Broadening Practical Science in Schools

Report from the 11 July 2019 Workshop

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Contents

Overview of the workshop

This workshop is part of a project to act upon the key findings from the Monitoring Practical Work in Schools and Colleges report[1] from a three-year longitudinal study monitoring the impact on practical science in schools from the changes to the GCSE and A level science qualifications in England. The study was funded by the Gatsby Charitable Foundation with a contribution from Wellcome.

Two of the key findings from the report were that:

- Practical science experiences for 11–18 year-olds are narrow and limited to lesson-length experiments that require "following instructions". Students do not carry out long-term open-ended practical work.
- Post-16 teachers do not know what practical work currently occurs in university laboratory settings, basing this on their own experiences of university.

This project brings together stakeholders including examination boards and science educational professional bodies to identify where additional guidance and support should be targeted to empower teachers to increase the breadth of science practical work undertaken in schools.

The Broadening Practical Science in Schools workshop took place on 11 July 2019 attended by 22 delegates from:

- Examination Awarding Organisations
- Science professional bodies
- Funders/education charities
- The government examinations regulator
- University science education research groups
- and three school teachers from schools identified as having best practice in this area.

The agenda for the day (see below) consisted of presentations by nine of the delegates, followed by small group discussion around the areas of interest and areas highlighted as needing action from the talks. Discussion was facilitated using four questions:

1) What do you understand by a broad practical experience for students in schools?
2) How does this differ by age range (11-14, 14-16, post 16) and subject?
3) What are the challenges faced by schools in providing a broad practical science experience for pupils?
4) How easy/hard is the challenge to change? What can be done to support schools to make a change for the challenges?

[1] Helen Cramman, Vanessa Kind, Andrew Lyth, Helen Gray, Kirsty Younger, Adam Gemar, Paivi Eerola, Rob Coe & Per Kind (2019). Monitoring practical science in schools and colleges. Durham, Durham University. Retrieved from https://www.dur.ac.uk/research/directory/view/?mode=project&id=934

Agenda

10.30am	Welcome and introductions
10.40am	Session 1 Longitudinal studies Practical support for teachers
11.25am	Session 2 – Best practice in the classroom
11.55am	Session 3 – Practical support for teachers
12.25pm	Summary – key points of interest so far
12.30pm	Lunch
1pm	Session 4 – Embedding practical work in the curriculum
1.45pm	Session 5 Small group discussion of areas highlighted as needing actions by the talks Group feedback and discussion
2.50pm	Plenary and close

Responses from the round table small group discussion of the four questions are summarized below.

Question 1 - What do you understand by a broad practical experience for students in schools?

The participants considered in groups what they considered a broad practical science experience for students to be. The responses from all groups have been combined and are summarised below:

- Developing transferrable skills
- Scientific literacy
- Science citizens
- Literacy and numeracy skills
- Investigative + non investigative research
- Independent thinking
- Extends the scope of requirements
- Includes outreach practically
- To include research engagements – which sources to trust
- Range of locations incorporating lab work, field/outside experience
- Variety of lengths of experiment
- Observational
- Balance and variety of all skills + techniques
- Experience as an individual, or in pairs/groups (collaborative opportunity)
- Investigative vs recipe
- Applying knowledge in different practical/theoretical contexts
- Developing attitudes not just techniques – confidence, scientific literacy, investigation
- Understanding how knowledge is gained – puts discoveries in context (history/philosophy of science)
- Qualitative and quantitative
- Different topics
- Demos by teachers
- Relevance beyond science
- Relevant – see why they are doing it – personal situation, local context
- Reflects STEM agenda -> needs in a modern society -> linked to real world for engagement
- Includes activities where students don't know what will happen/what the outcome will be
- Balance of biology/chemistry/physics/environment science etc
- Choices of equipment
- Experience of a range of practical activities
- Appreciate the purpose of investigation to further understand the world around us
- Range of investigative processes
- Range of techniques
- Variety of experiences
- Problem solving
- Gaining/acquiring skills and confidence
- Encouraging enquiry
- Involvement of people who work in science research
- Range of aspects of research: plan, data collection, recording data, analysis, evaluation, report etc
- Developing life skills
- Resilience

Participants also commented that practical work should be

- Inclusive to all students
- Accessible to all key stages
- Not just cover what is required in the specification i.e. include both off/within the curriculum practical work

Question 2 - How does this differ by age range (11-14, 14-16, post 16) and subject?

Younger age

Whole science (not individual subjects)

More open ended

More able to ask 'tricky' questions

Time rich

As increase age range to 14 – 16 (squeeze) less time + more accountability

Should be progression throughout curriculum not repeat

Skills develop across age ranges

Older ages

Individual subjects

Assessment focussed

Time poor

Should be increased autonomy/creativity to decide elements of a practical (ideally)

Should be a greater diversity of experiences (research placements, experiences of the workplace, industry visits)

11 – 14

More freedom to skill build

Not necessary to worry about content all the time

No choice, compulsory

No public exams

Establish skills

Foundation

Room for 'fun'

Extra curricular

More open ended

Teamwork/groups

14 – 16

External exams – therefore league tables

AO1/2/3 skills required

More specialised teachers

Specific terms

More complexity

Less time

More accountability

Post – 16

More data processing

More complex

More open ended

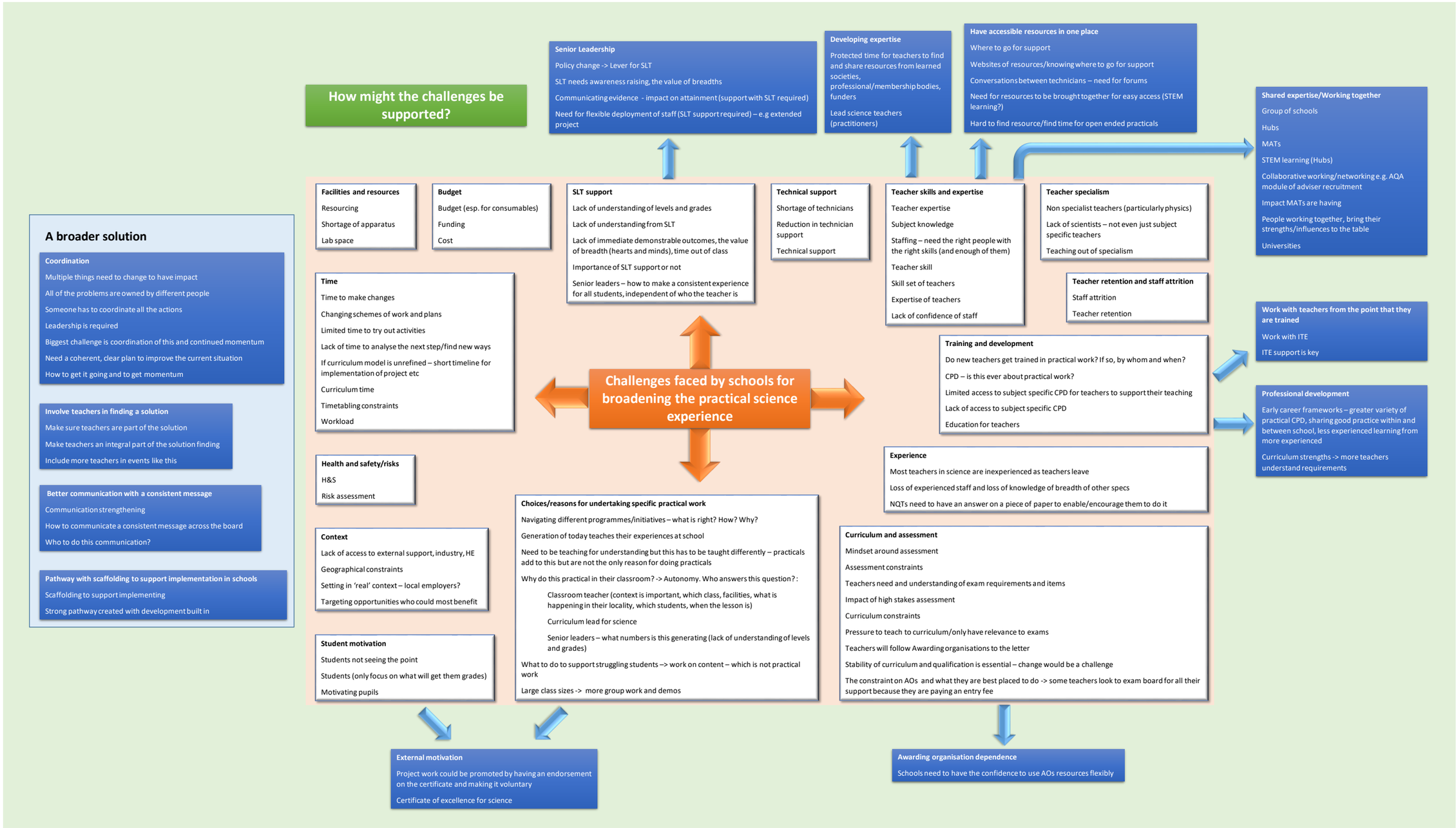
More dangerous

Individual/paired work

More flexibility due to timetabling post 16

Questions 3 and 4 - What are the challenges faced by schools in providing a broad practical science experience for students? How easy/hard are the challenges to change? How might this be supported?

Responses to questions 3 and 4 from all groups have been analysed for common themes and are summarised below.



Feedback

Participants were also asked to provide responses to two feedback questions at the end of the workshop

What did you find particularly interesting or new from the workshop?
The responses fell into five themes:

1) That the event had been a very useful way to fund out about what was going on in this field and that are a lack of forums for this. For those who thought they were already well informed of the research in the area, some expressed surprised that they heard about projects they had not come across before.
2) There was a sense of reassurance by the consistency of findings from across the multiple studies that were presented at the workshop.
3) There was a sense that the workshop had been a good opportunity to speak with people from different organisations that they had not spoken to before.
4) There was a concern at the lack of high level co-ordination to find a joined up solution to the problem.
5) Surprise was expressed by two of the teachers that there was such a large overlap in the research conducted by different organisations. One teacher also commented that "As a teacher I didn't know anything about any of this research - how are teachers going to find out?" This highlights the ongoing problem of how to ensure that teachers are well informed about research which could directly impact on their practice.

What actions will you take away from the workshop?
Two key themes emerged:

1) That they would follow up on conversations with other delegates and find out more about the work going on in other organisations.
2) That there was a range of changes to practice that they would consider, including more emphasis on breadth of practical work in CPD for teachers, increased support materials for schools, changing their individual school policies and introducing additional extra-curricular activities for within their school to address the challenges raised in the workshop.

Conclusions and next steps

The scale of the challenges facing schools in providing a broader practical science experience in schools was evident from the vibrant discussions and points raised by participants at the workshop. The main messages from the day were the need for a centrally coordinated approach to tackle the multiple challenges faced by schools and in ensuring that those on the ground in schools (teachers and technicians) are involved in helping to identify a solution.

The key challenges raised were:

1) The lack of experienced, specialist science teachers, who are well trained and confident in the provision of a broad range of practical science experiences for students, who have access to high quality support materials, are part of an active science community and who have time to investigate, develop, test and share ideas for successful provision in the classroom.
2) A lack of time, which was centred around two areas:
    a. Teacher workload providing insufficient time for the investigation of new ways of carrying out practical work, the opportunity to try out new activities or to update existing lesson plans with different activities.
    b. Timetabling constraints for individual lessons and a lack of time in the curriculum as a whole meaning that teachers focus on prescriptive practical work with defined outcomes to ensure students cover required material.
3) A lack of sufficient technical support, lab facilities and resources (especially for consumables).
4) A lack of understanding and support from senior leadership in schools as to the importance of a broad practical science experience for students and hence a lack of prioritisation for funding and staffing for such activities.
5) The need for more consistent and better communication round the provision of practical work with scaffolded plans to support schools with the implementation of a broad practical science experience for students.

The main consensus from the participants on the day was that the opportunity to meet and discuss the issues with participants from a range of backgrounds had been extremely valuable. Participants reported that they would leave with a range of actions which included: following up on conversations with other delegates to find out more about the work going on in other organisations; including more emphasis on breadth of practical work in CPD for teachers; increased support materials for schools; and changing their individual school policies and introducing additional extra-curricular activities for within their school to address the challenges raised in the workshop.

There was a desire for further workshops to continue the discussions in this areas. The strong recommendation was that future workshops should include additional representatives actively involved in science teaching in schools (teachers and technicians), Initial Teacher Education (ITE) providers, Higher Education science educators, the Department for Education and Ofsted.

The next steps for the project are therefore, to consider the best format and mix of participants for future workshops to move forward discussions and actions for how to support schools in broadening their practical science provision for students.