

Dr Nicola Robinson Teaching Practical Science during/post- Coronavirus Lockdown June 2020

Contents

Poll/Survey Context	1
Overall Summary:	1
Summary of responses to each question:	2
Appendix:	5
POLL QUESTIONS	5
Some question responses in more detail	6
Question 2 Responses:	6
Question 6 responses:	6
Question 7 Responses:	7
Question 8 Responses:	7
Question 10 Responses:	8

Poll/Survey Context

Secondary science teachers were asked to complete an anonymous survey (Microsoft Forms) for EI research purposes.

Message sent to individual teachers: Please can I ask you to complete a short survey on the feasibility of Practical Science in schools in September (if appropriate, please feel free to pass on to your science team). I'm writing a research paper looking ahead to September, and hence it would be invaluable to get some opinions from schools (N.B. no teachers' names will be used).

15 responses came from 6 different schools (Kent and Medway) from teachers teaching KS3 - KS5 Science (KS4 and 5 as subject specialists in Biology, Chemistry, Physics).

Overall Summary:

Most schools had not offered any practical activities to students across all key stages (12/15 responders);

Teachers identified the fact that the lack of a school environment was the reason for offering no practical activity, along with the fact that they could select material that didn't require practical work and they could substitute live practicals with on-line resources (e.g. video/simulation);

Teachers were mixed in their responses regarding practical work in September, needing more guidance e.g. DfE, Cleapps etc; but many thought limited practical work was possible (7/15 responders);

Barriers to practical work in September included Health and Safety issues and the assumption that social distancing constraints would mean students needing to have individual equipment/resources, which would be very challenging.

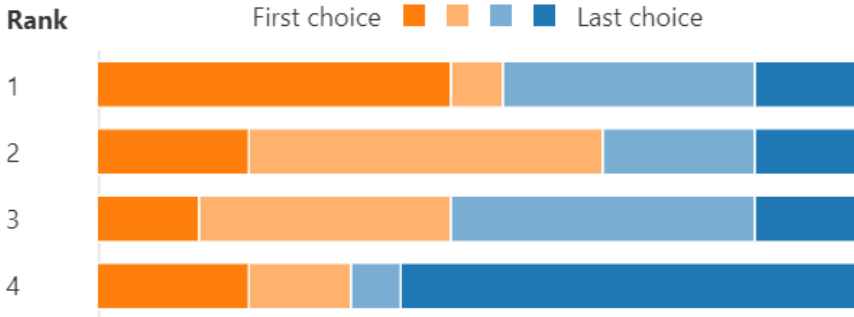
Concerns were highlighted relating to the feasibility of teachers being able to physically help students during practical work and for students to experience teamwork.

The teachers' responses indicate that many use practical work to support curriculum content only and for GCSE/A-level they are perhaps tied to the qualification required practicals.

The responses provide a need for further discussion concerning the value and purpose of practical science generally amongst teachers.

Summary of responses to each question:

Question	Responses
1. Have you provided any practical activities to any students during the Coronavirus lockdown? YES / NO	12 NO 3 YES
2. In relation to your response in question 1, if you answered no, please provide the reasons why you haven't provided practical activities	Themes: <ul style="list-style-type: none"> • Impossible due to home environment and lack of equipment/ equitable student access; exam spec required practicals can't be done at home • No time to organise/plan • Can use model data/simulations instead; • Teachers selected content not requiring practical work
3. In relation to your response in question 1, if you answered yes, please provide (i) the year group/Key Stage you provided the practical activities to and (ii) details of the activities (and whether they were directly linked to your previous SOWs)	A. KS3 simple HSW investigations B. KS3 students: simple investigations involving observations and/or measurement that pupils can easily do at home. E.g, investigating moments using a ruler, some coins and a pencil. We have avoided investigations involving the use of food. KS4/KS5 mainly set work that requires students to read material, answer questions and research topics online. For some activities we have use PHETs simulations. C. Electrolysis with IB1 using a battery at home and some salt solutions. RSC screen experiments (on-line virtual): Titration and Aspirin with A2 and IB1. Labster also has some simulation activities. These are experiments directly linked to the SOW / syllabus.

<p>4. Thinking ahead to September what are your views on the feasibility of practical work (assuming social distancing still in place)</p> <p>A. No practical work will be possible - students will watch videos or teacher demos of key practicals</p> <p>B. Limited practical work will be possible - e.g. Required Practicals (GCSE/A-level)</p> <p>C. Impossible to predict without guidance from DfE, School, Exam boards</p>	<p>A. 1</p> <p>B. 7</p> <p>C. 7</p>																									
<p>5. If you answered "no" to question 4 (or feel that you will need to significantly reduce practical science in the September curriculum) please provide reasons why - please rank the following:</p> <ol style="list-style-type: none"> 1) Health and Safety 2) Lack of equipment for individual students to perform the practicals 3) Need to compress the curriculum due to students missing significant face to face teaching 4) Technicians/staff will be unable to cope (e.g. having to set up, store, clean individual student equipment) 	<p>7 / 15 responders put <i>H&S</i> first; 7 / 15 responders put <i>Lack of individual student equipment</i> second; <i>Need to compress the curriculum</i> did not stand out as a major factor in providing practical science in September</p>  <table border="1"> <caption>Ranking Data from Chart</caption> <thead> <tr> <th>Rank</th> <th>First choice</th> <th>Second choice</th> <th>Third choice</th> <th>Last choice</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>7</td> <td>1</td> <td>4</td> <td>3</td> </tr> <tr> <td>2</td> <td>3</td> <td>7</td> <td>3</td> <td>2</td> </tr> <tr> <td>3</td> <td>2</td> <td>5</td> <td>5</td> <td>3</td> </tr> <tr> <td>4</td> <td>2</td> <td>2</td> <td>1</td> <td>10</td> </tr> </tbody> </table>	Rank	First choice	Second choice	Third choice	Last choice	1	7	1	4	3	2	3	7	3	2	3	2	5	5	3	4	2	2	1	10
Rank	First choice	Second choice	Third choice	Last choice																						
1	7	1	4	3																						
2	3	7	3	2																						
3	2	5	5	3																						
4	2	2	1	10																						
<p>6. Following on from Question 5, do you feel there are any other barriers to carrying out practical work?</p>	<p>(4 responders answered No/Not sure) Themes: Space/lab availability; Team-work; Time (Timetable constraints & anticipation of practical work taking more time in a lesson due to social distancing constraints); ability to administer 1st Aid/help; ability to clean equipment in order to share amongst different classes; availability of PPE/hand sanitisers for all students/staff</p>																									

<p>7. Do you have any creative ideas to overcome the barriers to practical work e.g. examples of practicals to do (at school or at home); using siblings to do paired practical work; outdoor learning etc.</p>	<p>2 responders answered No</p> <p>Themes: on-line simulations; demos; providing images/data for students to use; e-labs; doing experiments outside labs (mindful of H&S); modification if (GCSE) required practicals to be done at home (with H&S guidance); suggestions of practicals (e.g. using quadrats; making indicators;</p> <p>Also – concern for doing A-level required pracs – teachers need to observe students doing these in order to “sign off” key skills for students to “Pass” their A-level practical component.</p>
<p>8. Do you have any other views regarding practical science during the current/future Coronavirus context?</p>	<p>3 responders answered No</p> <p>Themes: concerns about future lack of student skills; concerns about lack of guidance from DfE/Cleapss; discussion on what practical science is for:</p> <ul style="list-style-type: none"> • “I think we should study all the important practical work using books, video etc., discuss questions associated with the practicals and use sample data provided by exam boards/ RSC for calculations and interpretation. After all, there are countries where they hardly do any practicals at school which does not prevent students from learning”; • “Many experiments can be observed and understood fully from videos and or teacher demonstrations but require more effort on the part of the student to ensure they are fully engaged. The taking part of practical work is what forces many students to think and engage in the actual work itself. So maybe it is possible to focus on the attention span and focus of the students rather than enabling them to partake in the practical work themselves”; • “Practical work is an important part of science education. Failure to run practical work will impact the up-skilling of our students which may have long term implications. Our only hope is that the guidance becomes more 'user friendly' in September and going into next year” • “Science doesn’t have to be about practicals. The skills learned are valuable, but the knowledge is more so”
<p>9. Do you think you will be using the Coronavirus Pandemic as a tool in the future to engage students e.g. when teaching about micro-organisms, vaccines, immunity (other)? YES/NO/MAYBE</p>	<p>YES 11 NO 1 MAYBE 2</p>

10. In relation to Question 9, please provide an explanation for your answer.	NO/MAYBE – teachers looking for direct links to content in their subject (Physics and Chem) Themes: good for real-life contexts; good for misconceptions and data handling/modelling. “I think this is undoubtedly one of the biggest global challenges the world has faced. It will go down in History as such. I cannot imagine any half decent education system not covering it.”
---	--

Appendix:

POLL QUESTIONS

1. Have you provided any practical activities to any students during the Coronavirus lockdown? YES / NO
2. In relation to your response in question 1, if you answered no, please provide the reasons why you haven't provided practical activities
3. In relation to your response in question 1, if you answered yes, please provide (i) the year group/Key Stage you provided the practical activities to and (ii) details of the activities (and whether they were directly linked to your previous SOWs)
4. Thinking ahead to September what are your views on the feasibility of practical work (assuming social distancing still in place)
 - No practical work will be possible - students will watch videos or teacher demos of key practicals
 - Limited practical work will be possible - e.g. Required Practicals (GCSE/A-level)
 - Impossible to predict without guidance from DfE, School, Exam boards
5. If you answered "no" to question 4 (or feel that you will need to significantly reduce practical science in the September curriculum) please provide reasons why - please rank the following:
 - Health and Safety
 - Lack of equipment for individual students to perform the practicals
 - Need to compress the curriculum due to students missing significant face to face teaching
 - Technicians/staff will be unable to cope (e.g. having to set up, store, clean individual student equipment)
6. Following on from Question 5, do you feel there are any other barriers to carrying out practical work?
7. Do you have any creative ideas to overcome the barriers to practical work e.g. examples of practicals to do (at school or at home); using siblings to do paired practical work; outdoor learning etc.
8. Do you have any other views regarding practical science during the current/future Coronavirus context?
9. Do you think you will be using the Coronavirus Pandemic as a tool in the future to engage students e.g. when teaching about micro-organisms, vaccines, immunity (other)?
YES/NO/MAYBE
10. In relation to Question 9, please provide an explanation for your answer.

Some question responses in more detail

Question 2 Responses:

- Impossible to do so
- (Grouped responses) Difficult in non lab setting; Pupils not in school; Students not in school; Students are working at home and probably do not have access to equipment; "Mainly because without specialist equipment it would not be possible for students to take part in them at home - even if they were delivered with simple equipment found in the home there is no guarantee that everyone would have access.
- (Grouped responses) Unable to access Labs and not enough time to think up ways of doing stuff at home; Difficulty in organising and planning. Unfeasibility of most practicals at home, and lack of access some students might have to required equipment
- Students don't have access to the equipment needed. We have however provided model results and asked pupils to evaluate and answers questions.
- "The types of practicals the students do for A-level chemistry require special equipment and chemicals and are often not safe to carry out at home unsupervised. Instead, we studied videos of practicals, did PAG write-up using data provided by OCR and discussed all the practical issues theoretically."
- The parts of the curriculum that we chose to study in lockdown don't really lend themselves to practical activity (space). This is partly why we chose it!
- Students have completed work via specific platforms only
- There has also been a sufficient amount of non practical material that can be delivered online. We have attempted to do some practical skills activities that require students to plot provided data and draw conclusions.
- Also, throughout this pandemic we have not known when the end point is - we did not know in March that most year groups would be away in September so there has always been to possibility that practical activities can be caught up when we return to school."

Question 6 responses:

- Teamwork will be limited - this is a time practical requisite too.
- staff levels and space to accommodate the smaller classes
- lab space and class size (the school labs are quite small), timetable restrictions.
- Simply the constraints of space. If students are two metres apart, then this removes most possibility for moving around the labs. Also, there is always the possibility for something to go wrong - usually in practical work it's possible for the teacher to spring into action but clearly this will be discouraged. Also, the inability to work in groups.
- Adequate resources of PPE and hand sanitiser for students, staff and technicians. Practical work comes with inherent risks. For example, how do we deal with accidents where first aid is required without face masks and gloves.
- physical space required even if individual equipment was available. Many Physics experiments require a lot of space to setup.
- "The ability to maintain social distance during practical work.
- Many practicals require team work."
- Inability to move around the classroom and provide help to groups.
- Time constraints - keeping students from getting too close to each other and completing a practical in a 50 minute lesson. Also the time it would waste by taking more lessons to complete the practical when we'll presumably be short on curriculum time.

- There may be limitations to the rooms we use (may not be in labs). Ability to clean equipment between use
- Sharing of equipment would be the major one - if one group can't use the same equipment as the previous group without it all being wiped, that would pretty much prohibit any class practical activities.

Question 7 Responses:

- virtual reality? e-labs?
- Additional practical sessions with rotation of students.
- Not for the type of work we do in A-level chemistry. In GCSE, some practicals can be performed safely at home using non-specialist chemicals and equipment.
- Online simulations can be quite useful.
- "For sixth form, I did a 'virtual practical', providing them with data from different capacitor discharges (in practice worked out mathematically by me) and they looked at the circuit layout and analysed the data. This was clearly not as good as the real thing but at least gave them exposure to the data analysis in addition to skills such as best-fit lines on graphs and finding gradients.
- Virtual practicals may also be a possibility to some extent using the PHET simulations or similar.
- I have also done powerpoints for some key practicals, taking photos of set-ups and readings, which students can interact with in a limited way (click on each item to see its purpose, calculate the specific heat capacity using the data you see...). This was actually done as a revision aid but may turn out to be of more use than I anticipated!"
- We are considering how we can conduct some experiments outside of the boundaries of school labs to give us more space. Of course, the number of investigations that can be conducted outside of a science lab is limited, and introduces additional health and safety concerns.
- many physics experiments can be complete by observing real world situation. Falling objects, objects in motion, collisions, momentum etc most would just require some form of timing equipment. However these would require a great deal of input to setup and include the variables, pupils would have to be competent at evaluating the own setup and therefore would be more appropriate to higher level students only.
- "Outdoor learning - quadrats, general observational work outside studying ecosystems
- At home - testing acids & alkalis, making an indicator, forces (pushes and pulls) investigations, "
- Significant modification of required practicals so they can be carried out at home.
- Try looking for interactive software to demonstrate practicals.
- Use of phet simulations
- No - especially with the A-level where to sign off the CPACs students have to be seen using certain equipment. If a school does not have one piece of equipment per student and equipment cannot easily be shared then I do not see how the practical activities can be done to the required level.
- Not without guidance re H&S

Question 8 Responses:

- difficult with ever changing situation.
- I would hope that the data being produced on the chances of infection for younger people will lead to a more sensible and realistic approach to the importance of teaching and practical work

to ensure students are equipped for their future and that their mental health must be a higher consideration.

- I think we should study all the important practical work using books, video etc., discuss questions associated with the practicals and use sample data provided by exam boards/ RSC for calculations and interpretation. After all, there are countries where they hardly do any practicals at school which does not prevent students from learning.
- During lock downs the teacher should have access to school facilities to record practical activities. Paired work will not be possible. Lab work will have to be done in shifts.
- I think we're all thinking about the immediate impact, but I'm as worried about the implications a couple of years away - we may have groups of students who lack very basic skills and confidence in handling equipment. Having said that - we have to be realistic. It's a very challenging and difficult time for everybody and I don't think that it would necessarily be wise to all spend hours and hours trying to think of ways of replicating something that actually can't easily be replicated.
- There appears to be very little discussion about health and safety. CLEAPSS and government advice is very limited at the moment.
- Many experiments can be observed and understood fully from videos and or teacher demonstrations but require more effort on the part of the student to ensure they are fully engaged. The taking part of practical work is what forces many students to think and engage in the actual work itself. So maybe it is possible to focus on the attention span and focus of the students rather than enabling them to partake in the practical work themselves.
- Practical work is an important part of science education. Failure to run practical work will impact the up-skilling of our students which may have long term implications. Our only hope is that the guidance becomes more 'user friendly' in September and going into next year.
- Big issue will be sterilising of all equipment between uses, as it would be impractical to have a set of equipment for every student. Paired work would also be impossible.
- Exams should be rescheduled to allow current Year 10 and 12 students to catch up and have sufficient time to get back into a practical science mindset.
- Science doesn't have to be about practicals. The skills learned are valuable, but the knowledge is more so
- Film teachers carrying out practical activities and provide students with data. Have individual students working on one practical while social distancing and post data for those not doing it to use.

Question 10 Responses:

- using science in context is key.
- "I always try to relate topics to life events and so will also do so with this.
- Covers many aspects for biology, lungs, mutation, disease, immune system, vaccines etc"
- Already using news and research papers to teach A Level immunity.
- Not sure how it can be related to the chemistry curriculum. If any future exam questions include Coronavirus, I will look into those with my students.
- IB Medicinal chemistry Option D, it will be useful for this.
- With the media coverage being so wide, students will almost certainly have picked up some of the science, and it's a clear way to link their learning to something that they will probably understand.
- It is an area of interest that is relevant and related to our students. It should, therefore, be explored and discussed with them.

- As a Physics teacher it may only come up when teaching lower school biology.
- Pupils like to learn about 'real' examples and relate their learning to their experiences and past knowledge. This definitely fits with this type of learning.
- Oh absolutely invaluable. Modelling the spread of a disease through a population, comparing the measures implemented by different countries and their relative success/failure,
- It's a good example as there are many misconceptions to be addressed and everyone is aware of it to some extent.
- Infectious diseases in biology, use of data in science skills
- I think this is undoubtedly one of the biggest global challenges the world has faced. It will go down in History as such. I cannot imagine any half decent education system not covering it.
- No direct links to Physics