- identifying differential inputs and impacts
- the context for the programme e.g. wider policy implications.

The models (see Figures 1 and 2) map the linked processes underpinning the work and how positive

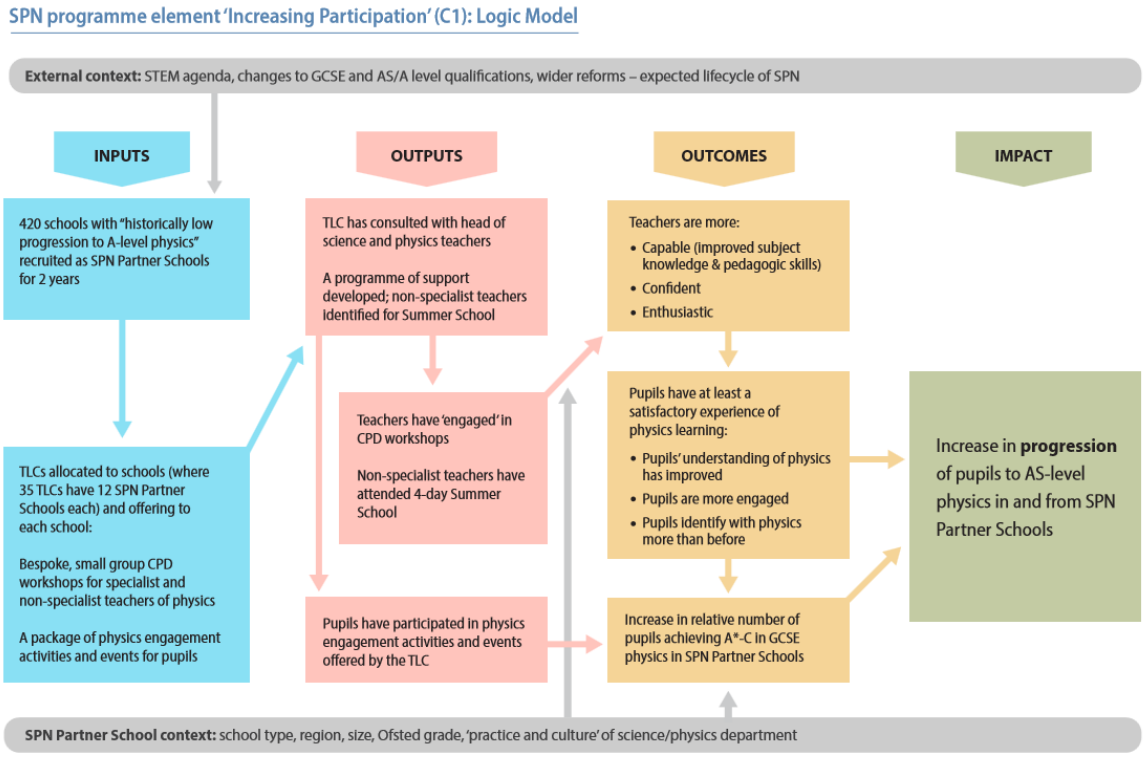
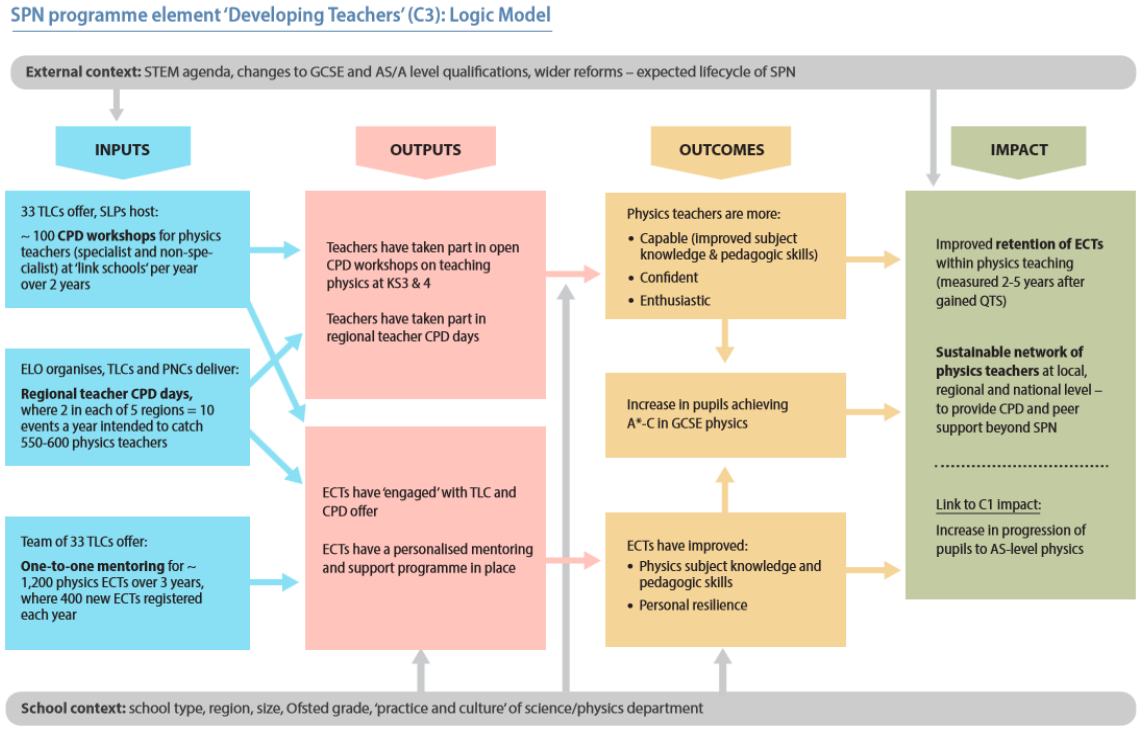


Figure 1: 'Increasing Participation' logic model (C1)

outcomes, leading to the desired impact, are expected to be achieved. This allows the identification of expected impact (*impact* study) and defines the inputs (coaching, workshops, summer schools and other CPD activity) – *process* evaluation.



The overall focus of the evaluation is on the outcomes and impact of the programme as identified in the logic models. The evaluation is also seeking to understand what has influenced any change process observed. In addition, the identification of outcomes and impact allows change to be considered over time.

Based on the logic models, the following key evaluation questions were agreed:

1. **Change to teaching practice at KS3/4**

How have teachers of physics changed their teaching practice as a result of taking part in the SPN programme? *(All aspects of the programme – partner schools plus individual teachers* (C3) in *non-partner schools)*

2. **Change in pupil attainment in physics at KS4**

What difference, if any, has there been in pupil attainment in physics at KS4 in partner schools? *(Partner schools only)*

3. **Change to patterns of progression to KS5 physics**

What impact has the SPN had on pupil progression to physics at KS5 in partner schools*? (Partner schools only)*

4. **Change in whole-school behaviour and attitude towards physics teaching and learning**

What difference, if any, has there been to whole-school behaviour and attitude towards physics teaching and learning in partner schools? *(Partner schools only)*

5. **Change in the retention rate of early career teachers (ECTs) of physics**

To what extent has one-to-one mentoring been influential on the retention of ECTs within physics teaching? *(ECTs only)*

Data for addressing these questions was collected using a range of methods:

Evaluation questions 1 – 4

- School online surveys – all partner schools from April 2012 (a baseline survey autumn 2014; follow-up survey autumn 2015). Quantitative and qualitative responses.
- Case-study schools – an in-depth study of 10 partner schools (sample taken from full list of schools). To include teacher and head of science department interviews (baseline visits in winter 2014 and follow-up telephone interviews with the head of science in winter 2015).
- Analysis of naturally occurring data such as CPD session evaluation forms from SPN events – with follow-up telephone interviews with an agreed sample of participants.

Evaluation question 5

- Telephone interviews with an agreed sample of participants.

The evaluation questions clearly focus the evaluation on the extent to which the programme has brought about change and what change looks like – potentially both expected and unexpected outcomes and impact. The questions also cover key performance indicators (KPIs) 6, 7, 8 and 9 for the programme agreed between IoP and the Department for Education. (See Table 1 below for details of the KPIs.) However KPI 9 has not been covered within this external evaluation as suitable data for this measure has not been available within the timeframe.

Table 1: SPN Programme (C1 and C3) KPIs covered by the main evaluation

	KPI	Annual target	Date
6	Teachers report increased ***pupil engagement*** in physics lessons.	75%	March 2015, March 2016
7	Heads of Science/Physics in SPN Partner Schools	75%	March 2015,

	report ***positive impact*** on departmental practice and culture.		March 2016
8	Positive impact on teaching practice of engaged ECTs.	80%	March 2015, March 2016
9	Improved retention of ECTs within teaching.	Retention after 3 years' support is 10% above control group.	March 2015, March 2016

Evidence for KPIs 6 and 7 was collected via the online survey (partner schools). Given that schools join the programme at different points in the academic year and the programme has been running since 2009, consideration has been made as to whether the KPIs relate only to specific cohorts (for example 2014/16) or can include cohorts from previous phases of external funding. We report on both in the evaluation, so that the impact over time can be seen, for example residual impact following a two-year programme of support.

For KPI 6, percentages were calculated as a proportion of those teachers/ heads of department reporting on pupil 'engagement' in partner schools participating in the online survey.

For KPI 7, percentages were calculated as a proportion of those heads of department from partner schools reporting on changes in departmental practice and/ or culture in the online survey.

For KPI 8, percentages were calculated based on ECT mentees interviewed who reported a medium or high level of engagement with the mentor programme.

KPI 9 remains problematic given (i) the timeframe - i.e. the focus of the evaluation in respect of the ECTs has largely been on the 2014/15 and 2015/16 cohort as requested, and (ii) the lack of availability of national datasets that allow for the identification and tracking of a particular cohort over time.

This final evaluation report focuses on findings on:

- whole-school behaviour and attitude towards physics teaching and learning
- pedagogy in the physics classroom
- pupils' engagement
- progression to AS and A level physics
- early-career teachers' experience of the mentoring programme

- non-partner school teachers' experience of the SPN programme

2 Data collection methods

The findings presented in this report are based on two annual online surveys for partner schools, case-study research with a sample of 10 partner schools, and telephone interviews with 88 ECTs in the mentoring programme and 31 non-partner school teachers who attended various SPN CPD events.

2.1 Online survey

2.1.1 School characteristics

The second of two annual online surveys of partner schools was undertaken in autumn 2015. The final report largely focuses on responses from the second online survey but compares these to responses from the first survey where this is helpful.

In autumn 2015 an email was sent to all SPN contacts in participating schools inviting them to complete the online survey and requesting that the link to the survey be shared with other science teachers to allow them the opportunity to complete an evaluation. Of the 363 schools invited to complete the survey, 105 submitted at least one response, giving a response rate of 29%. In total there were 137 individual responses to the survey. The maximum received from any one school was seven responses. (For a full report on the autumn 2015 survey see Annex A.)

Tables 1 - 4 show the characteristics of 105 schools from which responses were received. The majority were co-educational schools covering the 11 to 18 or 11 to 16 age range. All but two of the schools from which responses were received were non-selective (not shown in a figure). Most of the schools offered GCSE triple science (Table 4). Among the 48 schools that did not offer post-16 provision in physics, eight were schools for the 11 to 18 age range. Just nine schools did not offer triple science.

Table 3: Number of responding schools: by type

Type of school	n	%
Co-educational	96	91
Single sex - boys	1	1
Single sex - girls	8	8
Total	**105**	**100**

Table 4: Number of responding schools: by school age range

Age range	n	%
11-16	38	36
11-18	57	54
Other	10	10
Total	**105**	**100**

Of those who stated 'other' in response to the question asking which age range the school covers gave the following responses:

- FE / 16-18 or 9 (x4)

- 10-14 (x1)
- 11-14 (x1)
- 14-19 (x1)
- 11-13 (x1)
- 4-18 (x1)
- 13-18 (x1)

Table 5: Number of responding schools: by whether they offer post-16 physics

	n	%
Offers post-16 provision in physics	57	54
Does not offer post-16 provision in physics	48	46
Total	**105**	**100**

Table 6: Number of responding schools: by whether they offer GCSE triple science

	n	%
Offers GCSE triple science	96	91
Does not offer GCSE triple science	9	9
Total	**105**	**100**

Although not a survey question, it was possible to establish which phase of the SPN programme participating schools were part of using the school name and postcode and cross-checking against a list of participating schools provided by IoP. As might be expected at this stage of the programme, the majority of schools were phase 4 schools: 92 were phase 4 and 13 were phase 3 schools.

2.1.2 Respondent characteristics

Respondents were asked several questions about their role in the school and their teaching experience. Table 5 shows the role(s) respondents have at their schools. They were asked to tick all that applied, so some had two or three of the three roles listed.

Table 7: Number of respondents in each role(s)

Role(s)	n	%
Head of department	65	47
Teacher	56	41
Member of school leadership team	12	9
Head of department & member of school leadership team	2	1
Head of department & teacher & member of school leadership team	1	1
Teacher & member of school leadership team	1	1
Total	**137**	**100**

Half of respondents said they are head of department or equivalent either as their only role or in conjunction with other roles from the list. Just under half said they currently have a teaching role (Table 5). Around one in ten respondents (n=15) said they do not currently teach physics but the remaining respondents said they did. Figure 1 shows the proportion of respondents who said each science subject was their degree subject. Those who stated 'other' specified a range of subjects as

follows (each was cited by one respondent each): biochemistry, geography, sports science, materials science, physical sciences (chemistry, physics), psychology, maths, oceanography, biochemistry with a significant chemistry element.

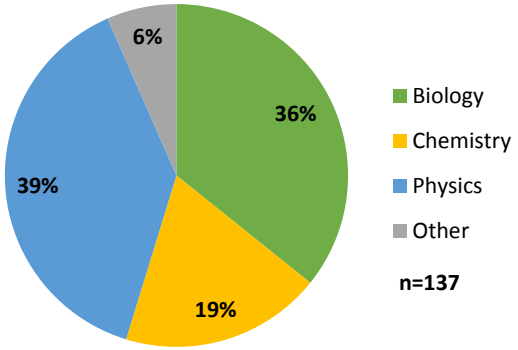


Figure 1: Percentage of respondents with each degree subject

As Table 6 shows, more than half of the respondents said they were not physics specialists.

Table 6: Whether respondents considered themselves to be a physics specialist

Do you consider yourself a physics specialist?	n	%
Yes	64	47
No	73	53
Total	**137**	**100**

Respondents were also asked how long they had been a qualified teacher; how long they had worked at their current school; and (where applicable) how long they had been head of science or head of department. Table 7 summarises the averages and the lowest and highest figures for each role.

Table 7: Length of time respondents have been in their role and at their school

How long have you..?	Lowest value (years)	Highest value (years)	Mean (years)	Median (years)	Number of responses
Been a qualified teacher	0	37	12	10	137
Been a head of science/department	0	18	5	3	68
Worked at this school	0	35	7	5	136

Table 8 shows how many respondents taught science and physics at the different levels, while Table 9 shows the level respondents teach at and whether they teach science or physics according to whether they consider themselves to be physics specialists. Around three-quarters of respondents who were non-specialists said they teach physics at KS3 and/or KS4 and as might be expected only a very small number (two) of non-physics specialists said that they teach physics at KS5.

Table 8: Level at which respondents teach science and/or physics

Level taught at	Science	Physics
KS3	120	83
KS4	103	112
KS5	34	45
Not at all	2	0

Table 9: Level at which respondents teach science and/or physics by specialist and non-specialist physics teachers

	Specialist		Non-specialist	
	n	%	n	%
KS3 science	**55**	**86**	**65**	**89**
KS3 physics	**28**	**44**	**55**	**75**
KS4 science	**38**	**59**	**65**	**89**
KS4 physics	**56**	**88**	**56**	**77**
KS5 science	**5**	**8**	**29**	**40**
KS5 physics	**43**	**67**	**2**	**3**

Note the base for percentages in Table 6 is the number of respondents in each category, i.e. 64 for the specialists and 73 for non-specialists.

Those who said they taught physics at KS4 were asked to indicate which course(s) they taught. Table 10 shows the responses.

Table 10: KS4 course on which respondents teach physics

KS4 course	n	%
Science	**104**	**76**
Additional Science	**103**	**75**
Triple science	**62**	**45**
Physics	**49**	**36**
Further additional Science	**23**	**17**
None of the above	**14**	**10**
Entry level certificate	**6**	**4**
IGCSE physics courses from any board	**2**	**1**
IGCSE double award science from any board	**0**	**0**

Note the base for percentages in Table 10 is the total number of respondents, 137. Percentages total more than 100% because respondents were invited to tick all that apply.

2.2 Case-study research

The purpose of the data collected from case-study partner schools was to build on the data collected from the online survey in order to gain a deeper understanding of how the SPN programme is, or is not, influencing change in teaching and learning and in attitudes towards physics. Ten case-study schools were identified: two from the 2012/14 cohort, two from the 2013/15 cohort and six from the partner schools joining in 2014. This enabled data to be collected from schools at potentially

different stages of change – the emphasis was on the current phase but there was an opportunity to look at change over time.

An initial sample of 10 schools (by SPN cohort) was selected from the list of those that had completed the online survey and they were invited to become case-study schools. A further 10 schools in total were contacted until the right number of partner schools per SPN cohort had committed to being case-study schools. As the heads of science and teachers of physics had completed the online survey prior to a researcher visiting the school, the interviews built on rather than duplicated responses to the online survey. The interview visits were carried out between early February and early March 2015. Table 11 below identifies the anonymised code given to each school, the age range taught, the year the school started on the programme (cohort) and the role of the staff interviewed.

Table 11: Age range, cohort, and interviews undertaken at the case-study schools

School code	School age range	SPN partner school cohort	Interviews undertaken
School 1	11-16	2012/14	HoS and 2 teachers
School 2	11-18	2012/14	HoS and 2 teachers
School 3	11-18	2013/15	HoS and 2 teachers
School 4	11-16	2013/15	HoS and 2 teachers
School 5	11-16	2014/16	HoS and 1 teacher
School 6	11-16	2014/16	HoS and 2 teachers
School 7	11-18	2014/16	HoS
School 8	11-18	2014/16	HoS and 1 trainee teacher
School 9	11-16	2014/16	HoS and 2 teachers
School 10	11-16	2014/16	HoS and 3 teachers

Follow-up telephone interviews with the head of science (or equivalent) were conducted in January and February 2016. The HoS and the trainee teacher interviewed at school 8 in February 2015 had left the school by early 2016 and no one else was available to be interviewed. Thus only 9 of the intended 10 follow-up interviews were undertaken. (A full summary of the case-study school findings are included as Annex B.)

2.2.1 Starting points for the case-study schools

In early 2015, the status of physics across the case-study schools varied, including the extent to which the senior leadership team (SLT) and students (other than those studying triple science) recognised physics as a separate subject – rather than just 'science'. The level of involvement in, and awareness of, the SPN programme by SLTs also differed. In one school (case-study school 7), for example, the SLT was closely involved and had clear ideas about how the programme would support their plans to increase awareness of possible career pathways and to engage more girls in physics.

But in another school (case-study school 2) the SPN programme was reported to be below the radar of the SLT. All case-study schools were enthusiastic about the support from the programme but for the majority (9 out of 10) the CPD was not obviously linked to school improvement plans in any formalised way.

For the most part, the case-study schools were already reporting an improvement in attitudes towards physics at the beginning of 2015. In part this improvement was the result of changes to pedagogy and of the TLC's work to support increased student engagement. Commonly, the improvement also coincided with other school-based initiatives such as improved mathematics teaching and learning, and a greater focus on exam preparation and formative assessment linked to target examination grade outcomes.

Usually a maximum of two classes in any school year group took triple science, with many of the case-study schools only offering triple science to one class of higher-attaining students.

Table 12 identifies the number of physics specialist teachers at each case-study school and any particular challenges identified by the physics departments when they were visited in early 2015.

Table 12: Key characteristics of the 10 case-study schools

School code	No. of physics specialist teachers in early 2015	Particular challenges for physics departments
School 1	2	Prior to taking part in the SPN programme, SLT were unaware of science staff specialisms and that everyone taught physics. Students hold deep-seated views of physics 'as a boys' subject'
School 2	2	SLT focus on exam grades, rather than developing understanding of physics
School 3	0	Lack of physics specialists for A level teaching impacts on take-up
School 4	0	Keen to increase the number of students taking triple science. Students hold deep-seated views of physics 'as a boys' subject'
School 5	1	Approximately 50% of students eligible for FSMs, low levels of literacy and maths skills
School 6	0	Only one class a year take triple science/ recognise 'physics' as separate subject
School 7	1	Engaging students, especially girls, in physics
School 8	1	SLT keen to improve status of physics as traditionally low take-up at AS/ A level. A lot of students perceive physics as the hardest subject in school
School 9	1.5	SLT has always seen physics as important. No particular

		challenges identified by the physics department
School 10	**0**	**Drive to develop physics teaching; SLT supportive of ongoing physics CPD. No particular challenges identified by the physics department**

2.3 Telephone interviews

ECT mentee interviews

During the year 2015 and January 2016, all ECT mentees who had joined the programme since the academic year 2012-13 were contacted twice to ask whether they would be willing to take part in an interview. In the second email, they were offered the opportunity to be interviewed during an evening, during a half term holiday and / or summer holiday. Some interviews were also undertaken during the weekend due to the ECTs being so busy during the working week. Nearly 100 people agreed to interview but not all responded to requests to arrange a date and time for the interview. (The request to agree date and time was only sent twice after which it was assumed that the ECT had changed their mind.) By early March 2016 when it was time to start the analysis of findings, 88 interviews had been conducted. These were fairly evenly split across the four cohorts, with slightly more interviewed from the 2014 – 15 cohort.

Non-partner school teacher interviews

Telephone interviews were undertaken with CPD event participants to a gain an understanding of the impact of the training on teachers in non-partner schools. The External Liaison Officers (ELOs) provided a large number of completed evaluation forms from SPN Link School CPD events that took place in 2015. Unfortunately, the standard form requested neither the CPD participants' email addresses nor their school affiliation (only the event venue). Only 94 evaluation forms with participant email addresses were received. Of the 94 emails sent, 11 came back as undeliverable. Of the 83, only six people responded and were interviewed. It was concluded that this approach to recruiting people for the interviews did not work. This was not only because proportionally few CPD participants email addresses were available but also because the CPD participants appeared to have perceived the evaluator contacting them as 'cold calling'.

A different approach was adopted to recruiting participants to SPN regional teacher days of physics CPD. A number of ELOs agreed to send a message to the participants to the regional events on behalf of the evaluator asking whether they would be willing to take part in a telephone interview. A total of 31 regional event participants contacted the evaluator to say that they were willing and 25 interviews were undertaken.

Of the 114 link school and regional CPD event participants for whom an up to date email address was obtained, 37 initially agreed to be interviewed and 31 interviews were undertaken. Six regional event participants appeared to have changed their mind, as they did not respond to two emails asking when would be a good day and time for the interview. The 31 SPN CPD participant interviews were conducted between June 2015 and February 2016.

3 Evaluation findings

3.1 Increasing participation

3.1.1 Whole-school behaviour and attitude towards physics teaching and learning

In the online survey information was gathered on any general changes across the school or department as a result of the engagement with the SPN programme. This was obtained via a set of questions given only to those survey respondents who said they were the head of science or head of department.

Heads of science/department who responded to the survey were asked whether they had noticed any whole-school or whole-department changes to the practice and approach to physics education. While just over half of respondents said it was too early to say, around two-fifths of those who answered this question said that they had noticed changes. The most frequently cited whole-school or department change was a general increase in colleague motivation and knowledge. Other frequently mentioned changes included greater use of practical work, improved confidence in teaching physics and improvements to the teaching of specific topics.

The interviews with case-study school heads of science/department sought to establish whether there had been any change in the status of physics at *whole-school level*, and in the eyes of the SLT in particular, since becoming an SPN partner school. Seven of the ten case-study schools reported there having been an enhancement in the status of physics at school level, where SLT interest in and attitude towards physics teaching and learning had improved. Two of the seven schools had a challenging starting point in terms of pupil demographics and physics attainment. Their engagement in the SPN programme, and TLC input in particular, had contributed to improvement in attainment, making physics a valued subject in the eyes of the SLT. It should be noted that the initial success at one of the two schools had not been sustained, as SLT permission to double the number of triple science pupils (despite there being no physics specialist teachers) had resulted in a significant drop in attainment.

At three of the seven schools SLT, science teachers and student estimation of physics was already high and had become even higher during SPN partner school years. One school had introduced physics triple science programme for the first time and another school had appointed a new physics specialist teacher. At the third school the number of pupils coming to STEM Club had increased considerably, including more girls than boys taking part whereas previously it has been mainly boys. When the remaining two schools became SPN partner schools, the profile of physics was no lower or

higher than other subjects. At one of them SLT interest in physics improved steadily due to A level physics attainment improving considerable year on year from 2013 to 2015, although the SPN support was not linked to the school improvement plan at any stage. At the other school, the SLT had expressed strong appreciation of the work the TLC had done, including seeking to get more girls into physics A level courses.

There were three case-study schools that did not report any change in the status of physics at whole-school level. The profile of physics at one of them had already improved before the school became a partner school, because students had developed a more positive attitude to maths and started to achieve better in physics. SPN input did not further enhance the situation. At another school, the SLT had already been keen to improve the status of physics due to low take-up of physics at AS/A level, and there was no evidence to suggest this had changed. At the third school, positive change was hindered by the SLT seeking to get the science department to focus on exam grades rather than developing students' understanding of physics. Also, prior to the school becoming a SPN partner school the SLT had cut both funding and time allocated to teaching A level physics.

At the *science department level*, the heads of science (HoS) at all case-study schools reported a noticeable positive change in non-specialist teachers of physics subject knowledge, subject specific pedagogic skills, confidence in and/or enthusiasm for teaching physics as a consequence of the SPN support and activities. The TLCs had run a CPD session at the departments approx. every half term and in some cases also provided one-to-one support to staff, and NQTs and non-specialist HoS in particular. Eight case-study schools reported a clear improvement in non-specialist teachers' subject specific pedagogic skills and seven HoS explicitly stated that there has been an improvement in teachers' subject knowledge. Six HoS also reported an increase in the confidence of non-specialist teachers referring to either confidence to teach specific topics covered by the TLC or overall confidence to teach physics. In addition, a few HoS mentioned that they had witnessed an increase in teachers' enthusiasm for teaching physics, where in one case the TLC CPD sessions have inspired a new non-specialist teacher of physics to go outside the school to improve his/her physics subject knowledge.

3.1.2 Changes to teaching practice

A set of survey questions asked respondents to describe any changes they had made or were planning to make to their teaching practice as a result of their engagement with the SPN activities and support. The most frequently cited change to teaching practice that survey respondents said they had either already made or were planning to make was changes to the teaching of specific topics (e.g. energy, electricity and forces). Greater use of practical work in lessons, revisions to

schemes of work and/or lesson plans, greater or improved use of demonstrations, and changes to the language/terminology used when teaching physics were also frequently mentioned changes to teaching practice that had been made or were being planned.

When asked which SPN activities or forms of support were the greatest contributor to any changes made or planned, as was the case in 2014, CPD workshops by the TLC at the school was the most frequently cited influence reported by survey respondents, followed by personal support from the TLC.

Five survey respondents indicated that they had taken part in SPN activities or received support but had not made and were not planning any changes to their teaching practice as a result. When asked why this was the case, four of the respondents explained that they are already doing most of the 'good practice' suggested by the activities and one respondent said that they are leading the sessions.

When asked to what extent the SPN activities and support they have received so far have met their needs and expectations, the majority of those who responded indicated that their expectations had been met or exceeded. A small number of comments were less positive, but these tended to be from respondents who either expressed mixed views or who were in their very early stages of involvement and had not participated in many activities. Just one respondent indicated that their expectations had not been met, but in this instance this was because they had expected more events specifically for students.

The most frequently requested type of support that survey respondents said they would like but had not yet received from their SPN involvement was additional support or resources for teaching specific topics. In 2014 the most frequently requested type of support was support with teaching physics at A level; while this wasn't mentioned this year, there were four requests for assistance with the curriculum changes at GCSE and A level.

Teachers of physics at all case-study schools had made changes to their teaching practice due to SPN/TLC input. The main types of changes included: Teaching in a more student led, activity/investigation based and hands on ways, including more practical demonstrations and experiments in teaching, focusing on developing students' understanding of concepts and the skills relevant to physics and relating physics ideas and concepts to students' lived experience. These changes to teaching and learning were reported to have enhanced student engagement in and understanding of physics in a large majority of the case-study schools. In terms of the frequency of

different changes to teaching being reported, Table 13 provides the details, where most schools mentioned two changes.

Table 13: Number of schools reporting specific changes to physics teaching practice

Change to teaching practice	Number of case-study schools reported
Teaching in a more student led, activity / investigation based and hands on ways	4
Using more practical demonstrations	5
Using more and/or new experiments in teaching	3
Focusing on developing students' understanding of concepts and skills relevant to physics	4
Relating physics ideas and concepts more to 'the real world' / students' life	2

By the time of the second interview in early 2016, the science departments of seven case-study schools had rewritten their schemes of work on one or several of the physics topics covered by the TLC in CPD sessions and/or one-to-one with the HoS or other member of staff. The changes to schemes of work had obviously resulted in changes to the teaching of the specific topics.

Several heads of science/department at case-study schools that had completed their time on the programme said they would have liked some continuity. Two HoS suggested that a 'drop-in' session where TLC came in even just once a year to check on how things have been progressing and to help teachers of physics to maintain the positive momentum gained during their two years as an SPN partner school. A third school would like *Ever Wondered Why Road Show* to be available to schools beyond their two years in the SPN programme.

3.1.3 Pupils' engagement and attainment

The survey sought information on how respondents gauge student engagement (the criteria they would use to assess changes in engagement) and then asked them to indicate the extent to which the school's involvement in the SPN has affected student engagement based on each measure they listed. These questions were asked to all respondents, not just heads of department.

Survey respondents were asked to identify up to five criteria they might use to determine whether students are engaged in their physics learning and against each, to indicate the extent to which they believe their involvement with SPN has impacted on levels of engagement. Attainment or progress being on track was mentioned the most often as an engagement criterion followed by take-up of GCSE and/or A level physics and then pupils being obviously engaged with the work. This represents a slight shift since 2014 when respondents were more likely to mention take-up than attainment.

Respondents' views on the extent to which SPN activities or support had affected these engagement criteria were generally rather more positive this year than in the 2014 survey: most expressed the view that involvement in SPN had contributed to improvements in these engagement criteria to some extent. Although in 2014 attainment attracted a slightly higher number of 'no impact' responses than the other criteria, this was not the case in the current survey: the majority of those who listed attainment as an engagement criterion this time indicated that the impact of SPN had been relatively high.

As was mentioned in the previous section, the changes to teaching and learning implemented as a consequence of SPN activities and support had enhanced student engagement in a large majority of the case-study schools. Eight case-study schools reported an increase in pupils' level of understanding of, interest in, enjoyment of and/or enthusiasm for physics. The ideas and approaches teachers had adopted from their TLC, including revised SOWs, were confirmed by three schools as having had a positive impact on students' understanding of the topics. Six schools stated that a very large majority of pupils' enjoyment of and/or enthusiasm for physics had increased as teachers had introduced more experiments, practicals and/or investigations in class. At two schools, girls interest in science / physics had noticeably increased and at another two schools pupils no longer thought physics was difficult (as they had thought before).

One of the two schools that reported no change in the level of student engagement explained that it had stayed at previous high level. At the other school, boys' interest in physics had remained at the previous medium level and there had been no change in girls' traditionally low level of engagement in physics. It should be noted that this school did not (and still does not) have any specialist teachers of physics and staff confidence to teach physics has considerably decreased since the TLC input ended.

Four case-study schools reported an increase in pupil attainment in physics. Physics attainment had increased noticeably over a couple a years at these schools, in three cases at GCSE level and in one case A level. The HoS at each school believed that the improvement in attainment had been a direct consequence of SPN programme input. At two schools, GCSE physics attainment had stayed at the same healthy level as before. Again, the HoS at both schools assigned the state of affairs to the support provided by the TLC. Three schools thought that it was too early to assess the impact of changes to pedagogy on student attainment. The HoS at the remaining school stated that he/she was unable to establish a link between SPN input and student attainment, as they perceived there to be a lot of variables influencing changes in attainment.

3.1.4 Progression to AS and A level physics

Respondents were asked to describe any impact they had seen on student participation in GCSE or AS or A level physics as a result of their school's involvement n SPN. Many of those who answered the question said it was too early to say whether there had been any effect but several respondents said that interest in physics had increased (some specified that this was among girls) and one respondent said that attainment in physics had generally improved. Note that some respondents pointed out in their comments that is was difficult to assess how far SPN involvement had contributed to these changes and a couple of respondents mentioned that the new physics curriculum had meant it was difficult to confidently attribute changes to the SPN or other factors.

One case-study school had experienced an increase in a take-up of physics at AS level in 2015, where the increased was reported to be approx. 40% to previous year. The increase had coincided with physics GCSE results improving two years in a row, in 2014 and 2015. The HoS believed that the increase in attainment and progression had been a direct consequence of SPN programme input. In his/her view, the kinds of experiments and hands-on activities that the TLC had taught the staff and the staff had implemented had stimulated students' interest in physics. At another school, more year 11 students had expressed an interest in taking physics at A level than in previous years, although the reason for this was thought to be a more stable teaching team and not the SPN programme input.

At six case-study schools there had been no change in students progression to AS and A level physics. The remaining two schools were 11 to 16 schools that get limited information on student choices at KS5, and thus did not know how many pupils had gone to take physics AS level in autumn 2015.

3.2 Developing teachers

3.2.1 Early-career teachers' experience of the mentoring programme

3.2.1.1 The level and nature of the mentoring contact between ECT and mentor

The nature of the mentoring offer varied depending on the approach of the mentor and, to some extent, the needs of the ECT mentee.

For most mentees the main focus of the mentoring relationship was on subject-specific pedagogy and most often contact with the mentor was as part of a group, either a face-to-face workshop or email group. The majority of mentees expressed satisfaction with the type and level of support they received whether it was group or 1:1 support. Although there was likely to be less satisfaction from mentees in their PGCE year if the mentor was not proactive and/ or only engaged with the mentee

via group emails. Four mentees in their PGCE year (2015/16 cohort) reported no contact or very low level contact from their mentor.

Where mentees reported having regular emails from their mentors these were usually to pass on information about upcoming events and/ or to send links to useful websites or suggestions for teaching particular topics such as electricity. Sometimes these suggestions tied in with particular items in the news: one mentor emailed out resources, links to websites and ideas on using the Nepal earthquake to teach particular aspects of physics. The frequency of email contact varied from termly to weekly.

Most of the mentees found the email contact very useful. One mentee said that the signposting to resources was 'great', another that the ideas and resources were useful as s/he was the only physicist in the school. One mentee has used the information in the email newsletters extensively in his/her teaching and has also shared them with colleagues. S/he cited one particular example of a newsletter on light that included relevant experiments. As this mentee pointed out teachers have little time to research extensively or devise experiments.

Where there had been face-to-face contact with the mentor this was more likely to be as part of a group workshop. Mentees spoke about group sessions they attended run by their mentor (who was sometimes the local IOP coordinator so it is not possible to say with any degree of accuracy how many of the events or workshop were mentee specific). Demonstrations of practical work was singled out by several mentees (7) as very useful as this was an aspect of teaching they felt least confident about. The group meetings arranged by some of the mentors included opportunities to network with other teachers and peer-to-peer support. The frequency of group meetings varied between once a year to as many as monthly.

Thirty (38%) of the mentees interviewed reported having had some 1:1 support either on the telephone, via email or face-to-face. Approximately one-fifth of mentees were visited in their school or university by their mentor. Of those one observed their mentor teaching a lesson, one received help with moderating controlled assessments and one with practical experiments. Other mentees reported that their mentor helped them with their teaching and pedagogy and five in career planning and completing job applications. One mentee said their mentor helped them through a difficult teaching practice, another that s/he had help with setting up a science club. Individual meetings were thought to be helpful for talking through difficulties by one mentee.

Where mentees expressed concern it was mostly about receiving more 1:1 help. Of the mentees who said they would have liked more 1:1 help one said help was offered, but too late and 4 asked

for some help but did not get a response. Several mentees felt that the mentor could have been more proactive in offering 1:1 support, perhaps making specific suggestions about the kind of help and support that was on offer because as one mentor put it 'at first you don't know what you don't know'. Mentees in their PGCE year (2015/16 cohort) were more likely to be unsure of what the mentoring relationship was meant to offer.

There was a degree of variation between the level of engagement between mentor and mentee and the level of need expressed by mentees. There are a number of possible reasons for this, the first of which is the different approaches taken by mentors to their role. The role of the mentor as described by the interviewees varies both in the activities undertaken by the mentor and the frequency of the interactions. Mentees too report varying degrees of need depending on amongst other things the time they have and the support they are receiving from their university, teaching placements or the schools they work in. Mentees were more likely to welcome the additional support of an IoP mentor if there were no other physics teachers in their school/ placement.

Of the 88 mentees interviewed, 78 had engaged to some extent with the programme, even if this had been fairly passive in nature such as just receiving and reading emails from their mentor but no further contact.

There were several reasons why some mentees had not engaged (10). A small number of PGCE students had not had any contact from their mentor (where appropriate we have informed IoP and this has been followed up), some mentees felt they currently had all the support they needed (this was more likely to be mentioned if subject-specific support was available in their school/ placement), several mentioned that they were not sure what the support was for and therefore had not engaged and a few explained that they had been too busy to engage so far (this was usually mentioned by PGCE students).

No particular difference in the pattern of help or support across particular cohorts has been detected when analysing the data across all three years of the programme. There are one or two examples where a change of mentor has led to less engagement between mentor and mentee either because the new mentor did not respond or the mentee did not find the new relationship worked.

The evidence suggests that mentees needs are more likely to be met when:

- their mentor is proactive but is also reactive when needed
- mentees are offered both group and 1:1 support

- mentees can engage with an IoP mentor at different stages of their teaching career depending on the time available to them and the support they are receiving elsewhere (or not)
- there is a clear framework in place stating what is on offer to IoP mentees.

Generally there was a high level of enthusiasm for the mentoring programme if mentees were able to attend workshops and/ or are regularly sent ideas and resources to support teaching by their mentor.

3.2.1.2 The perceived value and impact of the mentoring relationship

Although the nature and frequency of the mentoring support varied depending on the approach of the mentor, the majority of mentees felt they benefited from the input they received. Mentors who were expert practitioners with a wider professional knowledge offered mentees help and support that contributed to their teaching practice and their wider professional development. When questioned about the impact on their teaching mentees talked about a range of ways their mentor had helped them.

- Teaching and pedagogy – subject-specific help was touched on by the majority of mentees when interviewed. Mentors provided much needed help on subject knowledge, ideas for teaching particular topics and ways of introducing and relating 'the real world' to the physics classroom.
- Practical experiments – mentees appreciated the support they received in group sessions and as individuals on how to develop, set up and conduct experiments in the classroom. Of particular use were the ideas for using everyday objects and materials in experiments (kitchen cupboard science).
- Career development – some mentors offered or responded to requests for help with completing job applications and in one or two cases on career development, e.g. changing schools.
- General support – mentees talked about other aspects of the mentoring support they valued: knowing that the help and support was there if needed was important to some mentees. One mentee said that his/her mentee provided 'a safety net and security blanket' in his/her PGCE year, another that his/her mentor helped him/her through a difficult teaching practice. Other aspects of the support welcomed by mentees from their mentors were the opportunity to network and meet with peers, one-to-one support for individual

problems, support when s/he was the only physicist in school and building teacher confidence.

Of those recorded as engaged, 48 (62%) mentees considered that the support from the mentor had had a positive impact on their teaching. Of those mentees who reported a medium or high level of engagement with the programme, 38 out of 42 (90%) considered that the support they had received had had a positive impact on their teaching.

It has already been said that some mentees were unclear about what was on offer from mentors and a suggestion made that the IoP make it clear what is and what is not available to mentees. A few mentees said that they did not feel that the support offered, though useful, was mentoring. The evidence from the data suggests that whilst some aspects of mentoring were clearly on offer, others were not. The emphasis appears to have been on advice and guidance rather than establishing a relationship between mentor and mentee that involved a structured dialogue or learning conversation in which the mentee is encouraged to identify learning goals, shares planning with their mentor, develops an understanding of why different approaches work and takes an increasing responsibility for their own professional development. Mentors in this relationship encourage reflection on practice. This is an important aspect of the mentoring relationship, a process encouraged by establishing a confidence in the relationship, asking good questions, listening and reviewing and action planning with the mentee[1]. It could be that the IoP never intended that this would be the shape of the offer to mentees in which case a clear definition of what is on offer together with a change of title that more closely describes what mentees can expect may be helpful.

3.2.2 Non-partner school teachers' experience of the SPN programme

The SPN programme has offered two types of CPD opportunities to specialist and non-specialist teachers of physics from all schools, with an emphasis on seeking to engage teachers from schools that are not SPN partner schools. During the past two years (2014-2016), Science Learning Partnerships (SLPs) have hosted and TLCs have delivered approximately 100 CPD workshops a year for teachers of physics at SPN link schools. In addition, 10 regional teacher days of physics CPD have been organised by External Liaison Officers (ELOs) and delivered by TLCs and Physics Network Coordinators (PNCs) in the last two academic years.

[1] Taken from Curee Mentoring and Coaching Capacity Building Project: National Framework for Mentoring and Coaching 2006

A total of 31 people (of the 114 contacted) took part in a telephone interview. The purpose of interviews with CPD event participants was to a gain an understanding of the impact of the training on their teaching practice and subsequently on pupils.

Characteristics of the sample of CPD participants interviewed

Of the 31 interviewed, 27 were teachers of physics and four were science technicians. Of the teachers, 15 considered themselves to be physics specialist and one of the technicians had a physics related degree. The interviewees taught physics across key stages from KS2 to KS5, where roughly a third taught at KS4 only and another third at KS3 and KS4.

A total of 25 people responded to interview questions in relation to a regional teacher day of physics CPD and six responded in relation to shorter (a couple of hours) CPD events at their local link school. Of the 27 teachers of physics, 22 had attended and told about their experiences of a regional, whole-day event and 5 regarding a shorter link school CPD events. All interviewees had attended the event or events within six months of being interviewed.

Value of CPD events to teachers

The CPD participants were asked what they had learned or gained from the event in question. Every person interviewed had learned something they found valuable. A total of 13 teachers of physics reported having improved their subject specific pedagogic skills. Seven of them mentioned a specific topic, which included electricity, energy, light, forces, space, 'food physics' and voltage & current. Nine teachers had improved their subject knowledge regarding one or several specific physics topic, where the topics mentioned were electricity, energy, forces and light and sound. Four teachers also stated that their confidence of teaching physics had increased following the CPD event. Two people had gained a better understanding of gender issues in teaching physics.

Other teachers of physics reported having gained ideas and resources for how to engage low ability students, ideas on how to support non-specialist teachers of physics, deepened their understanding of how to prepare students for A level physics exams and increased their confidence in dealing with students questions in class. All four science technicians reported having learned new experiments and demonstrations and one of them specifically new A level practicals. A teacher of physics commented regarding a regional physics CPD day that took place in summer 2015: *'There was something for everybody. There were a lot of short and snappy sessions that covered everything you need to know in a day for physics teachers in a very positive way.'*

Changes to teaching practice

The 27 teachers were asked whether the CPD event had made a different to how they teach physics and all but one said yes. The reason why the event had not made any difference to one teacher's practice was because they are currently teaching science at KS2 and energy not a topic at that level. The 26 teachers were asked in what ways they had changed their physics teaching practice as a result of the SPN CPD event. A total of 12 teachers reported having implemented new demonstrations and/or experiments learned at the CPD event in class. Five people has implemented new, different ways of explaining key concepts with regards to specific physics topics and mentioned energy, forces and voltage & current. One of them said that they were now using analogies and visual ways of explaining key concepts clearly and has been able to challenge high ability pupils better.

Five teachers had introduced new practicals and two had introduced hands on experiments and now foster scientific enquiry in class. Others had changed their teaching practice by using new 'physics toys' or new starter activities they had been introduced to at the CPD event. One person was now teaching low ability students in a different, more engaging way. Three teachers mentioned that they had changed their scheme of work, and a fourth one said that they were planning to do so, following the CPD workshop. Two had rewritten their scheme of work for energy, one for electricity and the fourth person was planning to rewrite their scheme of work for teaching forces. It may be that more people had rewritten their schemes of work as they were not specifically asked whether they had done so or not.

After the teachers had explained how they had changed their teaching practice, they were asked to rate the level of impact on their teaching practice on a scale from 1 to 5, where 1 was low and 5 very high. Table 14 below provides the results and differentiates between participants to regional teacher days and shorter link school CPD events. Whilst the number of respondents regarding link school CPD events is small, the level of impact perceived by those who took part in whole-day regional events is higher as one might expect.

Table 14: The perceived level of impact of the CPD event on teachers' physics teaching practice

Response re: perceived level of impact	Number of regional event participants who gave each rating	Number of link school event participants who gave each rating
1 = low	0	2
2	6	1
3	10	0
4	5	1
5 = very high	1	0
Total	22	4

Impact on pupils

Those 26 teachers who had made changes to their teaching practice following an SPN CPD event were asked whether the changes had had any impact on pupils. With the exception of one teacher, all had perceived some impact. The person who reported no impact commented that as the changes had focused on new ways of preparing students for exams and students had not taken their exams yet, no impact had been detected. The 25 teachers who reported impact on pupils all reported one or two types of impact. The forms of impact and how many times each was reported can be seen in Table 15 below.

Table 15: The impact of changes to teaching practice on pupils

Type of impact on pupils	Number of teachers reported
Pupils are more engaged in class	13
Pupils' understanding of physics has improved	7
Pupils identify with physics more than before	5
Pupils' attainment has improved	5

Some of the 13 teachers who had found pupils to be more engaged in class specified a group of pupils affected. In one case they were girls who had previously been less engaged, in another case lower ability pupils and in third case pupils who have previously found physics difficult. Those seven teachers who reported that pupils' understanding of physics had improved, stated they had changed how they taught specific topic(s). The five cases in which pupils were perceived as identifying with physics more than before, teachers explained that pupils had shown an increased interest, motivation and/or confidence to study physics. One teacher who had taken part in the summer school for non-specialist teachers of physics in 2014 and a regional teacher day of physics CPD in 2015 said:

> *'The improvement of my subject knowledge and confidence has improved students' confidence. A number of my Y11 students who left in the summer said that they had come to enjoy physics over the two years I taught them whereas they did not before. Student attainment has improved and a number of them have gone to take physics at AS. There has been more impact on female pupils and lower achievers than other pupils.'*

The other four teachers, who linked an improvement in pupil attainment to the changes they had made to their teaching practice following participation in SPN CPD events, said:

- Pupils are very engaged and attainment is one level higher for all than expected.
- The school had very good physics results last summer. Generally pupil interest has increased and more pupils are coming to study support after school.

- There has been an increase in pupil achievement. In a resent mock exam my pupils got 50.3% A* - C, which is not far from the 53% target.
- The changes [to teaching practice] have made electricity more accessible to pupils. Pupils have been more engaged, i.e. asking and answering questions better, and had improved marks on electricity.

Summary points

Based on the self-selecting sample of 27 teachers of physics interviewed, the following can be concluded:

- All SPN CPD event participants interviewed had gained or learned something valuable at the CPD event they had participated in.
- The majority of teachers had changed their physics teaching practice in one or more ways as a result of taking part in the SPN programme events for non-partner schools.
- The changes to teaching practice had had a positive impact on pupils in terms of their level of engagement, understanding, identification with and/or attainment in physics having increased.