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Every child a scientist: student-centred approaches to active learning in science

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Sheffield Institute of Education

Every child a scientist: Student-centred approaches to active learning in science

Dr Emily Perry Sheffield Institute of Education Sheffield Hallam University



Dr Emily Perry, Sheffield Institute of Education, Sheffield Hallam University

Sheffield Hallam University Sheffield Institute of Education

Innovative approaches to learning and teaching





Our areas of work:

Teacher professional learning



Innovative approaches to learning and teaching

We develop, facilitate and evaluate CPD programmes for:

- Individual teachers
- Individual schools
- School groups
- Local authorities
- Publishers and employers
- Governments and Ministries of Education



Tuesday 18 Oct 2016 1600 – 1700. Workshop 6 in Room 4 AA102

Dr Emily Perry, Sheffield Institute of Education, Sheffield Hallam University



Our areas of work:

 Active and enquiry-based approaches to learning



Dr Emily Perry, Sheffield Institute of Education, Sheffield Hallam University

Innovative approaches to learning and teaching

We develop, with teachers, schools and students, curriculum plans and teaching materials for:

- Individual schools
- School groups
- Publishers
- Museums and charities
- Governments and Ministries





- Our areas of work:
- Widening participation to under-represented groups in STEM subject areas



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Innovative approaches to learning and teaching

We ensure access to and engagement with STEM education and STEM careers by working with:

- Students
- Teachers and schools
- Employers
- Publishers
- Museums and charities
- Governments and Ministries



Tuesday 18 Oct 2016 1600 – 1700. Workshop 6 in Room 4 AA102



- Our areas of work:
- Collaborative research and evaluation



Innovative approaches to learning and teaching

- We support teachers and schools to engage with research and embed findings in practice.
- We work with funders including charities, ministries and museums to evaluate educational interventions and programmes.

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We work locally, regionally, nationally and internationally



Workshop objectives

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- To explore the benefits of enabling students to act as scientists in their learning
- To illustrate successful projects and teaching strategies which support students to act as scientists
- To share and collaboratively develop further ideas for authentic student research

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Students acting as scientists: benefits and challenges

Students are:

- taking the initiative
- stating their own questions
- finding solutions to problems
- collecting and analysing data
- evaluating their findings
- communicating ideas



What are the challenges and benefits of supporting students to learn in these ways?

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What is needed is a value system that appreciates and understands the value of education at a much deeper level and on a much broader scope than merely getting good test scores or sending children to more selective and prestigious schools.

D.Y. DAI et al (2011) Inquiry-Based Learning in China: Do Teachers Practice What They Preach, and Why?

Teachers ...can face some difficulties [such as] being not able teach the science content accurately in the inquiry lessons, being not able to guide and help students appropriately in the inquiry-based science lessons and having insufficient knowledge about inquiry.

S. Kapucu (2016) Guided Inquiry-Based Electricity Experiments: Pre-service Elementary Science Teachers' Difficulties Managing learning activities ...requires much more planning, preparation and an ability to respond to different stimuli in the classroom. This can be unacceptable for many teachers, who therefore resort to traditional methods of teaching.

J. Sokda et al (2013) Inquiry-based science education – fashionable trend or hope for science education regeneration?



Instruction emphasizing active thinking and drawing conclusions from data or providing hands-on experience with scientific phenomena were associated with increased likelihood of scientific understanding.

M.O. Martin, et al (2012) TIMSS 2011 International Results in Science

[Students] enjoyed learning science when they were finding out answers to their own questions.

OFSTED (2013) Maintaining Curiosity

Through a combination of "handson" and "minds-on" learning, inquiry engages students in a process through which they learn science content best.

Every Child a Scientist: Achieving Scientific Literacy for All (1998)

The actual doing of science or engineering can pique students' curiosity, capture their interest, and motivate their continued study.

A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas National Academy of Sciences (2011)

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Chain Reaction: a case study





- Funded by the European Union
- 2013 2016
- 3.6M Euros
- 12 partner countries
- Students acted as scientists: carrying out real-life research and presenting their findings at conferences.

https://vimeo.com/116847032

http://www.chreact.eu/

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Chain Reaction: a case study



suitable natural materials to act as a liner for a landfill site?





Green Light What do Compact Fluorescent Lamps (CFLs) offer? Are they an alternative to

traditional light bulbs?

Ozone Conference What can we understand about ozone formation in the troposphere and ozone layer depletion in the stratosphere?

Green Heating How much energy can Solar Panels really produce? Do they offer a sustainable alternative source of energy?

Cosmic Website What was the Big Bang? What current research is taking place to understand the Big Bang?

Feed The World What impact can fertilisers have on farming and food production?

Marsology

If you could be involved in the next exploratory mission to Mars, what would you look for?

PHEPPS

What is the most efficient design for a Portable Hydroelectric Power Plant (PHEPP)?

Plants In Space What plants could grow in space and provide oxygen and food for astronauts?

- Pupil research briefs guided their enquiries
- Supported by teachers and role model scientists

Look through the Pupil Research Brief. In what ways are the pupils being supported to act as scientists? What could work about this approach with your students (whatever age)?



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Chain Reaction: a case study

- Students presented their findings at national and international "Express Yourself" conferences
 - 6,796 students, teachers and scientific role models took part in national conferences
 - 756 students, teachers and role models took part in international conferences







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Pict.1 - Nit

decomposition by bac

nitrites

(nitrifying bacteria)

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% Teacher participants at National Conferences 2014

http://www.chreact.org.uk/pages/interviews

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Chain Reaction

Embedding our approaches worldwide



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- Inspiring Science, Thailand
- Funded by British Council and BG Thailand
- Developed key teachers and Science Institute staff as expert curriculum developers.
- Teaching resources and website developed.
- Resources build scientific skills: problemsolving, communication, leadership, teamwork, thinking skills.

https://www.britishcouncil.or.th/en/programmes/education /our-work-support-basic-education/inspiring-science

Orchids

Episode 2:

Multiplying plants



Orchids Multiplying plants

Objectives:

- to consider the differences between sexual and asexual reproduction
- to consider ways to multiply plants quickly
- to consider sources of contamination in tissue culture





Engage

Today we are going to look at how to increase our supply of plants. We need to be able to do this so that we will have plenty to sell! Has anyone got any ideas?

inspiring SC!ence

Orchids Multiplying plants

Engage

What about growing plants from seeds?

We should just collect them from the wild. You can find loads of orchids in the rain forests.

Or taking cuttings? Can't you do that with some plants?

And I heard something about tissue culture? Don't some companies use that to make lots of orchids? Orchids Multiplying plants



Explore

OK! Plenty to think about. I need you to do some research to find out about each of those methods. How do they work and what are the advantages and disadvantages of each to us?





Explain

I'll need a report suggesting which method we should use and why. I'll need it in 20 minutes so you had better work in teams to gather the information you need.

Remember, you should already understand the science behind this task from your earlier work.



Orchids Multiplying plants



Contact Details

Contact the Inspiring Science team at

inspiring_science@hotmail.com





Orchids Multiplying plants

Embedding our approaches worldwide



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What topics for student research would work well in your contexts and countries?



- Hebat Sains Malaysia
- Teaching Enquiry through Mysteries Incorporated (TEMI) – European Union
- Inquiry-based Science Education Brunei
- Common Ground Curriculum for Science International Schools worldwide



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Students acting as scientists: what are the teachers doing?



Teachers are:

- letting students plan their own learning pathways
- releasing control of the classroom
- allowing freedom and questioning
- teaching content through practical work

How can we support teachers to use these approaches in their classrooms?

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Students acting as scientists: what are the teachers doing?

Teachers need professional development which allows them to:

- trial student activities for themselves
- reflect on how best to use these resources with their own students
- understand how subject content can be taught *through* enquiry
- devise activities for themselves which work in their own classrooms



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Feedback

Feedback

in schools

to schools

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Thinking and writing frames to structure investigations and collect evidence of learning



Engaging learners through authentic and intriguing starting points

Strategies for developing questioning and lines of enquiry

Will?

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Can?

Did?

What if?

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Have?

What?

Whyp

When?

Practising peer feedback

Workshop objectives

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- To explore the benefits of enabling students to act as scientists in their learning
- To illustrate successful projects and teaching strategies which support students to act as scientists
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Dr Emily Perry Sheffield Institute of Education Sheffield Hallam University Thank you for participating!