

HOW TO ENHANCE CPD TO MAXIMISE THE MEASURABLE IMPACT ON STUDENTS' ACHIEVEMENT IN SCIENCE?

*Dr. Irina Kudenko*¹ and *Pauline Hoyle*²

¹ Myscience, York, UK

² Myscience, York, UK

Abstract: The purpose of any teacher continuing professional development (CPD) is to ensure a positive change in pupils' outcomes, yet the evaluative evidence to support this relationship is often weak or missing. The assessment often relies on qualitative data of teachers' opinions rather than any data related to pupil progress. Using the CPD programme for science teachers and support staff at the UK National Science Learning Centre, this research investigates how CPD strategies can facilitate the most impact on students' achievement in sciences backed by 'hard' and rigorous evidence.

Using impact forms that teachers complete two or more months after each residential CPD session, this study provides quantitative and qualitative examination of teachers' accounts of their post-CPD actions, evidence of outcomes and impacts. Two contrasting narratives employed by teachers to depict their post-CPD experience are identified: Narrative 1 is pupil-focused, structured and contains measurable evidence, while Narrative 2 contains a description of what and how teachers did and what they think about the experience. Looking at the content and methodologies of the sampled CPD courses, we established that teachers used Narrative 1 more frequently when their CPD courses contain special training in 'reflective practices' and 'action research' methodologies. This learning facilitated their ability to plan a sequence of actions, focus on tangible outcomes for pupils and systematically measure these outcomes. Improving teachers' research and reflective skills and their ability to use evaluative data can also boost teachers' confidence and motivation to continue innovating, increase the sustainability of change and the likelihood of its further dissemination to colleagues in school and beyond. This finding is consistent with other studies that point to the value of 'action research' in CPD and will be used in the National Science Learning Centre's ongoing revision of CPD strategies and evaluation tools.

Keywords: professional development, impact on pupils, impact evidence, action research

BACKGROUND, FRAMEWORK AND PURPOSE

Continuing professional development (CPD) for science teachers is an essential strategy in improving the quality of teaching and learning in science classrooms in England. Although the ultimate purpose of any CPD activity is to ensure a positive change in pupils' outcomes (Guskey 2000), the evaluative evidence to support this relationship is often missing (Harris et al 2006). Instead the assessment frequently relies heavily on qualitative data of teachers' opinions rather than any data related to pupil progress.

Driven by the current UK Coalition Government's ambition to create a more autonomous and self-improving school system, there are cultural changes in the English education landscape including the monitoring of schools' quality of self-evaluation and the impact of their provision on students' achievement (Department for Education 2010). One of the English school accountability requirements is the new Ofsted Framework for the Inspection of Schools (2012) which places an explicit requirement on schools to show the link between performance management, CPD provision and the impact on outcomes in the classroom.

Using the CPD provision for science teachers and support staff at the UK National Science Learning Centre, this research investigates which CPD strategies provide the most impact on students' achievement in science using 'hard' and rigorous data as evidence.

Rationale

The National Science Learning Centre provides CPD for science teachers and technicians throughout the 5-19 age range in England with some devolved provision in Wales, Scotland and Northern Ireland. The Centre provides single and multi-contact residential CPD for teachers on subject content knowledge, subject pedagogical knowledge, leadership of science, as well as CPD for support staff including technicians and teaching assistants.

The outcomes of the CPD are evaluated using the Guskey (2000) model of the five impact levels including teacher's reaction, learning, changing practice of self and colleagues and outcomes for pupils.

An 'impact toolkit', using three evaluation instruments, is embedded into the CPD sessions:

- *The intended learning outcomes* are collected from participants prior to the first CPD session
- *A personalised action plan* is developed by participants as a result of each residential CPD. Teachers are encouraged to think what action points will be most relevant to their own schools and then to produce a detailed outline of goals, beneficiaries, success criteria, timeline, required resources, potential barriers and sources of help they might need to succeed.
- *Impact report* - a self-reported evaluation of the actions completed two or more months after each residential CPD session which is approved by their line manager before being submitted. It includes evidence of impact on participants' knowledge and practice, pupils, colleagues and wider school.

Based on the principle of 'embedded evaluation' (Parry & Berdie 2004) the 'toolkit' aids participants' learning and simultaneously provides valuable evaluation and impact feedback. Most of the questions are open-ended and there are no restrictions on how participants structure their answer, e.g. bullet points or vignettes.

METHOD

Research design for this study consisted of both quantitative and qualitative examinations of impact reports from the participants of multi-contact CPD courses, which contain teachers' feedback on actions they implemented in school after the

first training period, including the analysis of impacts and review of evidence that teachers collected to support their impact claims.

Our main research interest was twofold; we looked into the nature of reported impact on pupils and collected evidence in order to:

- a) uncover structural differences in the level of reported impact and evidence
- b) understand reasons behind this variation, i.e. what elements of CPD training help to maximise the impact on pupils and to improve the quality of evidence

Quantitative study

Using pre-existing evaluation data that is annually composed from the analysis of a stratified sample of impact reports, we undertook a year-on-year comparative examination of the data that records the impact on pupils. Overall, we reviewed 825 impact forms from 46 multi-contact CPD courses that were provided by the National Science Learning Centre between September 2009 and May 2013.

The sampling principle behind the selection of courses for the annual evaluation analysis is to mirror the overall structure of courses offered in the current academic year. Since the CPD programme is also annually revised in line with the changing educational landscape and fluctuating demand for particular CPD topics, the combination of courses sampled in each year can vary. Actual availability of impact data at the time of the analysis places an additional constraint on this selection. Overall, it means that only a small number of courses feature in the analyses in three subsequent years. However, the theme range of analysed CPD courses remained similar and included CPD in *subject specific* and *general teaching and learning science, leadership of science, primary science* and *support of teaching science*. Table 1 shows impact forms in each category of CPD theme that were quantitatively analysed.

Table 1

Number of impact forms included in the quantitative analysis by CPD Themes

	2009-10	2010-11	2011-12	2012-13	2009-13
<i>Leadership</i>		65	79	110	254
<i>Subject-specific</i>	52	92	81	79	304
<i>Teaching and Learning</i>	8	14	35	44	101
<i>Primary</i>	38	67		22	127
<i>Supporting Science Teaching</i>	18		21		39
ALL COURSES	116	238	216	255	825

Qualitative research

From the analysed sample we selected two sub-samples of subject-specific courses in two different categories:

Category 1: two courses (33 impact forms) that contained the highest number of participants who reported impact on pupils and provided higher quality ‘hard’

evidence of the impact on pupil's progress and attainment (e.g. test results, research experiments, pupil questionnaires)

Category 2: two courses (30 impact forms) with the lowest level of reported impact on pupils and mostly 'soft' data (e.g. self-reflection, colleagues' or pupils' anecdotal comments) presented as evidence

For each category we undertook qualitative text analysis of impact forms and identified the prevailing narratives that teachers employed to depict their post-CPD experience including the impact on pupils' outcomes.

The next step of the research was to develop a better understanding of the structure and elements of CPD training that prepare teachers for their post-CPD actions. For this purpose we reviewed the four CPD courses involved in the qualitative analysis comparing their goals, session content, training strategies and instructions for planning post-CPD actions (i.e. support in action planning) and their evaluation (impact form). This was done through the analysis of course materials (sessions and resources), interviews with course leaders and a number of CPD session observations in one of the courses with the highest rate of reported impact on pupils.

The findings of the qualitative research was corroborated by re-examining the quantitate impact and evidence data collected annually.

RESULTS

The evaluation data collected from 46 CPD courses delivered at the National Science Learning Centre between 2009 and 2013, which is shown in Figure 1, demonstrates that although there was an overall year-on-year increase in the number of participants reporting impact on pupil, there were very noticeable variations between different courses.

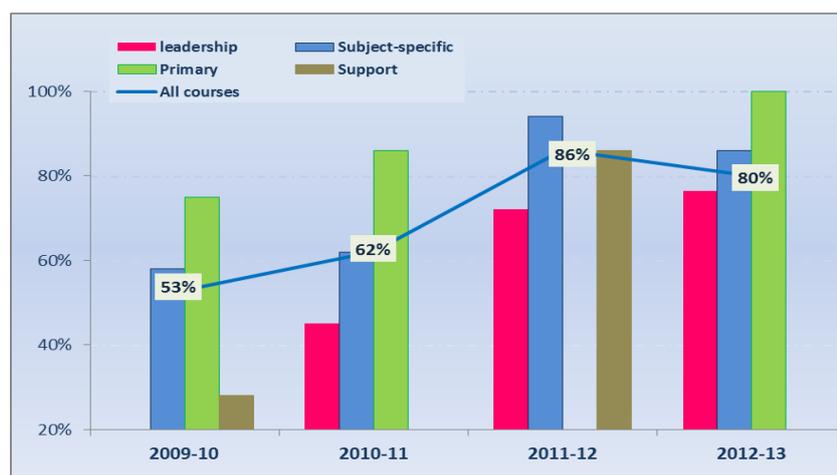


Figure 1. Impact on pupils reported by participants of multi-contact CPD courses, NSLC, 2009-2013

This was expected for differently themed courses. For example, it is reasonable to suggest that teachers who attend subject leadership CPD are more likely to focus on management and longer-term departmental goals and consequently, less likely than, for example, attendants of subject-specific CPD to generate direct impact on pupils

and/or collect the necessary evidence for it in two-three months after the CPD training.

Yet, when we analysed the impact data for similarly themed courses such as subject-specific courses, there was still a noticeable and significant difference in the number of teachers who report impact on pupils. This is shown on Figure 2.

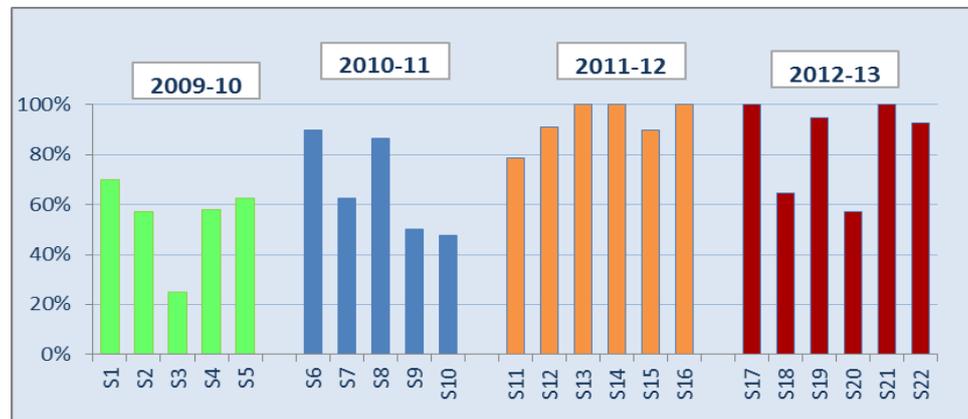


Figure 2. Impact on pupils reported by participants of subject-specific courses (% of all reports per course)

Without a doubt, participants' teaching experience or position within the school (e.g. science subject leader vs. newly qualified teacher) can influence the scale and success of post-CPD actions and consequently explain some variation in the level of reported impact. For instance, occasionally we receive impact reports from participants who were unable to implement their original action points and/or had to radically change their action plans. These are more likely to be junior members of the teaching staff, like newly qualified teachers or technicians, who, when back in school after CPD, can find that their line managers or school have changed priorities and asked them to focus on different goals.

However, this factor alone could not explain all the significant differences. The same teachers, who experience difficulty with reporting the effect on pupils, are very positive and confident in describing benefits to their own knowledge, improvements in the quality of their teaching and showing the use of new skills and pedagogical strategies in the classroom. Overall, the reported impact on 'Self' is much higher than impact on pupils and it is relatively consistent across courses.

On average, nine out of ten participants claim impact on personal knowledge and practice with some courses recording 100% impact, but even the least 'impactful' (in terms of pupil outcomes) courses display no less than 80% impact on 'Self'. For example, courses S18 and S20 in Figure 2 with relatively modest rates of impact on pupils have correspondingly 88% and 100% participants reporting impact on their own knowledge, skills and practice. If teachers say that they have used new knowledge, skills and resources in classroom, why are they not able to assess its effect on pupils?

To investigate deeper causes behind such an obvious discrepancy in evaluation data, we performed a narrative analysis of impact reports selected from courses with the highest (Category 1) and the lowest (Category 2) levels of reported impact on pupils.

Although teachers' impact reports within each category vary in style and language used, there were nevertheless recognisable similarities in the way the accounts within each group were structured, which set them apart from the impact reports in the other category. Using a comparative analysis of impact reports across categories we were able to discern two contrasting types of narrative which teachers use to portray their post-CPD actions, to describe outcomes, analyse impacts and demonstrate supporting evidence.

Narrative Type 1 is a pupil-focused and structured account of impacts with an explicit reference to measurable evidence (past, present or future). The sequential description of events and actions that teachers took is not time-bound, but is reminiscent of a pre-conceived 'research design' that glues together post-CPD actions and incorporates a plan for evidence collection. When reflecting on personal learning the narrator keeps the focus on outcomes for pupils.

In contrast, *Narrative Type 2* is a teacher-centred description of actions that were done after CPD, where the analysis of impacts is mixed with or fully substituted by a timeline or inventory-style list of accomplished actions. In a similar fashion, the reference to hard evidence is scarce while personal or colleagues' opinions and dissemination activities are frequently cited as evidence of impact. The reflective learning is predominantly centred on 'self' (i.e. "what I did correctly and what needs changing") without any reference to outcomes for pupils. Table 2 summarises the key elements of each type of narrative and Table 3 provides their illustrations taken from teachers' impact reports.

Table 2

Summary descriptions of Narrative 1 and Narrative 2

<i>Narrative Type 1</i>	<i>Narrative Type 2</i>
<ul style="list-style-type: none"> • focus on measurable outcomes for pupils • sequence of actions structured by 'research design' • evidence collection is pre-planned (e.g. collection of baseline and post-intervention data) • use of measurable evidence to promote further dissemination of 'good practice' to colleagues 	<ul style="list-style-type: none"> • focus on actions by self and others • unstructured 'menu' of post-CPD actions • ad hoc evidence collection and general difficulties with evidencing the impact on pupils • use of opinions, subjective judgements and examples of dissemination as evidence of impact

In the next stage of our research we looked at the content and training strategies of the sampled CPD courses, trying to identify if there were any obvious reasons that could explain this qualitative difference in reporting the CPD impact. To compare the courses we studied course programmes and materials and interviewed CPD providers.

We established that although all CPD courses at the National Science Learning Centre have been using the Impact Toolkit and requiring participants to develop an Action Plan of after-CPD activities, courses in **Category 1** also provided participants with an additional training in 'reflective practices' (Bolton 2010) and 'action research'

(McNiff & Whitehead 2002). This training was not included in CPD courses in **Category 2**. Hence, teachers were more likely to use Narrative Type 1, i.e. provide pupil-focused accounts and show understanding of the importance of rigorous evaluation, when their reflective and research skills were also targeted by CPD.

Table 3

Narrative 1 and Narrative 2: Examples from teachers' impact reports

Narrative 1	Male teacher, CPD Course: <i>Physics for non-specialists</i> , 2011
<p><i>Reflection on Learning:</i> I appreciated that I do already incorporate a great deal of engaging activities in my lessons. The value of INSET and the research is in expanding the number of engaging and effective teaching activities/strategies I employ and in showing me how effective they are in moving the student' learning forward. I kept this project manageable and focused and as a result got useful information from it.</p> <p><i>Impacts and Evidence:</i> I have two year 8 groups. I tested the baseline knowledge of both using a concept cartoon. One group were 'lectured' on energy transfer theory and then asked them to do text book questions.</p> <p>The second group I taught the same concept, but with more imaginative techniques, such as a modelling activity and engaging demonstrations followed by discussion. Through these activities students were able to iron out misconceptions. (Lesson plan attached)</p> <p>I then re-tested both with the same concept cartoon. I found the first group went from 30% demonstrating an understanding at the start to 52% at the end. The second group went from 44% to 97%. These successful teaching techniques have been added the scheme of work in the school.</p>	
Narrative 2	Female teacher, Course: <i>Applied and Vocational Training for 14-19 year olds</i>
<p><i>Reflection on Learning:</i> To achieve the action plan and also to recruit "friendly" colleagues to work with on tasks. Reduce the size of each task to a manageable level. Planning for next year has been organised for BTEC delivery and I am determined to encourage colleagues to take part.</p> <p><i>Impacts and Evidence:</i></p> <ul style="list-style-type: none"> • Organised external seminar at UCWTN • Organised opportunity to "measure-up" a real space for lab design project • Visited Blackpool Victoria Hospital Pathology Department with a view to linking to practicals <p>Personal visit to QCNW to include element in assignment work</p>	

Course leaders were interviewed after the delivery of the courses. Their view was that training teachers in reflective practices transforms their attitude and understanding of professional learning, makes teachers active and critical users of knowledge, skills and pedagogical strategies acquired through CPD. The use of action research in CPD helps teachers to realise that their post-CPD interventions is a type of social research, which requires proper planning of impacts and ways to measure them.

Moreover, this type of CPD equips teachers with a set of methodologies and tools, used in social rather than science research, thus facilitating teachers' ability to plan actions and impacts in advance, focus on tangible outcomes for pupils and evaluate by

systematically measuring these outcomes. Figures 3a and 3b show two of the presentation slides used for teaching action research within a Category 1 course.

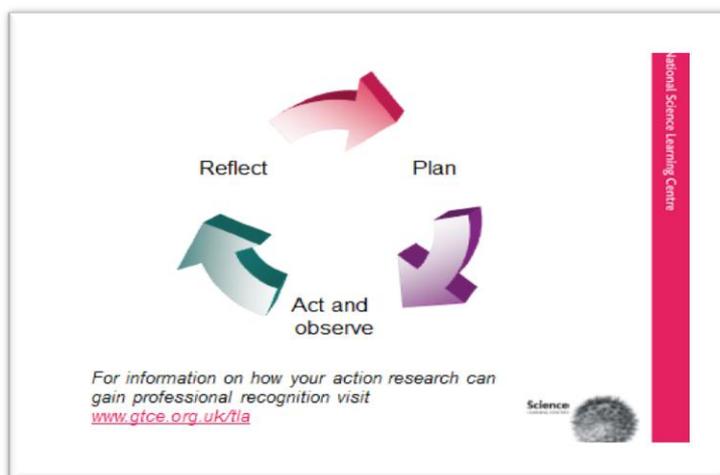


Figure 3a: *Presentation slide from the CPD course Physics for Non-Specialists describing Action Research*

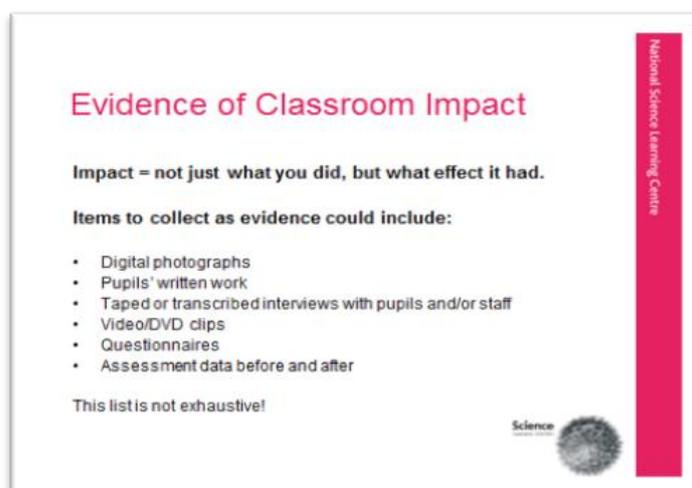


Figure 3b: *Presentation slide from the CPD course Physics for Non-Specialists (Category 1) showing how to collect evidence of impact after classroom innovation*

When participants come to the second residential period of CPD they make presentations of what they did after the first training period and show collected evidence of impact. According to course leaders, who observe and compare participants' presentations, the inclusion of training in reflective practices and especially in 'action research', improves the effectiveness of teachers' work after CPD as well as the quality of impact evidence they accumulate. CPD leaders attribute this change to the improvement in teachers' research and evaluation skills that allow moving away from ad hoc search for evidence to pre-planning of quantifiable impacts and ways to measure them. Figure 4 demonstrates a piece of high quality evidence submitted by a teacher who received training in action research. It shows that the test group of pupils had a higher increase in the number of pupils attaining their target grades than in the control group.

Control group							Test group						
Firstname	Set	Baseline Data	Target	7BFJ Mark	Level	+/-	Firstname	Set	Baseline Data	Target	7BFJ Mark	Level	+/-
Boy 1	73/Sc	4a	5B	27	5c	-1	Boy 1	72/Sc	4a	5B	18.5	4b	-1
Boy 10	73/Sc	4c	4A	20.5	4b	-1	Boy 10	72/Sc	4c	4A	25	5c	+1
Boy 11	73/Sc	4c	4A	20.5	4b	-1	Boy 11	72/Sc	4b	5C	18	4b	-2
Boy 12	73/Sc	4c	4A	24.5	5c	+1	Boy 12	72/Sc	5c	5A	26.5	5c	+2
Boy 13	73/Sc	5b	6C	33.5	5a	-1	Boy 13	72/Sc	4b	5C	22.5	4a	-1
Boy 2	73/Sc	3b	4C	26.5	5c	+3	Boy 2	72/Sc	3c	3A	19.5	4b	+2
Boy 3	73/Sc	3c	3A	13.5	3a	0	Boy 3	72/Sc	4b	5C	19.5	4b	-2
Boy 4	73/Sc	5b	6C	27.5	5b	0	Boy 4	72/Sc	4a	5B	26	5c	-1
Boy 5	73/Sc	2b	3C	10.5	3b	+1	Boy 5	72/Sc	4b	5C	24.5	5c	0
Boy 6	73/Sc	5b	6C	27.5	5b	-2	Boy 6	72/Sc	4a	5B	26	5c	-1
Boy 7	73/Sc	4b	5C	19	4b	-2	Boy 7	72/Sc	3b	4C	14	4c	0
Boy 8	73/Sc	3c	3A	20.5	4b	+2	Boy 8	72/Sc	1a	2B	16.5	4c	+5
Boy 9	73/Sc	4b	5C	18.5	4b	-2	Boy 9	72/Sc	5c	5A	27	5c	0
Girl 1	73/Sc	4c	4A	9	3b	-4	Girl 1	72/Sc	4b	5C	28	5b	-1
Girl 2	73/Sc	5a	6B	30	5b	-3	Girl 2	72/Sc	3c	3A	21.5	4a	+3
Girl 3	73/Sc	6c	6A	24.5	5c	-2	Girl 3	72/Sc	5c	5A	28.5	5b	-1
Girl 4	73/Sc	5c	5A	19	4b	-4	Girl 4	72/Sc	4c	4A	17.5	4b	-1
Girl 5	73/Sc	5c	5A	27	5c	-2	Girl 5	72/Sc	4c	4A	15	4c	-2
Girl 6	73/Sc	4c	4A	13.5	3a	-1	Girl 6	72/Sc	4b	5C	25.5	5c	0
Girl 7	73/Sc	5c	5A	22.5	4a	-3	Girl 7	72/Sc	3a	4B	24.5	5c	+2
Girl 8	73/Sc	4c	4A	25	5c	+1	Girl 8	72/Sc	4c	4A	12	3a	+3
							Girl 9	72/Sc	3a	4B	19.5	4b	0

% above target	23.81	% above target	27.27
% hitting target	4.76	% hitting target	18.18
% 1 sublevel below	19.04762	% 1 sublevel below	22.72727
% 2 or more sublevels below	52.38095	% 2 or more sublevels below	31.81818
	100.00		100.00

Figure 4: Example of evidence of impact presented by a participant of CPD course Physics for non-Specialists (Category 1) at the second residential training session

From the interviews with CPD leaders we learnt that with time they gradually introduced ‘reflective practices’ to more courses run at the National Science Learning Centre. Re-examining aggregate impact data from 2009-2013, presented at Figure 5, we established that the overall increase in the reported impact on pupils was accompanied by a growing focus on pupils’ learning and achievement and a decrease in the number of teachers who only claim ‘softer’ impacts (e.g. ‘Pupils seemed to enjoy the experience’), which corresponded to a growing number of courses that introduced or increased the element of ‘reflective practice’ and ‘action research’ element in their CPD.

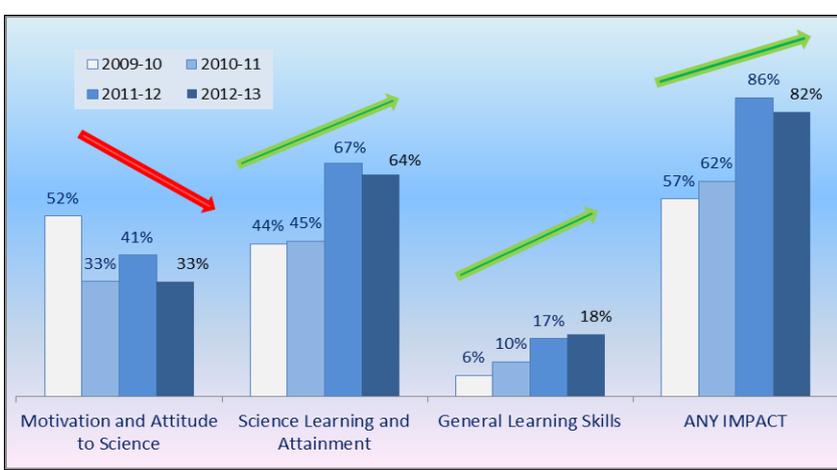


Figure 5: Different impacts on pupils reported by CPD course participants in 2009-2013

The introduction of reflective practices was particularly noticeable in 2011-12, so we reviewed the evidence that teachers from the sampled courses collected for their impact reports in this year and compared it to the evidence that was presented in 2009-10. As it is demonstrated in Figure 6, the increase in the volume and quality of data was very apparent: more teachers more frequently used ‘hard’ measured evidence of pupils’ outcomes.

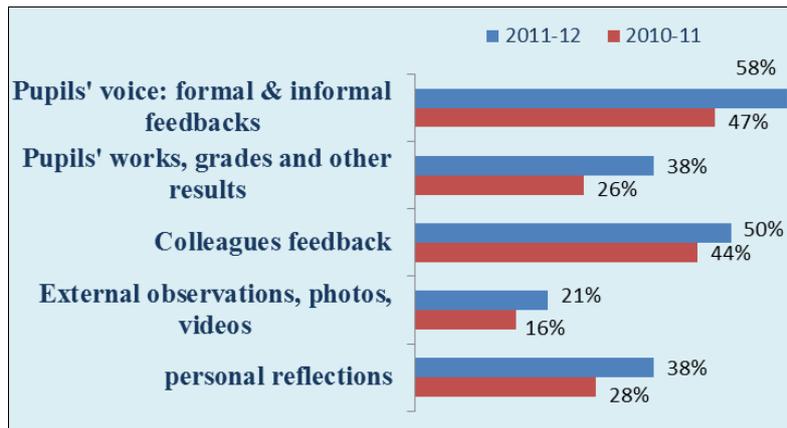


Figure 6: Evidence used by teachers to verify the impact (by types of data)

CONCLUSIONS AND IMPLICATIONS

Our research indicates that the embedding of ‘action research’ and ‘reflective practices’ in CPD training has a definite beneficial effect on teachers’ ability to plan for pupil-centred outcomes and to collect evidence of impact on pupils’ achievement. Teachers learn to understand the context in their own classroom, department or school, identify small changes that they had the power to implement and criteria to weigh the success of their actions. Positioning the teacher as the ‘agent of change’, who is able to critically evaluate the evidence, has implications for the sustainability of change and the likelihood of its further dissemination to colleagues in school. It boosts teachers’ confidence and motivation to continue with research and innovation, while the credibility of hard evidence helps to convince management and colleagues to try out the innovation.

This finding is consistent with other studies that point to the value of ‘action research’ in CPD (McNiff 2010) and is being used in our ongoing revision of strategies used in CPD training at the National Science Learning Centre. The challenge is that teaching ‘action research’ and reflective practices takes additional training time, which makes it unsuitable for professional development of shorter duration (one or half day). To reduce the training time and make the learning of evaluation skills more consistent across courses, we are in the process of revising the tools in the Impact toolkit and the supporting material offered to all CPD participants. The purpose is to make teachers, irrespective of the content and type of CPD they undertake, focus on outcomes for pupils and to flag the importance of planning for the collection of evidence of impact well before the action is started. The new impact toolkit and evaluation process is being piloted during the academic year 2013/14 and a revised version will be implemented from September 2014.

REFERENCES

- Bolton, G. (2010). *Reflective Practice, Writing and Professional Development*, SAGE publications, California
- Department for Education (2010). *The Importance of Teaching: the Schools White Paper 2010* (Cm. 7980). London: The Stationery Office. Retrieved December

12, 2013, from <http://publications.education.gov.uk/eOrderingDownload/CM-7980.pdf>

Harris, A., Day, C. & Goodall, J. (2006). Evaluating the Impact of CPD. *Scottish Educational Review* 4 (1), 23-29.

Guskey, T.R. (2000). *Evaluating Professional Development*, Thousand Oaks, Ca: Corwin Press.

McNiff, J. and Whitehead, J. (2002). *Action Research: Principles and Practice* (2nd Edition) London, RoutledgeFalmer.

McNiff, J. (2010) *Action Research for Professional Development*, September Books

Ofsted (2012). *The framework for school inspection*. Retrieved December 12, 2013, from <http://www.ofsted.gov.uk/resources/framework-for-school-inspection>

Parry, C. and Berdie, J. (2004). *Moving from teaching to evaluation: Using embedded evaluation to promote learning and provide feedback*. Berkeley, CA: California Social Work Education Centre, University of California. Retrieved December 12, 2013 from <http://calswec.berkeley.edu/files/uploads/pdf/CalSWEC/MacroEvalFrameworkReportFinal.pdf>