

# Evaluating the impact of climate emergency career-long professional learning (CLPL) for primary teachers in Scotland to enable sustainable learning

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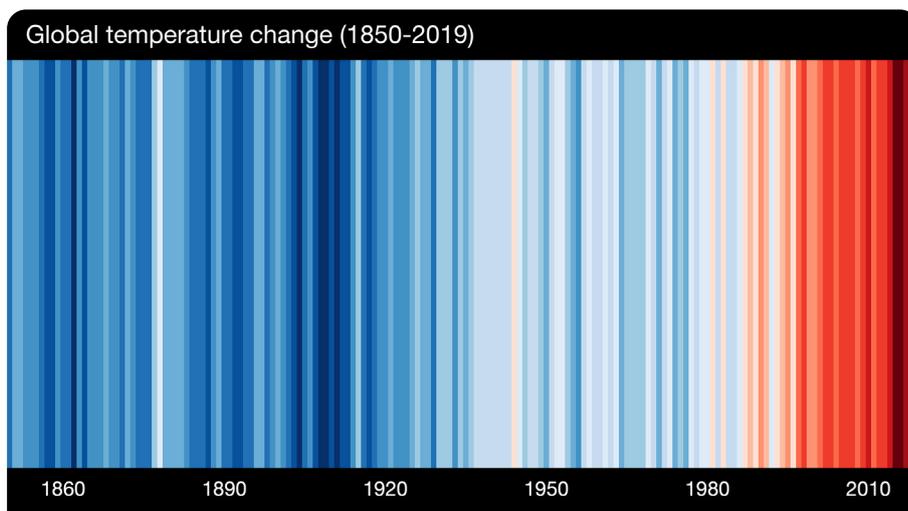
**Abstract** This article reflects on the impact of delivering career-long professional learning (CLPL) to Scottish primary teachers (teaching pupils aged 5–11 years), in the context of the climate emergency. Drawing on reflections from teachers, recommendations made focus on building primary teachers' confidence in implementing practical science activities in collaboration with outside groups (such as the Royal Society of Chemistry) and include a focus on encouraging pupils to act on the climate emergency, laying foundations for secondary climate education. This research contributes to protocols aimed at laying the foundations for both primary and secondary schools to contextualise their curriculum in the context of the climate emergency and sharing best practice for delivering impactful professional development for the teachers to develop their own teaching. Ultimately, we expect this to advance pupils' learning outcomes and increase teacher efficacy as a result of teachers receiving high-quality professional development.

We are already seeing the effects of the climate emergency, with an increasing number of extreme weather events and worsening air pollution (De Sario, Katsouyanni and Michelozzi, 2013). Young people are acutely aware of the environmental, political and socio-economic problems that societies face today (Amnesty International, 2019). They have demanded urgent action on a global scale (Cone, 2019), with demonstrations such as 'school strikes for climate', as well as becoming engaged with Greta Thunberg's activism (Sabherwal *et al.*, 2021), who is often cited as a role model, arguably widening access and inclusion (Shin, Levy and London 2016). Reinforcing this, the next generation are 'deeply concerned about climate change and the environment' and demanding 'a call for accountability and action' as a priority (Deloitte, 2021).

Young people are more inclined to choose a career that addresses these global concerns and are more determined than ever to take action, both locally and globally (Barhate and Dirani, 2021). Schools across the UK were encouraged to start a 'conversation' on the climate emergency with their pupils ahead of the UK hosting the global climate summit COP26 (DfE, 2021). These conversations should not

be limited to the classroom but should continue with family, friends and peers using their voices as customers, writing to their local Member of Parliament, becoming active citizens, or pursuing a career that will make a difference (Monroe *et al.*, 2019; Rousell and Cutter-Mackenzie-Knowles, 2020).

At COP26 in Glasgow, each nation agreed to devise a plan to cut their carbon emissions and so I sought to develop a workshop for primary teachers that focused on carbon dioxide, the primary greenhouse



**Figure 1** The 'show your stripes' image has been designed by Professor Ed Hawkins of the University of Reading (<https://showyourstripes.info/s/globe>) to illustrate rising global temperatures and spark conversations and action around the climate crisis. These 'warming stripe' graphics are visual representations of the change in temperature as measured over the past 170 years.

gas emitted through human activities and accounting for the highest impact on global warming. This article focuses on primary level; however, it gives secondary teachers insight into primary teaching of science. The workshop has also been developed for secondary teaching, which is included in the workshop recording and links to resources and uses the same experiments, but expands on the questioning and progresses the learning outcomes.

The workshop was developed in three stages to gradually release scientific content and build teachers' confidence in delivering this topic in their classroom: 'What is carbon dioxide?', 'Measuring carbon dioxide' and 'What happens when carbon dioxide is produced?'

## Methodology

The Royal Society of Chemistry works to build confidence in teaching primary science by effectively linking science to other curriculum topics, showcasing engaging investigations that are feasible in a primary school classroom and providing access to scientific professional development. (Figure 2)

A 2-hour face-to-face workshop was developed focusing on the science of carbon dioxide and making links with the Scottish curriculum (Education Scotland, n.d.). The workshop included demonstrations that could be incorporated into each teacher's teaching sessions, as well as discussing learning outcomes. Each of the practical activities was carried out with additional time dedicated to pause and reflect on the impact of their own teaching techniques throughout.

The workshop was independently peer-reviewed by two Royal Society of Chemistry education coordinators and then quality-assured by two Primary Science Teaching Trust College Fellows to gain insight within a primary context and ensure that it aligned with current primary classroom teaching. This feedback was essential for developing the workshop and highlighted areas that



Figure 2 Making an indicator and measuring CO<sub>2</sub>

'were a bit fast paced' and requests to adjust the practical activities to make them more accessible for primary teaching – 'practical experiment demonstrations weren't realistic for the preparation time and resources I have available on a day-to-day basis' (Teaching Trust Fellow). The workshop was continually monitored, using primary-teacher feedback after each one to identify improvements or developments required. After evaluating teacher feedback, the changes listed in Table 1 were implemented to refine the workshop for primary teachers.

Table 1 Summary of implemented changes and subsequent impact on teachers' professional development

Implemented change	Impact
Integrated instructions were produced for each of the practical activities to reduce the cognitive load (Paterson, 2019)	More time for attendees to ask questions and discuss how these could be used in their classroom and pedagogy approaches
Links to pre-lab activities, such as practical videos and simulations	Enhancing the impact of the practical activities on their learners, by allowing them to familiarise with the process in advance and to concentrate better on the lesson itself
Dedicated time for teachers to self-reflect and share their own teaching practice with specific reference to their own school's health and safety guidelines	Discussions around delivery of the workshop in their classroom in accordance with their school's health and safety guidelines
Examples of reducing the hazards	Teacher demonstration of practical activities, pupils working in groups, placing tealight candles in a tray of sand, diluting household acidic and alkaline chemicals

The focus of the workshop was to discuss the implications of the climate emergency and possible solutions on a global scale, alongside easily accessible but effective supporting practical activities to help pupils visualise and engage with the climate emergency. There was an emphasis on how this applies to the pupils' own lives, on a local scale, and providing ample opportunities for teachers to share and discuss how this would apply to their own classroom teaching. The teachers would then take these learnings and apply them to their own classroom teaching and cascade the outcomes to their colleagues. Teachers were encouraged to give their pupils the opportunity to shape their own learning by applying their understanding through investigative talk and critical analysis of the information presented to them. There was further focus on the integration of cross-curricular activities, literacy and numeracy, as well as attainment of science capital, to encourage cooperative collective and active learning for pupils and collegiate working within schools, across authority and where possible with their secondary clusters.

All workshops were fully funded by the Royal Society of Chemistry, with 19 face-to-face sessions confirmed with primary schools, predominantly across the central belt of Scotland. Workshops were advertised to all primary teachers in Scotland and later opened to primary teachers across the UK, as well as international teachers. Advertising of the workshop was carried out through our own networks, with support from other educational organisations who had a common audience and through primary teachers' word of mouth. Multi-channel marketing enhanced the credibility of the workshop and increased exposure to primary teachers in Scotland.

Between 200 and 400 primary teachers would have been expected to have attended the workshops, but owing to the COVID-19 lockdown, 13 of the workshops had to be cancelled. For the six face-to-face sessions delivered, 117 primary teachers attended. The workshop was later adapted for virtual delivery via *Zoom*, with demonstrations of pre-prepared practical activities and reducing the time from 2 hours to 1 hour. Four virtual workshops were delivered, with a total of 58 primary teachers attending.

## Results and discussion

To reduce paper usage, all feedback was collected via electronic web-based surveys. These surveys were carried out following standard practices in which informed consent was obtained from participants. This included stipulating that information provided could be used in reports or future research aimed at improving the quality of teacher professional development. A return rate of 42% ( $n = 175$ ) was achieved, with an even spread of primary teaching experience across three broad groups: <5 years, 5–10 years and >10 years. Attendees were encouraged to



think about feedback throughout the session and had dedicated time at the end of the workshop to complete the survey (Tables 2 and 3). Attendees were asked two net promoter score (NPS) questions, which is a standard benchmark used to measure customer satisfaction and enthusiasm: *How useful did you find this session?* (NPS score = 84) and *How likely would you be to recommend an event like this to another teacher?* (NPS score = 89).

Teachers favoured opportunities for lesson planning and for discussing impact on their classroom teaching and pupils' learning outcomes. It was also important for teachers to feel relaxed and have a positive and enjoyable experience, which resulted in increased participation. This, to an extent, stimulated retention and retrieval of the workshop, with teachers following up months after the workshop and commenting positively on the workshop experience.

The majority of attendees were unaware of the support on offer from the Royal Society of Chemistry, which highlighted the importance of multi-channel marketing with other organisations working with our targeted audience. Further, most attendees did not consider themselves primary science specialists, so it was imperative to control the pace and pitch of the workshop and create a positive environment to engage the teachers. This helped to avoid misconceptions by giving time for clear and detailed explanations to emphasise how the theme of the climate emergency could be applied to the Scottish curriculum. Feedback highlighted the use of integrated instructions to reduce cognitive load, which in turn made the session more relatable by making time for informal discussions and humour that was integral to building strong relationships, alongside time for embedding scientific content into their classroom teaching and highlighting the support available from the Royal Society of Chemistry.

The feedback from this workshop indicated that 51% of teachers requested lesson plans and resources for

**Table 2** Teacher feedback following the workshop

Statement	Strongly agreed (%)	Agreed (%)
The level of teaching was just right	86	12
I feel more confident delivering and communicating the topic of climate change	77	20
I feel more positive about chemistry	75	20
This event has been worthwhile	79	17

**Table 3** Reasoning why teachers gave their feedback scores

Statement	Summary of teacher feedback
The level of teaching was just right	69% recommended the workshop as high-quality professional development, meeting the needs of primary teachers and organising future workshops for their schools – <i>'it is invaluable to have someone who can communicate the science in a way that is easy to understand and with easy-to-use resources and examples'</i>
I feel more confident delivering and communicating the topic of climate change	46% mentioned the practical ideas for teaching climate change – <i>'experiments were easy to complete and had an almost instant reaction – perfect for children'</i> , <i>'making the link between these experiments and climate change'</i> with teachers reporting an increase in confidence because the practical's risk was assessed, it was accessible and there were teacher notes for delivery
I feel more positive about chemistry	39% mentioned the links and resources that could be used in the classroom – <i>'help teachers relate to an experience and outcome or a science benchmark for planning'</i> , <i>'gives me a much better sense of how we can work together on collaborative projects and events'</i>
This event has been worthwhile	25% mentioned the presentation style – <i>'made it engaging, explained it well and was well prepared'</i> , <i>'good explanations of how they demonstrate science in real-life situations. Pitched at a good level. The workshop encouraged lots of engagement with everyone taking part'</i>

their classroom, 36% of teachers wanted professional development workshops and 20% of teachers wanted funding to purchase scientific equipment. There was an emphasis on providing better knowledge of scientific pedagogy to increase confidence in teaching sciences, as this is often not the strength of primary teachers, and the need for additional support with lesson plans, risk assessments and interdisciplinary learning. The feedback also indicated that teachers wanted a focus on knowledge progression through professional development, resources and practical activities.

Practical science is not only important for enabling pupils to learn scientific knowledge and theories, but also for how to do science, especially when contextualising with real-life problems and providing pupils with career aspirations that will make a difference to the world in which they live. This workshop aimed to provide teachers with the skills and knowledge to begin implementing the topic of 'the climate emergency' within their teaching curriculum. Although the scientific content would form one part of a teacher's lifelong development, the approach provided teachers with additional opportunities to participate in professional development, addressing issues like climate justice and dealing with climate anxiety among their pupils. The success of this workshop also enabled the scientific content and practical aspects to be later developed for secondary teachers, which would support the primary to secondary transition by clearly mapping out the progression for different age ranges, while encouraging collaborative work with their secondary cluster schools.

A clear limitation of this approach is the fact that it is a one-off programme that was well timed in the context of current affairs and the recent COP26 climate conference. As a result of findings from this research,

further sustained professional development needs to focus on providing pupils with the information to make informed decisions on how they can influence change. There needs to be a bigger discussion around the communication of the climate emergency to society. Misinformation and fake news have confounded effective communication, but so too have the different voices proposing different solutions. The focus should be on the collective to come together with a clear and concise message, with the opportunity for sustained discussion, especially when the future focus is likely to involve reduction in consumption. As a catalyst for renewed commitment and focus, there must be an effort to go straight to the pupils, who are open to change, highlighting the importance of fair testing and scientific integrity to combat the more extreme and vocal climate deniers.

Through a professional development workshop for primary school teachers, it is apparent that there is a significant lack of confidence when teaching practical science. This workshop has started to bridge this gap by providing teachers with a range of resources that support their continuing professional development. Feedback from the workshops indicated that the scientific content and practical demonstrations were relevant, engaging and allowed for easy integration into the primary classroom. This supported schools to deliver high-quality learning experiences because the workshop had been curriculum mapped to the experiences and outcomes of their pupils, helping to lay the foundations for further climate education at secondary level. From these initial experiences, many teachers have continued to use Royal Society of Chemistry resources, requesting bespoke professional development for their schools, applying for funding and developing and filming the

practical resources, which continues to benefit pupils, teachers and in some cases the wider community.

The outcome of this workshop highlighted three key points that teachers considered most vital for continued development: lesson plans, professional development workshops and funding. Following this workshop, additional supporting material was shared with attendees, with links to the Royal Society of Chemistry support covering all three of these key points.

Following the success of the primary workshop, a workshop for virtual delivery was developed during the COVID-19 pandemic. Although no discussion has taken place regarding face-to-face versus virtual delivery, owing to lower virtual feedback numbers, it did make the workshop more accessible to a greater and more diverse audience. There is the potential to develop pre-workshop tasks and cook-along style workshops in the future, but the main observed difference between face-to-face and virtual delivery was the hesitant pauses for informal discussion that proved key to the success of the face-to-face workshop. To an extent, interactivity and discussion were recreated in virtual sessions by using live voting via in-session polls and graffiti comment walls with the web-based software *Padlet*. This enabled

participants, including the host, to maintain and carry out real-time collaboration and sharing of teaching practices. This would help to build professional learning networks that would continue to grow long after the professional development intervention, by building on mutual respect and trust to support one another's classroom teaching, sharing expertise and resources, and begin the formation of a collaborative and supportive network for primary teachers.

Managing and developing cross-collaboration with other organisations, especially when we have a common audience, was fundamental to delivering this workshop to so many primary teachers. This led to stronger communication and valuable relationships that have enabled us to share, reflect and constructively contribute to each other's work. This is evidenced by the development of a cross-collaborated climate justice resource (see IDEAS for Global Citizenship in the *Resources* list below). This was developed to encourage interdisciplinary learning within schools and highlight the ethical, legal and moral issues associated with the climate emergency. It aims to enrich the teaching of the climate emergency to accentuate its importance and the opportunity for young people to make a difference in everyday life, both locally and globally.

## Resources

Recorded COP26 workshop: [www.youtube.com/watch?v=mw189jBAUplk](https://www.youtube.com/watch?v=mw189jBAUplk); links to all content and teacher discussion can be found here: <https://padlet.com/hendrys1/1zhaoy5fvo12an3k>  
 IDEAS for Global Citizenship – *Exploring Climate Justice: A human rights-based approach*: [www.ideas-forum.org.uk/climate-justice-education](http://www.ideas-forum.org.uk/climate-justice-education)  
 Royal Society of Chemistry sustainability resources – <https://edu.rsc.org/resources/collections/climate-change-and-sustainability>

[edu.rsc.org/resources/collections/climate-change-and-sustainability](https://edu.rsc.org/resources/collections/climate-change-and-sustainability)  
 Pedagogy articles for teaching the UN Sustainable goals in the classroom: <https://edu.rsc.org/eic/collections/sustainability-in-chemistry>  
 Chemistry World Research and Innovation for sustainability: [www.chemistryworld.com/sustainability/welcome-to-our-sustainability-collection/4013777.article](http://www.chemistryworld.com/sustainability/welcome-to-our-sustainability-collection/4013777.article)

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