Including real-life global contexts within science teaching

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Abstract If you haven't yet come across Practical Action's teaching resources, this article will open your eyes to a wealth of free high-quality materials that will support your teaching of science within a real-life global context. The potential benefits and importance of this approach, both for increasing student engagement in science and for the future of our planet, are outlined. Examples of resources and how they have been used are given at the end of the article.

Why include real-life global contexts in your teaching?

Along with many others in the education sector, I strongly believe that ensuring young people understand how science is related to the real world and their everyday lives is hugely important, as well as motivating, for them. In particular, I believe in supporting them to see how their own science learning is relevant to global issues. I have worked in the sector in a number of roles, including as a teacher, for over 20 years and am now Head of Education at the international development group Practical Action. With everything that is going on in the world, both close to home and globally, I feel it is more important than ever before that, in our role as educators, we give our students the opportunity to make that connection.

Practical Action's education work

At Practical Action we work with local communities in over 80 countries in the developing world, producing ingenious solutions to devastating problems. In our work we see how appropriate use of science and technology, and often very simple solutions, can have a dramatic impact on people's lives. By engaging children in the work that we do, we hope to enhance their understanding of what is going on in the wider world, and to inspire them to want to make a positive difference to global poverty reduction. We are an organisation that, with others, is working towards achieving the UN Global Goals for Sustainable Development (www.globalgoals.org) and to eradicate poverty by 2030, something that we are passionate and excited about and we want children to have the opportunity to be part of that too. We want the next generation to both understand the challenges we all face globally and be able to make informed decisions and choices about any actions they may take as a result of that understanding. This could be as simple as reducing their use of plastics and making sustainable choices about the food and other products they buy, or choosing to becoming the scientists, engineers and politicians of the future.

The importance of including real-life contexts in science

There are of course other reasons why including real-life contexts in science is important.

Scientific literacy

Firstly, we want a scientifically literate population. For some students, the science they study up to GCSE (age 16) will be the end game, so in my opinion it is vitally important that by then they connect the science at school with their everyday lives. During their lifetime, students will come across all sorts of articles in the media, on- and offline, that present information as scientific 'fact', such as '*drinking five cups of coffee a day reduces your risk of cancer*', and we want them to have the knowledge and skills to be able to review that information critically so they can decide for themselves if it is likely to be true.

Inspiring students to go onto STEM careers

We also want to inspire some students to continue their studies of science beyond GCSE, for them to become the scientists and engineers of the future that our country, and the world, so desperately need to help solve global issues that affect us all.

At Practical Action we believe that technology is the key to poverty reduction. The next generation of scientists can help to eliminate poverty by working directly with communities in the world to develop innovative and sustainable solutions, such as solar-powered water pumps made of affordable, easily maintained components. Alternatively, and equally importantly, they can help to reduce our contribution to climate change, which is already affecting the poorest people on our planet (who contribute least to the causes), by minimising the use of energy, water and other resources in the manufacture of products that we all use, ranging from toothpaste to cars.

Studies such as that by Microsoft (2018) have shown that engaging in real-world contexts is particularly inspiring for girls, so a great focus on that may help address the gender balance in science subjects taken at A-level and in the careers that can lead on from those. There is a significant disparity in the number of men and women in STEM careers in the UK. In 2017, surveys carried out by WISE (2017) indicated that women make up 23% of core STEM professions and, although this was a positive change from 21% in 2016, there is still a great deal of work to be done before we reach the 30% achieved in other European countries, such as Cyprus, and the ideal target of 50%. The EU-funded project in which I have been involved, Girls into Global STEM (GIGS), aligns with the findings from Microsoft that girls in particular are motivated to solve real-world global issues using STEM. With such low percentages of women in STEM, there is a great a need for initiatives and materials that appeal to girls and that will help us to fill the skills gap that we currently have (Figure 1).

Figure 1 Practical Action resources inspiring students to pursue STEM careers; tweet from Rose Russell, STEM coordinator, Ursuline Academy

Making a difference

There is one other final important reason. Understanding the science behind how their own actions can impact on their planet helps students to make decisions about how they want to live their lives, both now and in the future – making that link between their own actions and the impact on other people and the planet. I'm thinking about climate change, plastic waste, reusing and recycling, food choices and many more. Helping students to make connections in this way also fosters respect for others, cultural awareness, empathy and a desire to make a difference to the world… all important values for the future generation. Surely this has to be more important to mankind than students being able to describe the Haber process!

What are the main barriers?

Many teachers will no doubt say that the curriculum is so content-heavy that, to 'get them through their exams', the focus needs to be on the content rather than the application of science, including real-life contexts. This means that they are simply perceived as nice 'added extras' rather than core to the subject. This is a view I heard recently from heads of science at a meeting looking at the future of our subject.

My argument, however, would be that you can teach the content, but setting it within a real-world context is not just more engaging for students because it helps them make those connections (which ultimately means they are more likely to want to continue to study science), it helps them to understand the scientific principles too. Many well-respected science teachers agree with me and incorporate our material into their mainstream curriculum (Figure 2).

What help is available?

At Practical Action, we produce free resources for science teachers that particularly focus on global issues

Figure 2 Embedding Practical Action's materials in the key stage 4 curriculum; tweet from Overton Grange

in science, technology, engineering and maths. Our more recent materials include reference to the UN Global Goals for Sustainable Development, which as an organisation we are working towards achieving ourselves and are encouraging others (including children) to do likewise. We have produced a document showing how our resources map to the UK science curricula (Practical Action, 2018). Our most popular materials are our STEM challenges, some examples of which are given in the final section of this article. Boxes 1 and 2 offer examples of feedback we have received.

Box 1 Impact of using Practical Action's materials on A-level choices

For the last few years, our STEM challenges have provided the focus for the main outreach activity on the International Women in Engineering Day at Birmingham City University (BCU). Each year, 80+ year 9 (age 13–14) girls from schools in Birmingham work with STEM Ambassadors from industry on one of our challenges. These challenges have had real impact on the girls' understanding of the potential of science to change people's lives for the better and, as a result, have inspired some of them to choose STEM subjects at A-level.

'*I was speaking to a head master from a school that took part last year. He told me that on parents' evening one parent said following the day at BCU their daughter was so inspired she changed the A-levels she was planning to take to all science and maths so she could become an engineer and really make a difference to the lives of others.*'

Vice Principal, Birmingham City University

Box 2 Feedback from students and teachers on Practical Action's STEM challenges

Students

'*Today has been awesome. I find science quite hard sometimes but I'm really good at design and can come up with brilliant ideas. This activity has shown me that I could be a really good engineer when I am older.*'

Cameron, Redmoor Academy

'*When you think of engineering you think of things like cars, but from today I know there are more parts to engineering, like using it to help people…and not only men can be engineers but women too.*'

Caitlin, Tudor Grange

'*We have learnt a lot more about the impact of plastic on people around the world as well as the environment.*'

James, Culloden Academy

'*This project has made me almost certain that I will have a career in science…and more determined to raise awareness and focus on creating solutions.*'

Florianne Fidegnon, Ursuline Academy, IET Junior board member, BSA Youth panel member

'*I really enjoyed developing problem-solving skills; using what I learnt in science in a real situation, and finding out about Ethiopia and the Global Goals.*'

Hugo, Les Quinnevais School

Teachers

'*I think this is fantastic. It's a practical application and really easy to run. Great that it is set in a real-world context that the kids can relate to. I'm thinking we could use it for a CREST Award.*'

Hannah Grey, Assistant Head Teacher, Langley School

'*Using Practical Action's resources has really impacted my teaching. I refer to the work of Practical Action in all sorts of ways when teaching topics like energy resources. I think about how to introduce topics in a whole new way.*'

Helen Rogerson, Head of Science, Westonbirt School

'*We have just incorporated Stop the Spread into our KS3 curriculum and we are using it for our year 8 assessment as well as Student Leaders Awards.*'

Elaine Manton, STEM coordinator, Loreto Grammar School

Examples of Practical Action's STEM challenges

Squashed Tomato

Hugely popular, this physics-based challenge encourages students to use their STEM skills to design, build and test a model of a system that could move tomatoes down a mountainside, based on a real problem faced by farmers in Nepal. This does fit the curriculum, and can be used within a science lesson but, like all of Practical Action's

Figure 3 Students taking part in Practical Action's Squashed Tomato challenge at Winchester Science Centre

STEM challenges, is also flexible enough to be used as a great activity for an off-timetable enrichment day. This challenge has been used by hundreds of students to gain a CREST Discovery Award, a prestigious award scheme run by the British Science Association (Figure 3).

Stop the Spread

How do infectious diseases spread? What can you do to reduce the spread of infection in a primary school in Kenya, and help young people understand why it is important? These are problems faced by students taking part in the 'Stop the Spread' challenge, which puts into context knowledge about microbes and how they spread, combined with how to use levers to build a hand-washing device. Students are also asked to design teaching/learning activities to explain to children in Kenya why hand-washing is important in preventing the spread of disease (Figures 4 and 5).

Figure 4 Girls from Felsted School, finalists in the CREST Awards' Youth Grand Challenges competition 2017, presenting their model of a hand-washing station

Figure 5 A student from Abingdon School testing his model as part of Practical Action's Stop the Spread challenge

Plastics challenge

Students investigate the properties of plastics and then find solutions to problems caused by plastic waste globally. Covering many of the elements in the various UK science curricula for ages 11–16 around plastics, the challenge offers opportunities for students to engage with practical science investigations and enquiry-based learning. Teachers can choose from a variety of activities, including making bioplastics, before embarking on the main challenge, which is designing and making products from waste plastic for a UK or international market.

Beat the Flood

In this STEM challenge, students look at the global issue of flooding around the world and then focus on designing, building and testing a model of a flood-proof house. Before building the house, they test a set of materials for absorbency and strength and make an informed decision as to which are the best to use for their model. This gives a real purpose to their learning. Models are tested by standing them in water and squirting them with a hosepipe (Figures 6 and 7).

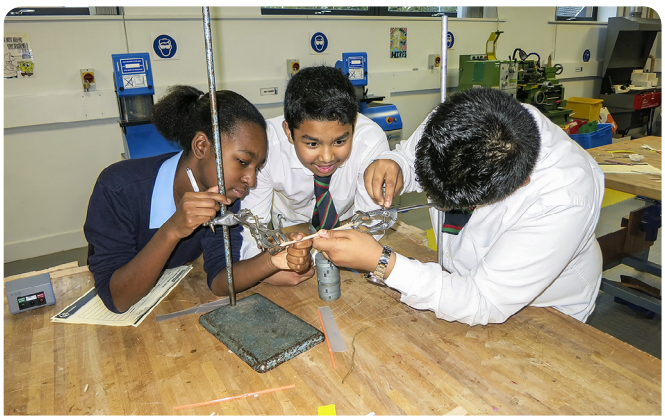

Figure 6 Students from Judge Meadow School testing materials for tensile strength as part of Practical Action's Beat the Flood challenge

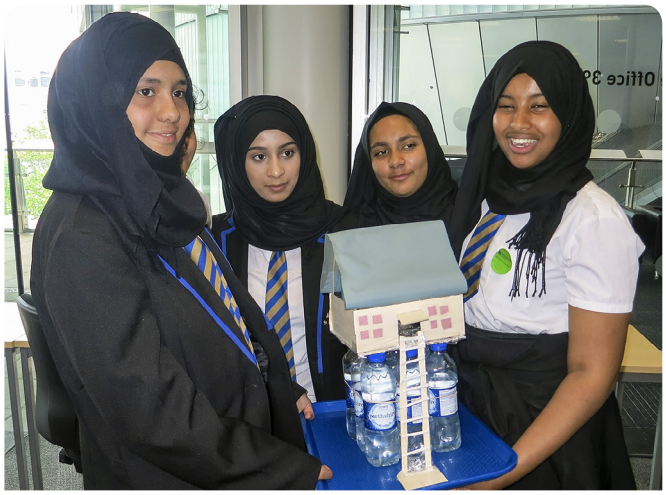

Figure 7 Students proudly showing their model of a flood-proof house at Birmingham City University's International Women in Engineering Day (IWED)

Solar challenge

Launched at the ASE Annual Conference in January 2019, this latest STEM challenge from Practical Action focuses on electricity. Based on our work in southern Zimbabwe, students build circuits using solar cells and make decisions about the use of electrical appliances for a community in Zimbabwe that has a limited supply of electricity. Designed to cover electricity at key stages 2 and 3 (ages 7–14), this challenge also encourages the use of maths skills to solve a science challenge (Figure 8).

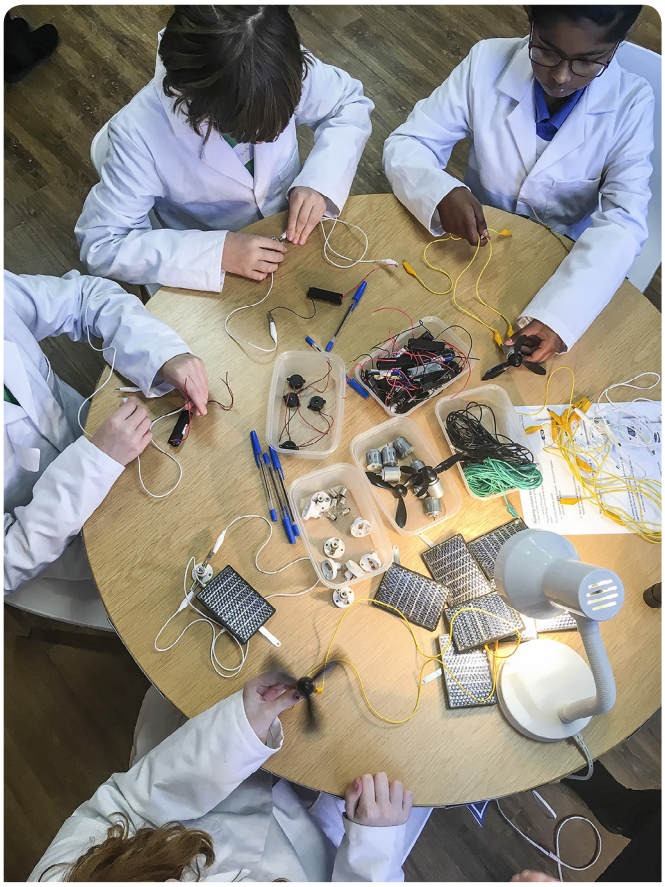

Figure 8 Students from Hillmorton Primary School making circuits using solar cells

Summary

In an ideal world, the science curricula in the UK would have more of an emphasis on the application of science in a real-world global context, including how science can contribute towards solving the big global issues of the future, with a focus on sustainable solutions. As this is sadly not the case, I would encourage all teachers who don't already do so to find the space within the current curriculum to embed materials that do this within their own teaching, for the benefit of their students and future generations.

PRACTICAL ACTION
Technology challenging poverty

Figure 9 Practical Action's logo

References

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Website

Global Goals for Sustainable Development: www.globalgoals.org.
Practical Action: https://practicalaction.org/schools.

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