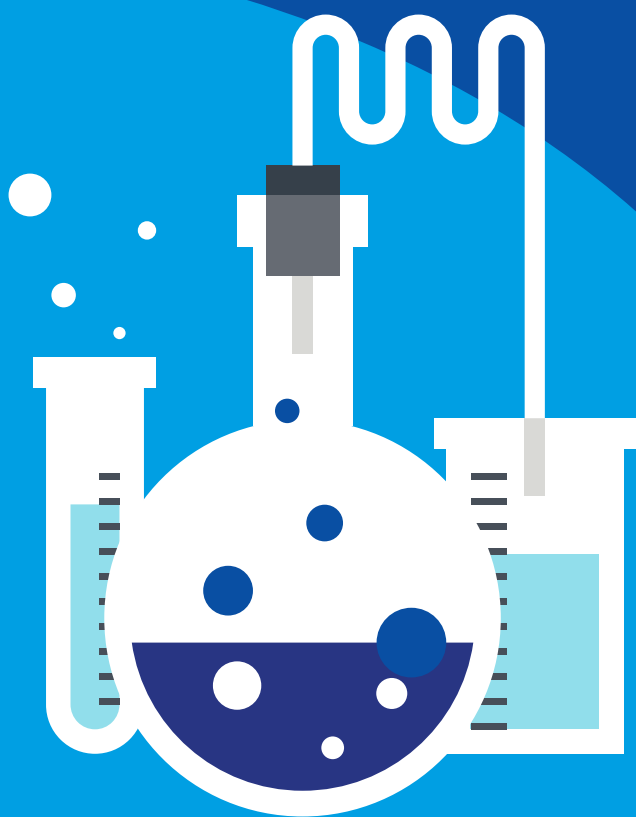


Good Practical Science - making it happen post-Covid-19

The impact of the
Covid-19 crisis on
the Good Practical
Science benchmarks
- a qualitative
report and
recommendations
for the future



The Association
for Science Education

Promoting Excellence in Science Teaching and Learning

Good Practical Science - making it happen

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First published 2020
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Supported by the Gatsby Charitable Foundation

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The ASE wishes to thank the following experienced science leaders for their contributions to this report: Matt Docking (Kings Lynn Academy), Euan Douglas (Saint George Catholic College), Craig Gower (Launceston College), Caroline Greer (Bloomfield Collegiate School), Jon Hitchcock (Helston Community College), Tara Neve-Scott (Great Torrington School).

The Association for Science Education (ASE) is the largest subject association in the UK. As the professional body for all those involved in science education from pre-school to higher education, the ASE provides a national network supported by a dedicated staff team. Members include teachers, technicians and advisers. The Association plays a significant role in promoting excellence in teaching and learning of science in schools and colleges. For more information, go to www.ase.org.uk

In 2017, the Gatsby Charitable Foundation launched Good Practical Science by Sir John Holman. The report provides a framework for good practical science in schools and colleges. Using international visits, surveys and literature reviews, ten benchmarks were identified, which schools and colleges can use when planning their own approach to delivering practical science.

Foreword

The Covid-19 crisis has touched on all aspects of school life and across all subject areas. As an intrinsically practical subject, science education has been particularly impacted by this year's school closures, with difficulties in carrying out practical work set to continue into the new school year.

The importance of this issue for science teachers, leaders and technicians is clear and has been reflected in ASE's recent practical science activities, with over 1,500 teachers and technicians registering for our practical science webinar and almost 900 teachers and technicians responding to our online surveys on practical science in a post lockdown world.

These activities have highlighted both the pressure to catch up on content missed during lockdown and challenges associated with social distancing within classrooms and school laboratories, both of which will reduce the likelihood and frequency of practical work being carried out over the next school year. Alarmingly, at the point where the surveys' snapshots was taken, one in five respondents were anticipating carrying out no practical science at all with their examination classes (GCSE and A-level) in the autumn term.

The Association for Science Education (ASE) is committed to championing the role of hands-on practical science both through the current crisis and in the future. We believe that, as part of an excellent science education, all students should have access to frequent, varied and purposeful practical science, led by expert teachers, with strong technical support and suitable facilities and equipment. Although the Covid-19 crisis has certainly made this more challenging, we believe that it is still possible – and vital – to carry out practical work effectively.

This report provides an expert review of the [Good Practical Science benchmarks](#)¹ through a Covid-19 lens, setting out where usual practice will need to be modified in light of the pandemic and with recommendations for schools and colleges, policymakers and others working in science education. We hope that the report will provide a valuable source of guidance to help ensure that frequent, high quality practical science can continue through this unprecedented period and we are grateful for the support of the Gatsby Foundation with this work.



Hannah Russell, ASE Chief Executive Officer

Introduction

In June 2020, the ASE carried out two online surveys into practical science in a post-lockdown world: [one of science leaders and teachers](#)² (410 responses) and a second [survey of science technicians](#)³ (472 responses). Responses to both surveys identified a number of concerns about teaching science, and particularly the use of practical science, during lockdown caused by the Covid-19 pandemic, and the subsequent return to school for some students.

These responses and the emerging concerns were used as the focus for discussions with a number of experienced subject leaders. These discussions took place online in late June between small groups of experienced science leaders and the ASE 'Good Practical Science - Making It Happen' team.

The following report identifies, for each of the [Good Practical Science benchmarks](#)⁴, where it has been or shortly will be necessary to modify usual practice, and provides suggestions for how the benchmarks could be enhanced to give further support to less experienced science teachers and those in science leadership roles. The discussion comments in each benchmark section contain either free text responses to survey questions, or summaries of comments made during the online discussions. Recommendations for each benchmark are included for schools and colleges and, also more generally, for policymakers and others working in science education, to help inform future work in this area.

Benchmark 1: Planned practical science

“Every school should have a written policy that explains why teachers use practical science, the outcomes they expect from it and how they achieve those outcomes. The process of producing the policy is as important as the policy itself.”

Rationale

Existing policies on practical science have been shown to be effective in developing consistency and good practice within the department in normal circumstances. However, the introduction of home schooling and the anticipated return to school or college, once infection measures are eased, have demonstrated that these policies need to be reviewed to take account of new ways of working, and for contingencies in case further school restrictions are required.

The ASE’s benchmark 1 project has produced [two resources](#)⁵ and a [poster](#)⁵ to support schools and colleges who are considering their own written policy.

Discussion comments

“ In future, we will probably invest more use in online classroom technology, but will need to provide support and training for pupils and their parents in using these effectively.”

“ The home has become a bigger influence on a student’s progress than previously, so parental support and things like Internet access need to be considered in future policies.”

“ As inexperienced teachers may be encountering practical science teaching with even less confidence than usual, it will be necessary to provide effective subject-specific mentors.”

Commentary

A good proportion of survey respondents (60%), and our focus group science leaders, have a practical science policy in place and this helped during the current crisis to focus efforts. Discussions indicated that all benchmarks would need to be revisited when updating policies, and started with the purposes of practical activities, leading on to different types of effective activities, the challenges plus opportunities presented by technologies for remote learning, and supporting teachers and technicians to ensure that practical work remains an essential component of science learning. Each of these is explored further in their relevant benchmark sections of this report.

The purposes of practical science most frequently emphasised were using practical work to help students understand theory, and for motivation. Far less emphasis was placed on the teaching of practical skills, principles of enquiry or communication and

Benchmark 1: Planned practical science

teamwork, although, on return to school or college, respondents intended to place a similar emphasis on each of these five purposes.

Teaching students remotely from home has led to far greater use of digital technology than previously, but there is concern that many students may not have adequate access to hardware and the Internet, or adequate support structures when away from school. In some schools and colleges, there are restrictions on the forms of digital communication that are permitted, but all the teachers in discussion groups were making some use of specific types of online classroom.

The use of such technology is leading to different ways of communicating, recording data and storing resources. However, this can be time-consuming, and experiments conducted online have not always been successful. Such 'remote working' has also shown the importance of clear and well-structured instructions to students. Hence, as well as the need for support and training for students and their parents, there is also a need for further teacher professional development.

Since the onset of the pandemic, teachers have been providing classes with data sets when teaching investigative skills rather than relying on students' own data collected in a practical activity. Restrictions on the amount of practical science that is possible have led to an uncoupling of the teaching of enquiry processes from practical skills so that a clearer focus can be achieved. The timing of when areas are taught has also been modified, leading to the spreading of teaching specific skills across all year groups, so that more teaching of skills in lower school will be retained as this has been found to be successful.

During lockdown, pupils at home and in school were working with simulations more than other types of practical activity. There were few examples of open-ended investigations, fieldwork or citizen science activities, and so schools and colleges need to consider how to redress this balance.

Recommendations to schools and colleges

- Review practical science policies in the light of uncertainty around returning to normal working conditions and the possible need for remote teaching in future.
- Put in place steps to support students who may be at significant disadvantage if the department decides to make greater use of digital technology for home learning.
- Plan for the training and support needs of students, parents, technicians and teachers for any planned changes to current practice.

Benchmark 2: Purposeful practical science

“Teachers should know the purpose of any practical science activity, and it should be planned and executed so it is effective and integrated with other science learning.”

Rationale

Practical science activities can promote the learning of science in different ways, such as learning new practical techniques, supporting the understanding of a scientific theory and developing the skills of scientific enquiry, but they also have a wider purpose of engaging with learners and helping them to develop broader skills such as teamwork and communication.

Whilst isolated at home, some of these outcomes have been difficult to achieve, but using practical work to support the learning of science theory and engage and motivate students has become increasingly important. Whilst interaction with other people, and with equipment and materials, is made more difficult when working from home, careful planning by teachers has enabled many students to remain engaged in work set by schools and colleges.

Discussion comments

“ Practical science activities will be important as a means of introducing the new intake of students to science in secondary school.”

“ Teaching enquiry skills without equipment avoids distraction and has been more successful – focus on providing context or data rather than carrying out an investigation.”

“ On return to school some practical science activities will be tweaked to increase pupil motivation, which will have been badly affected by children being isolated from school for so long.”

“ In lockdown it is hard to teach skills, and so the focus has been on developing understanding. Practical work is a good way of revising work carried out whilst at home.”

Commentary

Many teachers have been setting simple practical activities to do at home, as well as making use of technology to replicate practical science. Their purpose has been to reinforce the learning of science subject matter, as well as to engage students in their learning. It has been recognised that a significant proportion of students has not engaged in learning from home, so some teachers have tried, with some success, to use video clips of practical work to re-engage learners at home. On return to school, practical work will be used to help revise and consolidate understanding of science

Benchmark 2: Purposeful practical science

theory, and also to help those children who did not engage with home learning to get back into the routines of learning science in a school laboratory.

The teacher survey results show 65% of teachers expected to place a large emphasis on the use of practical science to support understanding from September, and 60% were planning to focus on using practical science for motivation. However, many teachers (50%) were planning to offset the impact of lockdown on practical science by placing a large emphasis on the development of practical skills and the principles of scientific enquiry.

There was concern expressed in the focus groups that there may be a reduced uptake of A-level sciences by students caused by a reduction in confidence. With less direct practical experience for students in their GCSE courses, teachers believed that a proportion of potential students would be unwilling to embark on an A-level course that contains a compulsory practical component in the examination.

Recommendations to schools and colleges

- Consider if, how and when practical activities should be planned that help introduce new students to effective ways of learning, or reintroduce those students who may have become disengaged with learning whilst absent from school.
- Identify which practical activities are most effective at helping students develop a better understanding of science. Identify those aspects of science that benefit most from practical activities.
- Identify which groups of pupils are most motivated by practical science and those who are more motivated by other aspects of the subject, and review your curriculum to take account of these differences.
- Decide how to offset the lack of opportunities for students to plan investigations or acquire practical techniques given the changes made to examination requirements and the likely impact that this may have in subsequent years.

Benchmark 3: Expert teachers

“Teachers should have subject-specialist training (both initial and continuing) in the subject (biology, chemistry, physics, etc) and age range they teach, so they can carry out practical science with confidence and knowledge of the underlying principles.”

Rationale

Expert teachers are able to select appropriate practical activities and exploit each activity to achieve their intended educational purpose. During lockdown, when teaching children remotely and using online technologies in some cases, teachers found themselves needing to build up new expertise and that of their colleagues in these ways of working.

As schools and colleges return to full class sizes, changes in teaching practices will place more emphasis on safe teaching techniques, and so practical science activities are likely to make greater use of demonstrations, simulations and video clips than previously. There will need to be support for teachers and technicians in the use of these approaches, and particularly for new and inexperienced teachers who have had little exposure to practical science teaching.

Discussion comments

“ Inexperienced teachers sometimes lack confidence when performing demonstrations.”

“ Increased network opportunities due to online webinars, particularly [from] the Royal Society of Chemistry and ASE, and online TeachMeets have been great.”

“ Many new teachers are not well experienced in teaching practical science or doing practical work themselves as students.”

Commentary

Teacher expertise in how to use online classroom tools is improving, although some teachers have found it easier than others to set practical activities that can be done at home and which have a clear learning benefit. Teachers have found that their classes became bored when watching externally-produced video clips of practical demonstrations, but responded much more positively to clips of their own teacher doing the same demonstration but in familiar surroundings. There is an opportunity here to share expertise in the production of such clips and other aspects of digital technology, such as how to provide quality instructions that make teaching points effectively but succinctly.

Demonstrations of practical activities are likely to play a more central role in science teaching on return to school, but this is a difficult strategy to master. The teacher needs

Benchmark 3: Expert teachers

to be confident in carrying out the activity, whilst controlling the class and engaging students in a responsive learning dialogue. One suggested approach when planning demonstrations is to ask a technician to carry out the practical work, so freeing up the teacher to interact with the class.

Additional pressures on return to school may mean insufficient time can be devoted to supporting colleagues. The teacher survey revealed that 16% of respondents did not feel their science teams have plans in place to support newly qualified teachers, inexperienced teachers or those teaching outside their subject specialism.

A further concern is that 25% of respondents do not feel that their school or college has adequate technicians with experience to support safe practical work. Yet there were numerous examples in the technicians' survey illustrating how technicians have exploited changing working conditions during the pandemic to support their department and engage in their own professional development, as suggested by this example:

“ Due to many events moving online, lots of CPD opportunities have opened up and time to reflect on ways to improve the technical service moving forward. I really hope the remote webinars, training and networking events for technicians continue - in terms of access and cost effectiveness, these are a big plus for a lone technician.”

Recommendations to schools and colleges

- Ensure that expertise in the use of demonstrations, simulations and video clips can be shared across the department.
- Consider what steps are needed to support inexperienced teachers of science.
- Identify time and cost-effective means of supporting professional development made available through the increased use of online technology.

Benchmark 4: Frequent and varied practical science

“Students should experience a practical activity in at least half of their science lessons. These activities can be short or long, but should be varied in type.”

Rationale

This benchmark has provided strong guidance for planning in many schools and colleges, which have modified their policy with the proviso ‘when appropriate’. Taken literally, the benchmark could lead some schools and colleges to timetable separate theory and practical lessons, but this idea was rejected by teachers in our expert panel. Rather, they saw this solution as imposing too many constraints, including the loss of spontaneity, which they consider very important, and it runs the risk of separating practical experience from theoretical understanding.

As schools return in the coming months, there is a recognition that less practical science will be possible, and therefore it is important to prioritise this limited resource according to purpose and need.

Discussion comments

“ It has pushed us towards microscale chemistry which I have been trying to introduce for a while.”

“ Structure and boundaries for movement around lab are working very well. Autism Spectrum Disorder children are much calmer and able to co-operate better with rigid rules in place.”

“ We have been researching new experiments to better fit the curriculum whilst in lockdown.”

Commentary

There is a concern that, because of the understandably precautionary approach advised by authorities such as [CLEAPSS](#)⁶ and [SSERC](#)⁷, there will be less practical science and that spontaneity will be reduced. In the short term, practical science will need to be more structured and planned. A varied approach to practical science is needed to address the full range of learning purposes, and this will be particularly important as not all students engaged with working from home.

It was noted that some children in examination classes may be anxious about lost time and may not be willing to engage with practical science at the perceived expense of theoretical knowledge. This challenges teachers to make the connections explicit in learning science theory through practical work.

Benchmark 4: Frequent and varied practical science

The marking out of labs to ensure safe movement, following guidance from CLEAPSS, has proved very successful and other lockdown experiences have shown that individual working rather than small group working has made learning more effective in some schools and colleges. Relationships with vulnerable pupils have improved, there has been an improvement in student behaviour, and the quality of learning is better. However, this has to be balanced against fewer opportunities to do practical science, some rationing according to need, and an increase in preparation time for technicians. In turn, these experiences have led to re-evaluating practicals to ensure that they add value to learning.

The teacher survey showed that pre-Covid-19 lockdown, the majority (60%) of students aged 11-14 were doing some form of practical work in over 50% of lessons. This percentage fell in 14-16 and post-16 age groups, but was still over 30%. It is anticipated that this proportion will fall significantly, on return to school, to less than 18% in any age group, with about 20% of secondary students not doing any practical science at all.

Recommendations to schools and colleges

- List a wide range of activities that can support both face-to-face and distance learning, should further school closures be necessary.
- Investigate the use of demonstration as an effective means of teaching how to carry out practical science, and as a means of generating data for learning.
- Explore the potential of home learning as a way of facilitating types of activity that will be difficult to organise in school in the coming months, such as fieldwork and open-ended investigations.

Benchmark 5: Laboratory facilities and equipment

“Schools should have enough laboratories to make it possible for every teacher to do frequent practical science safely. Each laboratory should have sufficient equipment for students to work in small groups..”

Rationale

Whilst distance learning, few students will have had access to technical equipment and spaces where they can carry out practical science. Teachers are keen for students to re-engage with science learning, and their plans often include the use of practical science for this purpose.

However, following current guidance may mean that many schools and colleges lack adequate space for practical science whilst maintaining social distancing, and lack sufficient equipment for students to work individually. A further concern is the need to restrict unnecessary movement within and between laboratories.

Discussion comments

“ We are ensuring that basic equipment is provided in each laboratory rather than moving things, even considering individualised kits.”

“ We as a tech team have had time to discuss and make plans for projects and changes to be made in the prep room to make our working environment more efficient.”

“ We plan to put a demonstration box of equipment in each classroom near the teacher desk so that teachers can continue to show practical activities and techniques whilst reducing unnecessary movement around the room.”

Commentary

All the teachers in our discussions were following CLEAPSS guidance published during lockdown and they all found it helpful. The need for additional protective equipment was not a major concern as long as teachers had access to PPE in case an emergency arose. One school was considering issuing every student with their own eye protection to overcome problems of sterilisation of eyewear between classes but, in general, few were budgeting for the purchase of additional protective equipment.

Working with small groups of students during lockdown has shown that individual trays of equipment have provided a better learning experience for students than the small group work that has been the norm. Without further expenditure, the implication of this finding is that a major review of the management of practical science will be required.

Benchmark 5: Laboratory facilities and equipment

There was a consensus that a visualiser has become an essential piece of equipment in every classroom, as it allows students to see a demonstration without having to move from their seats. The same apparatus is also useful for sharing diagrams, model answers, etc.

There was considerable anxiety caused by a lack of clarity and guidance on managing a safe return to schools. About 40% of respondents indicated that their schools and colleges have been unable to plan for the start of next term. Schools and colleges need more clarity over the provision of PPE and its appropriate use, safe distancing in teaching spaces and when providing services in laboratories, provision of additional equipment for practical science, and how equipment and learning materials can be sterilised or quarantined. As the situation continues to evolve, it is important that regularly updated guidance is readily accessible, and is appropriate to audience (senior leaders, teachers, technicians).

The teacher survey revealed that about 50% of teachers had plans in place for conducting practical science with social distancing measures. More (70%) had developed plans to map the curriculum and to sequence work appropriately. Fewer had plans for the use of PPE by staff and pupils, or were able to plan for lab and prep room space with social distancing or to provide equipment for individuals or smaller groups of students.

Recommendations to schools and colleges

- Decide whether visualisers can be provided to support learning. They can broaden the range of teaching approaches and increase the impact on learning of activities such as running demonstrations, analysing data and critiquing conclusions.
- Decide whether it is appropriate to provide students with individual trays of equipment for practical science activities. The improvement in learning experiences will need to be offset against careful sequencing of the curriculum and management of equipment.
- Share current information between teachers, technicians and senior leaders and adapt plans appropriately as guidance continues to be modified.

Benchmark 6: Technical support

“Science departments should have enough technical or technician support to enable teachers to carry out frequent and effective practical science.”

Rationale

Technicians play a key role in enabling students to access safe and effective practical science as well as providing vital support to science teachers. Although many technicians in independent schools were furloughed during lockdown, others in both state and independent schools have continued to be employed whilst students work from home.

In many cases, this has allowed additional time for reorganising teaching and preparation spaces, developing systems to be more efficient when classes return, and this has allowed technicians more time to meet with others or to engage in professional development.

Overall, this could lead to a more efficient and effective working relationship in the future, with technicians playing a significant role in supporting health and safety throughout the school and using their expertise to devise more effective ways of teaching practical science.

Discussion comments



I have done some great online CPD and courses, and I'm looking into RSciTech status.”



A chance to have a greater input on the role of the technician and really highlight the skills, especially Health and Safety knowledge, that a technician has. Also having a seat at the table in the discussion as to how a practical experiment could work.”



Technicians have been invisible in the school for a long time. Most managers and Senior Leadership Teams don't even know what we do on a day-to-day basis and our role plus all the extra jobs we do as a whole for the school. This is the first time that I have seen an increase in communication between Heads and techs and trying to get techs involved in future decisions.”

Commentary

Anecdotal evidence received over the past few months has highlighted concerns by school science technicians that, with an anticipated reduction in practical work over the next school year, they may be at risk of redundancy, particularly where they have already been furloughed. If correct, this will be a false economy, in both the short and longer term, which will further increase pressure on teachers.

Replacing an experienced and knowledgeable technician workforce in the future, when attempting to return to normal expectations around practical work, would certainly

Benchmark 6: Technical support

be difficult to achieve. Moreover, the need for technical support will increase on return of students to school this autumn. It is anticipated that more preparation time for equipment will be needed and additional measures will need to be put in place to reduce the risk of transmission of infection amongst children and adults. The additional workload for technicians could limit the quantity of practical work carried out, which in turn could stimulate reviews of the curriculum to ensure that only activities with proven learning benefits are supported.

Over 80% of technician respondents had some concerns over an increased workload or changes to working practices and 25% of technicians anticipate that their workload will not be manageable within their normal hours. In our focus group discussions, it was suggested that this could lead to a rationing of technician support time for each teacher or that other non-technician staff in schools and colleges could be asked to help clean equipment.

Recommendations to schools and colleges

Working collectively as a science team, teachers, technicians and a senior leader could:

- Review the curriculum to ensure that planned practical science activities are effective and efficient in the likely limited time available.
- Decide priorities for practical science in terms of classes, activities and managing safety within the science area.
- Review current guidance to identify necessary changes to current workload and laboratory practices.

Benchmark 7: Real experiments, virtual enhancements

“Teachers should use digital technologies to support and enhance practical experience, but not to replace it.”

Rationale

In normal situations, simulations can be a useful way of extending a practical science activity, for example by investigating the effect of changing additional variables or collecting additional data. Video clips are useful for reminding students of practical procedures or for revision purposes.

During home schooling these digital tools have replaced rather than enhanced normal activities, and therefore careful planning is needed to ensure students engage with the material and that the experience contributes to learning science.

Discussion comments

“ It makes a massive difference for children to hear their own teacher’s voice in a video clip.”

“ We now have an effective online offering for Key Stages 3 and 4 that will be useful in the future for students out of school through illness etc.”

“ The college has really grabbed the opportunity to launch online live teaching.”

“ When most children only have access to smart phones rather than laptops, video clips are more effective than simulations at supporting learning.”

Commentary

Home produced resources are more effective than commercially produced material as children respond well to the sight and sound of their own teacher in familiar surroundings and with familiar equipment on video clips. Such clips do not need high production standards, and simple voice overs can be added using conferencing software. Even slide presentations can be enhanced using proprietary software tools that add a video thumbnail of the teacher discussing each slide.

Simulations have been used effectively as instruction tools in some situations, such as microscopy where a good simulation can teach the names of parts of a microscope, how to prepare a slide, how to measure objects under magnification and so on. One teacher suggested that on return to class teaching they would continue to use the simulation coupled with a digital microscope that could present images on a screen. This was considered a more effective introduction to microscopy than previous practice.

The survey results showed that simulations have been used extensively for home schooling. The use of such tools is a potential area for professional development as

Benchmark 7: Real experiments, virtual enhancements

[recent research](#)⁸ is showing that children's learning is enhanced considerably by effective teacher dialogue around the use of such activities. However, considerable experience is required to generate learning opportunities from these discussions and guidance for effective demonstrations will be valuable, particularly for less experienced teachers.

It was also pointed out that access to hardware and online connectivity is a significant problem in some areas and for some children.

Recommendations to schools and colleges

- Share good practice on how to create digital resources within a sensible timeframe and budget.
- Share good practice on how to plan an effective lesson that incorporates digital resources.
- Review ease of home access to online digital resources for your students.
- Look out for ASE's free webinar series during the autumn term, in partnership with Institute of Physics, Royal Society of Biology and Royal Society of Chemistry, with a focus on virtual enhancements.

Benchmark 8: Investigative projects

“Students should have opportunities to do open-ended and extended investigative projects.”

Rationale

Students should have opportunities to do open-ended and extended investigative projects. This is more challenging at home in the absence of teacher interaction and equipment, but is still possible, and a number of organisations provide support and opportunities such as the [OPAL biodiversity survey](#)⁹ or [Zooniverse’s Backyard Worlds project](#)¹⁰. On returning to school, such projects could be used to offset the Covid-19 related problems around working inside laboratories and sharing equipment.

Discussion comments



Enquiry can be taught through any practical activity – it does not need a specific type of investigation.”



We have broken down enquiry skills to be worked on discretely in different practicals but once a term we set a full enquiry investigation. This has been abandoned during lockdown. We spread out the teaching of skills and techniques over five years in normal practice and so disruption caused by this is minimal.”



Some investigations have been done at home using simple activities. Some staff need support in setting appropriate types of activity as some have not been well thought out. The better ones involved controlling variables.”

Commentary

Many students working at home were set investigative projects, and particularly in the 11-14 age range, but also in exam classes. Of the 400 responses in the survey that reported setting some form of practical work for students working at home, 280 classed these as ‘experiments’ and 160 were classed as ‘open-ended investigations’.

These figures represent about double the number of those relating to set tasks within school over the same period. Many teachers had risen to the challenge of planning these activities to ensure that they were ‘minds-on’ as well as ‘hands-on’ by requiring students to make decisions about things such as measurement, data collection and the effect of different variables.

On return to school, about 50% of respondents intended to place a big emphasis on teaching the principles of scientific enquiry, which was echoed in discussion with our focus group teachers – there will be opportunities in each practical activity undertaken at home to draw out some aspect of scientific investigation when classes return to school.

Benchmark 8: Investigative projects

Recommendations to schools and colleges

- Discuss with colleagues whether to increase the use of open-ended investigations. These include outdoor science and fieldwork and could be used more frequently in the curriculum to offset some of the difficulties of conducting practical science inside laboratories.
- Explore resources such as the British Science Association 'CREST in the Curriculum' or projects such as the Royal Society's 'Partnership Awards Scheme' to support the teaching of open-ended investigations.
- Plan a number of investigations that could be effectively carried out at home in case of future school closures.

Benchmark 9: A balanced approach to risk

“Students’ experience of practical science should not be restricted by unnecessary risk aversion.”

Rationale

Schools and colleges are good at managing risk within science lessons and make extensive use of guidance produced by organisations such as CLEAPSS and SSERC. Additional support from these organisations since schools and colleges ceased to operate normally on how to teach science ‘remotely’ has been welcomed. Their guidance on additional measures for a safe return to school are being put in place, as science departments are not be restricted by unnecessary risk aversion.

Discussion comments



School leaders need additional guidance for all subjects where equipment is used.”



Once schools are back into their routines, there should be guidance so that all school adopt common practices.”



The CLEAPSS guidance is adequate. It is absolutely clear. It is the only source of guidance for us in Northern Ireland, as the education department guidance is too variable.”

Commentary

The survey of teachers and technicians revealed that, pre Covid-19, a small minority of schools did no practical science with their classes (8% - 11/14, 8% - 14/16, 12% - post 16). There was a marked increase in the numbers anticipating no practical science activity in the term following a return to school (22% - 11/14, 20% - 14/16, 20% - post 16). In some schools, site teams and leadership have instructed that there should be no use of practical resources due to health risks. Science departments are responding to risks in different ways, with some ordering additional eye protection, either to issue personal equipment to students, or due to the time taken to effectively clean and sterilise eye wear. Some schools are considering the purchase of additional textbooks so that books loaned to students can be quarantined without this impacting on other classes.

Recommendations to schools and colleges

- Share accurate information and guidance at all levels.
- Prepare a strong evidence-based case to present to school leaders to ensure that no students are disadvantaged by being unable to carry out practical work over the forthcoming school year, and particularly to comply with examination requirements.
- Plan the likely impact of managing risk in the coming months and years, for all students throughout the school, with the whole department.

Benchmark 10: Assessment fit for purpose

“Assessment of students’ work in science should include assessment of their practical knowledge, skills and behaviours. This applies to both formative and summative assessment.”

Rationale

Regular individualised feedback is vital for helping teachers plan further learning activities and also for helping students recognise the progress they are making and to give them the confidence to move forward.

Such assessment depends on small-scale social interactions stimulated by observations and discussions that take place when teachers have built a learning relationship with their students and can move freely between groups or individuals.

Such social interactions are inhibited when teaching remotely, as children work at home either online or using more traditional paper-based activities. As schools and colleges begin to return to normal and admit students once more, there will remain in place restrictions on free movement and distancing, which will continue to inhibit social interaction and therefore impede the assessment process that is central to learning.

Teachers need to plan how to provide assessment opportunities for practical science and for other aspects of science teaching, given that normal laboratory interactions may not be possible for some time.

Discussion comments

“ Children want more feedback when working remotely. This can partly be provided by online classroom software, even though there is less teacher / student dialogue.”

“ Google Classroom is good for providing feedback to classes and individuals, and Google Meets are being used for question and answer sessions. The staff are adapting to new ways of working.”

“ When teachers meet new classes for the first time, they need to build a relationship with individual students. This may become more difficult in future, particularly if remote working continues, and so new ways of building interactions with students may be needed.”

Commentary

Our expert teachers recognised the importance of informal assessment, and the challenges presented by the current situation. They highlighted the need expressed by their students for feedback in the current situation, and their own concerns about providing informal signals such as facial expressions, nods of the head, auditory signals and body language when teaching remotely. One teacher reported on how much additional time it was taking to provide personalised online written comments to

Benchmark 10: Assessment fit for purpose

students compared to normal practice, but all saw such feedback and assessment as essential for maintaining student progress. On returning to school the situation is likely to improve, but restricted movement around classrooms, and other social distancing measures, mean that informal feedback is probably going to remain a challenge into the future.

In all cases, our expert teachers were using online classroom software to provide feedback to students, and many thought the need for such feedback was greater when students are working remotely than when in the classroom. There was optimism that colleagues were learning new skills and adapting to this change in practice.

In England, this sample of expert teachers were generally confident that assessment of practical skills for GCSE and A-level are manageable and did not expect to have to make significant changes to their current practice. They each had a well thought out policy for summative practical skill assessment in place. However, in Northern Ireland there was concern that the model of practical assessment in use meant that students would be unable to fulfil the requirements and it was suggested that the practical assessment component of GCSE be removed for one year.

Recommendations to schools and colleges

- Ensure that your written policy for practical science makes provision for the development and assessment of science skills and techniques over the full period of secondary education.
- Plan further practical science induction activities both for students new to the school and for classes with new teachers. This is to ensure that, in the case of remote teaching being necessary, effective dialogue and feedback may continue.
- Consider the use of online classroom technology as an effective solution to improving communication between staff, students and their parents.

Recommendations for policy makers and others working in science education

The recommendations accompanying each benchmark in this report are intended to support schools and colleges. However, the impact of Covid-19 on practical science also highlights the following recommendations for policymakers and others working in science education, which will be crucial in enabling the benchmarks to be achieved:

- **Clearly signal the value of practical science** – Policymakers should continue to emphasise their commitment to assessed practical science in the longer term. Such messages will serve to remind school and college leaders of the need to ensure that frequent, purposeful and impactful practical work characterises their rich science curriculum offering for all students.
- **Increase access to high quality continuing professional development for teachers** in the effective use of demonstrations, simulations and video clips in practical science, alongside student activities, particularly for new and inexperienced teachers who have had little exposure to practical science teaching. Recent professional development activities provided by ASE and others have shown that many of these can be successfully delivered online, avoiding the need for unnecessary travel and face-to-face meetings during the current pandemic.
- **Ensure access to expert support and advice** to help teachers to teach science effectively in these testing circumstances, for example how to use demonstrations and simulations for maximum learning benefit. Policymakers should support professional bodies such as ASE to provide further guidance on planning for purposeful practical science and assessing its impact, and to provide opportunities for sharing of expertise. As highlighted in the original Good Practical Science report, all schools and colleges should belong to CLEAPSS or SSERC, either individually or through their local authority or Academy Trust and should use their expert advice to ensure a balanced approach to risk, particularly given the restrictions placed by the current pandemic.
- **Level up student access to practical science** – Building on [government commitments on laptops for home learning](#)¹¹, schools and colleges must be supported to in turn support those students who may be at significant disadvantage if the department decides to make greater use of digital technology for home learning.
- **Ensure that practical work remains a key part of assessment in science** – Interim changes to the assessment of practical science through examination should be regarded as such, and messages from policymakers should not inadvertently signal a change in policy about the importance of practical work as experienced directly by students. Any interim arrangements around the A-level Practical Endorsement should be monitored throughout this academic year. Research should be carried out into valid, reliable and manageable ways of assessing practical science given the current pandemic, to help ensure that practical work remains a key element of science education at all levels.

Recommendations for policy makers and others working in science education

- **Monitor workload and support those at risk of leaving the profession** – It is widely recognised that science teachers and technicians experience heavy workloads. It will be important to monitor workloads and changing work patterns during this academic year and to provide guidance to support those that are experiencing difficulties, for example through frameworks such as the ASE’s Science Teacher SOS.
- **Value school science technicians** – Technicians play a key role in enabling students to access safe and effective practical science as well as providing vital support to science teachers. As with teachers, technicians will need access to high quality professional development opportunities to adapt to new ways of working in light of Covid-19. Policymakers should also monitor technician numbers in schools and colleges to ensure that any short-term reductions in practical work do not translate into longer-term reductions in this important part of the school and college workforce. Additionally, learning from the Technician Commitment in higher education, consider the feasibility and potential impact of a Technician Commitment for school- and college-based technicians.

Links

- 1 - A report by the Gatsby Foundation www.gatsby.org.uk/education/programmes/support-for-practical-science-in-schools
- 2 - Science leaders and teachers survey www.surveymonkey.com/create/preview/?sm=m2_2FbRLfA_2FO8x0EoZVEBTqEZzfAvqk94foQ1GmjwIXwE_3D
- 3 - Technicians survey www.surveymonkey.com/create/preview/?sm=_2BlrPBL3w3LFuoVr5V2ihRUrYdrtON5jOtruq6tRJUMo_3D
- 4 - A report by the Gatsby Foundation www.gatsby.org.uk/education/programmes/support-for-practical-science-in-schools
- 5 - ASE's Good Practical Science benchmark 1 resources:
www.ase.org.uk/resources/good-practical-science-making-it-happen
www.ase.org.uk/sites/default/files/GPS%20Poster.pdf
- 6 - CLEAPSS www.cleapss.org.uk/
- 7 - SSERC www.sserc.org.uk/
- 8 - Interim findings of the Practical Assessment in School Science project www.kcl.ac.uk/events/assessing-practical-skills-through-written-examination-questions
- 9 - OPAL biodiversity survey www.imperial.ac.uk/opal/surveys/biodiversitysurvey/
- 10 - Zooniverse's Backyard Worlds project www.zooniverse.org/projects/marckuchner/backyard-worlds-planet-9
- 11 - <https://www.gov.uk/government/news/new-major-package-to-support-online-learning>