Teacher CPD in object based learning to support inquiry learning in informal settings and schools

PATHWAY

Summary:

Teachers work with museum educators who specialise in object-based learning through inquiry to practice techniques which can be used both within the classroom and informal learning settings.

Aims:

This activity aims to support teachers in:

- developing teaching approaches which promote discovery learning in science lessons
- developing opportunities for learning science outside of the classroom

Main activities:

out of school training for in-service and initial teacher trainees.

Narrative:

The Horniman Museum and Gardens in London delivers a successful object-based learning programme to 23 000 students each year. In this case, the University of Cambridge will work with the Horniman Museum to develop and deliver specific teacher training in how object-based learning can be used to promote inquiry learning both within the science classroom and within informal learning environments such as museums, zoos, botanical gardens, science centres and aquariums. An open invite will be given for secondary science teachers to take part in free on-site training at the Museum.

The training will:

5. Use a teacher-as-learner model to introduce teachers to object-based inquiry. Teachers will conduct their own object-based investigations with a workshop leader modeling best practice in facilitating object-based inquiry.
6. Demonstrate how to build on natural curiosity to explain things in the world around us.
7. Role-model student-directed learning approaches where there may be multiple different outcomes and answers.
8. Encourage the discussion and evaluation of multiple hypotheses and lines of inquiry.
9. Challenge teachers to reflect on their own practice.

The training session will include collaborative group tasks in which participants are given opportunities to develop and share ideas for how the approach could be used to promote inquiry-based learning in their own classroom practice.

End user:
Experienced and novice teachers and students aged 5-18

Involved actors:
Secondary science teachers (both teacher trainees and in-service teachers); informal learning officers (museum educators)

Location:
Horniman Museum and Gardens, London

Connection with the curriculum:
The cross-curricular nature of this training means that it can be used across all three science subject areas (biology, chemistry and physics) from lower to upper secondary age groups.

Languages available:
English

Where to find the application or case:
The Horniman Museum and Gardens, 100 London Road, Forest Hill, London SE23 3PQ

Evaluation parameters:
The efficacy of this approach is shown by informal participant feedback, survey responses via feedback forms, and a short feedback session as part of the training, and in line with the museum's policy for course evaluation. Evaluations seek explanations of how teachers apply what they have learned in their own practice.

Duration: 2.5 hours

Additional information or resources:
training will be advertised on the museum website at www.horniman.ac.uk and through the London STEMnet networking channels.

Teachers' Competencies

1	subject matter/content knowledge	
2	nature of science	
3	Multidisciplinary	
4	knowledge of contemporary science	
5	variety of (especially student-centred) instructional strategies	
6	lifelong learning	
7	self-reflection	x
8	teaching/ learning processes within the domain	
9	using laboratories, experiments, projects	
10	common sense knowledge and learning difficulties	
11	use of ICTs	
12	knowledge, planning and use of curricular materials	x
13	Information and Communication Technologies with Technological Pedagogical Content Knowledge	

Mapping best practices with main principles

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1. Building interest in natural science phenomena and explanations:

This will be a main thrust of the training. By selecting objects deliberately designed to generate curiosity, awe and wonder about the world, participants will see first-hand how engagement with scientific inquiry is sparked by personal interest and a desire to find out more. By using objects which may be unfamiliar to the participants, they will be placed in the position of the learner and will experience a student-directed, discovery learning approach.

2. Building up informed citizens: Students understanding the nature of Science & Science in society:

By engaging with such objects, and being facilitated to undertake an enquiry learning approach, they will understand how scientific discoveries are made, how patterns are sought in data, and how the comparative method in science can enable a developed understanding amongst scientists.

3. Develop multiple goals:

- **understanding big ideas in science including ideas of science, and ideas about science**
- **scientific capabilities concerned with gathering and using evidence**
- **scientific attitudes**

Each training session will look at how teachers can use objects to support students in developing skills for analysing and evaluating evidence. The objects themselves form an evidence base from which students can be encouraged to make inferences, propose hypotheses and weigh up different ideas or possible explanations. The training will model classroom dialogue approaches for questioning and critiquing claims and proposed explanations.

4. Understanding students' concepts and learning style about of science phenomena:

Object-based inquiry can be particularly useful to help students to build bigger ideas from smaller ones and to make connections across subject domains and areas. The training will emphasise the importance of getting students actively engaged in investigating their own questions. The idea here is to demonstrate that students are more motivated if they can become absorbed in a study stemming from their own interest and that their understanding will be deeper when they arrive at answers themselves.

5. Relevance of the content to daily life of students:

Helping students to seek and use evidence to come to decisions can help them to interpret ideas presented in the media, and to judge the quality of others' arguments.

6. Understanding science as a process not as stable facts. Using up to date information of science and education:

By using real objects as evidence for the inquiry process, emphasis is on the use and analysis of empirical evidence as a means of developing knowledge and understanding. Museums and other informal learning environments have unique access to objects that can be used to demonstrate changes in scientific thinking based on emerging evidence and new data.

7. Activities for gaining knowledge, not for entertainment, nor for simple imitating of results:

By discussing and reflecting upon their learning, and by constructing and sharing activities to exploit object-based learning in their classrooms, teachers will gain knowledge themselves. Given that the activities produced, in response to the objects, will enable students to build their own learning, and to build their own questions, the training as a whole facilitates the construction of knowledge by both teachers and pupils.

8. Doing science: experimenting, analyzing, interpreting, redefining explanations:

In object-based inquiry the teacher's role centres on questioning skills. Rather than answering student questions, the teacher facilitates students in reaching their own answers by developing their critical thinking and reasoning skills. An 'open' questioning approach is adopted throughout whereby the teacher scaffolds a process of discovery by refocusing the students on their own observations, inferences and deductions. A central idea is to avoid a narrow focus on single correct answers and instead to support students in formulating and evaluating different possible hypotheses. The teachers will experience this process first-hand. They will take part in object-based inquiries which build on own prior knowledge and deepen understanding as they develop hypothesis and evaluate these based on the evidence in front of them.

9. Assessment: formative ~ of students' learning and the summative ~ of their progress:

The process of object-based inquiry learning can be summarised as a process of formative assessment. The approach places the teacher in a role of facilitator and sessions are student-directed thus freeing the teacher to observe students as they work and interact with others. Through these observations the teacher is able to determine which students are developing understanding of central concepts or ideas and which students might need further guidance or support.

10. Cooperation among teachers and with experts:

By working with expert museum educators, and other teachers, they can learn from each other, drawing on their varied traditions of informal and formal learning to deepen and enrich their students' curricular experience.