

Module 1: Using questions of teachers and children

Aims of the module:

- Introduce participants to the roles of questioning by both children and teachers in inquiry-based and creative approaches to early years science education.
- Share strategies for stimulating, recognizing and building on children's questions.
- Increase awareness of different forms of questioning teachers can employ to scaffold children's creativity and independence in generating and evaluating ideas.

Links to the Content Design Principles and Outcomes

6. Teacher education should provide pedagogical content knowledge to stimulate inquiry and problem solving in science and mathematics education.

6.3 Teachers should be able to recognise the key roles of children's questioning and existing ideas (both implicit and explicit) of science and mathematics.

6.4 Teachers should be able to use a variety of strategies for eliciting and building on children's questions and ideas during inquiry processes (before, during and after explorations and investigations).

10. Teacher education should enable teachers to recognize and build on children's ideas, theories and interests for the teaching of science and mathematics.

10.1 Teachers should be able to use a range of strategies for picking up on children's ideas, interests and questions.

10.2 Teachers should be able to build flexibility into planning to take advantage of unexpected events, children's interests and questions.

11. Teacher education should enable teachers to use questioning effectively and encourage children's questions in order to foster creativity and inquiry.

11.1 Teacher should be able to use different forms of questioning at appropriate points to scaffold creative learning outcomes in science and mathematics, and in particular to encourage children's reflections and explanations, foster their independence and extend their inquiry.

11.2 Teachers should value and be able to build on the potential of children's own questions to foster their curiosity in science and mathematics, and support their generation and follow up, including those that are investigable.

Rationale for the module

Why is questioning important?

There is widespread evidence that young children show curiosity and seek to explore the world around them from a very young age, and questions, both those generated by children and those initiated by teachers, have a central role in both inquiry based and creative approaches to learning and teaching. A key priority in early years science is to sustain and build on children's early interests and explorations both in and outside the classroom. However, there is international concern that the educational process can inhibit and stifle their curiosity, their impulse to question and their engagement in mental play. Furthermore there is evidence in some countries of children's declining interest in science across the primary school.

As noted in the following extracts Conceptual Framework adopted by the CEYS Project (Creative Little Scientists, 2012):

Whilst it is widely accepted that young children are innately curious and seek to explore the world around them, Nickerson (1999) suggests that the educational process can both inhibit and stifle their curiosity, their impulse to question and their engagement in mental play. Some studies indicate that teachers who use a lot of questions achieve high levels of pupil involvement and promote learning (Rojas-Drummond and Zapata, 2004), and others, that creative teachers often employ open ended questions, and promote speculation by modelling their own curiosity (Craft, 2002; Cremin et al., 2009; Robertson, 2002). Arguably, they make use of open questions to promote deeper, transferable thinking and to invite learners to engage with problems of relevance. With upper primary learners in science and mathematics, this can, it is claimed, improve standards of understanding and knowledge through increasing metacognition (Shayer and Adey, 2002). (p55)

The role of the context in questioning is also important in considering children's own questions. (...) Younger children in particular may need time, and space to explore materials in order to formulate ideas and questions (Glauert, 1996). Moreover, it is important to consider that children's curiosity may not be expressed verbally, but through other modes. Children's drawing, gestures, or even actions with materials may illustrate the focus of their investigation; attending to these other modes can provide teachers with means to build upon the different ideas children are exploring, ... (p55)

In science Harlen and Qualter (2004) draw attention to the different kinds and purposes of questioning for example whether they are person or subject centred, open or closed or designed to foster inquiry or to explore ideas. They indicate that questions can be framed for different purposes and emphasise the importance of giving time for thinking and response. (p56)

What are the issues for teachers?

- A key consideration is how to establish a classroom climate and contexts for learning that stimulate questioning. Younger children in particular may need time, and space to explore materials in order to formulate ideas and questions.
- There are also issues associated with recognizing, valuing and building on young children's questions – these may not always be made explicit.
- Children's questions may not be expressed verbally. Young children often convey questions through action, expression and focused engagement and exploration. Children will need support in formulating questions and developing questions that can be investigated.
- There are often challenges in working out how to build on children's questions. Their questions are not always expressed in a way that can be investigated directly, so work is needed to translate them into a form that does lend itself to investigation.
- There are also issues of how to build in time and flexibility in planning to respond to children's questions.
- Teacher questioning has key roles in encouraging children to make their thoughts and questions explicit, in supporting the development of children's strategies and ideas and in modeling scientific questioning.
- It is important to be aware of different forms of questions and ways they can be used to support children's independence and creativity in scientific inquiry.


Overview of the module

The workshop consists of the following activities:

1. **An introduction to the central role of questioning** within both creative and inquiry-based approaches to learning in science, illustrated by classroom examples.
2. **Opportunities for participants to share their classroom experiences** of stimulating and building on children's ideas and questions – approaches they have found successful and challenges they have faced.
3. **Discussion of classroom examples** to examine - What helps prompt children's ideas and questions? In what ways do teachers build on children's ideas and questions?
4. **Reflection on how teaching approaches** adopted might foster children's creativity.
5. **Analysis of teacher questioning** in classroom examples with a focus on: the types of questions teachers ask, the sequence of questions over time and insights gained into children's developing thinking.
6. **Discussion of implications** for planning both of the classroom environment and the teacher's role.
7. **Reflections on what has been gained** from the module – both content and process, in relation to the aims of the module.

Module at a glance

Time	Task	Materials	Grouping
00.00	<p>1. Introduction to the role of questioning within creative, inquiry based approaches</p> <p>Introduction to the CEYS project and CEYS definitions of creativity in early years science (as appropriate)</p> <p>Introduction to the module</p>	<p>Powerpoint presentation</p> <ul style="list-style-type: none"> • Session rationale - this could be illustrated by examples from the CLS Final Reports (see Support Materials below) • Aims • Links to Content Design Principles and Outcomes • Module outline 	Whole group
00.15	<p>2. What approaches have you found useful in stimulating children's ideas and questions?</p> <p>What challenges have you faced?</p> <ul style="list-style-type: none"> • As an individual - Write down answers to these questions on separate post its and place on the sheet on the table. • As a group – See if you can sort these – Any common themes or differences? • Display posters round the room, allow time for review • Discuss common themes and issues 	<p>Post its</p> <p>A1 sheet of paper for groups to share and sort responses</p> <p>Pens</p> <p>Blutack to display posters</p>	<p>Groups of 4/5</p> <p>Followed with feedback with whole group</p>
00.45	<p>3. Discussion of classroom examples.</p> <ul style="list-style-type: none"> • What is the evidence of children's ideas and questions – both implicit and explicit? • How ideas and questions are triggered? Could you provide some more possibilities? • How children and/or teachers are building further on ideas, questions and theories? • Role of the teacher in the episode? What questions might you ask? <p>Note down key points on the recording sheet provided.</p> <p>Brief feedback of general comments related to each question. Indicate links to pedagogical model from Siraj-Blatchford et al (2002) that highlights</p>	<p>Copies of 4 episodes or templates from CLS for example:</p> <p>Selected episodes</p> <p>BE Sandbox,</p> <p>GE Water Enquiry</p> <p>Templates</p> <p>UK EN Cars and Ramps</p> <p>UK EN Sound</p> <p><i>For each group</i></p> <p>Copies of 2 examples</p> <p>2 copies of A3 Recording sheet with 4 boxes to record responses to the questions listed.</p> <p>Flip chart and pens</p> <p>Powerpoint slides of task,</p>	<p>Groups 4/5</p> <p>Work in 2/3 to discuss one example. (If time swap to discuss second example and add to the recording sheet of the other 2/3.)</p> <p>Feedback with whole group</p>

	<p>the importance of both <i>pedagogical interactions</i> (between teachers and children) and <i>pedagogical framing</i> (related to the classroom context). Keep A3 sheets for display.</p> 	<p>examples and of pedagogical model of Siraj-Blatchford et al (2002)</p>	
1.20	<p>4. Reflection on how teaching approaches shown in the examples might foster creativity. Introduce definition of creativity in early years science from CLS and list of creative dispositions. Share first in pairs. Start with one example to study in detail. Take your recording sheet – annotate to indicate opportunities for fostering creativity in your example. Review other examples briefly if time. Brief feedback with whole group – opportunities within each episode – particular strengths/ aspects that need further encouragement – record comments. Keep and display record sheets for reference later in the session.</p>	<p>Powerpoint slides of definition of creativity in early science and list of creative dispositions Flip chart and pens</p> <p>Classroom examples One of each example for each group.</p>	<p>Groups of 4 divided into 2 pairs</p> <p>Share with the whole group</p>
1.30	<p>Break and review of recording so far</p>		
2.00	<p>5. Analysis of teacher questioning in classroom examples. Introduce categories of teacher questions (from Harlen 2000) – subject centred, process centred, person centred, other.</p> <ul style="list-style-type: none"> • What types of questions are asked by the practitioners (subject centered, process centred, person centred, other)? Annotate your example. • What is the focus of teachers’ questions? • Do you note any change over time? • What insights are gained into children’s ideas, questions and strategies? • How might/does the teacher build on these? <p>Brief feedback on each example.</p>	<p>Slides of categories of teacher questioning Copies of 4 episodes or templates from CLS for example Selected episodes GR Ice Balloons PT Sun Distance Templates GE Building Blocks UK EN Beebot For each group copies of 4 different examples Powerpoint slides of types of questions Task 5 recording sheet</p>	<p>Groups 4/5 Work in 2/3 to discuss one example each.</p> <p>Feedback with whole group.</p>
2.30	<p>6. Implications for planning Brief feedback on each example Record general implications for planning – adding to issues discussed following activity 3. Share suggestions in slides from the Exploratorium workshop.</p>	<p>Powerpoint slides of classroom examples Flip chart and pens</p> <p>Slides of implications Creating an atmosphere and take home messages</p>	<p>Whole group</p>
2.45	<p>7. Reflections on what has been gained from the workshop</p> <ul style="list-style-type: none"> • Look back at your original poster of post its as a group – anything you might add? Add in any additional comments or issues in another colour (pen/post it). • Note 2 actions you will take building on workshop content record. • In what ways did the different activities support your developing thinking? • How far have the aims of the module been met? 	<p>Powerpoint slides of activity and aims</p> <p>Collect posters from activity 2 and return to the groups</p> <p>Pens, post its Flip chart</p> <p>Evaluation form</p>	<p>Groups of 4/5 For activities Sharing with the whole group</p>
3.00	<p>End</p>		

Teacher education pedagogy

1. Introduction to the central role of questioning within both creative and inquiry-based approaches to learning in science. This module draws on the definition of creativity in early years science developed in the Creative Little Scientists project, and key features of inquiry-based approaches to science education. You may find it useful to provide opportunities for participants to become familiar with these prior to the workshop. Examples of relevant modules and resources you might utilise are provided in the support materials below.

2. What approaches have you found useful in stimulating children's ideas and questions? This second task provides an important opportunity to capitalize on participants' experiences and expertise. The use of post-its ensures that all contribute. The sharing and sorting of ideas to produce a poster helps to draw out a repertoire of strategies that can then be shared with the whole group. The poster also provides an important reference point for participants to return to in reflecting on their learning across the session.

3. Discussion of classroom examples. The classroom examples have considerable potential to foster interest and encourage debate. However participants may need support initially in engaging with the evidence shown in the episodes and templates. It is helpful if the module facilitators are familiar with the background to the episodes/templates selected and provide a brief introduction to each one at the start of the activity. Details can be found in the relevant Country Reports found on the CLS website www.creative-little-scientists.eu under deliverables D4.3 Country Reports.

It tends to work well if each table is given one copy of each example. Participants work in pairs to study one example in detail, and then has a short time to review the remaining examples.

The recording sheet with the four key questions helps focus discussion and provides a basis for sharing analyses with others. Finally reference to the pedagogical model of Siraj-Blatchford et al (2002) helps to underline the importance of *both* pedagogical framing and pedagogical interactions in fostering and building on children's ideas and questions. It is helpful to note specific comments about the role of the teacher on a flip chart to add to later in discussing Task 6.

4. Reflection on teaching approaches. The additional layer of analysis in this task (building on recording in task 3) – in asking participants to reflect on opportunities for creativity is important in making connections with creativity *explicit*. The activity helps participants, not just to become more familiar with the definitions, but also to consider in more specific terms how they might be evidenced in the classroom.

5. Analysis of teacher questioning. This part of the session draws on a framework for analyzing the types of teacher questions used widely in primary science. References and activities that you may find helpful in relation to this task are listed in the support materials below. As in task 3, it is helpful if you are familiar with the classroom examples selected. Asking participants to *annotate* paper copies of the classroom examples is useful in focusing in *detail* on the types of questions in the transcripts. The annotation also helps to draw out the sequence of questions and how types of question change over time.

6. Discussion of implications for planning. It can be useful to relate the feedback from this activity to key points made in relation to task 3 – to provide an overview of implications for the teacher. This helps provide a stimulus for the final task in the module. There is a suggested follow up activity that could be used during/after the event. It encourages

participants to plan the kinds of questions they might ask to foster children's inquiry and creativity.

7. Reflection on what has been gained from the workshop. The posters produced in task 2, and other recording completed during the session, are designed to provide participants with a starting point for reviewing their discussions and learning across the session and the implications for practice. They encourage consideration of the processes as well as the content of learning to feed into an evaluation of the session.

Background reading

Defining creativity in early years science

This workshop draws on both the definition of creativity in early years science developed in the Creative Little Scientists project and key features of inquiry-based approaches to science education. You may find it useful to provide opportunities for participants to become familiar with these prior to the workshop. For example both:

- Module 4 Focus on inquiry-based science – link with creativity and
- Module 5 Focus on practical investigation which fosters creativity, explore links between inquiry-based and creative approaches to science education.

The executive summaries of the Final Reports of the Creative little Scientists project

- D6.5 Final Report on Creativity and Science and Mathematics Education for Young Children EXECUTIVE SUMMARY
- D6.6 Recommendations to Policy Makers and Stakeholders on Creativity and Early Years Science EXECUTIVE SUMMARY

also provide an accessible introduction to the definitions of creativity and inquiry used during the session, with illustrations from the classroom. These documents can be found on the CLS website at <http://www.creative-little-scientists.eu/content/deliverables>.

Effective teacher questioning in science

The Institute for Inquiry materials available at www.exploratorium.edu/ifi/workshops include a useful practical workshop on *Effective Questioning* in science that introduces the different types of questions discussed in this module. *Effective Questioning* is Workshop III in the materials focused on *Assessment for Learning*. The website provides very detailed and helpful step-by-step guidance to support the practical workshop.

Fostering questioning

Harris, D. and Williams, J. (2007) Questioning 'open questioning' in early years science discourse from a social semiotic perspective. *International Journal of Educational Research*, 46(1-2), 68-82.

This article develops an analysis of 'open' and 'closed' questioning in science classroom discourses from a socio-cultural perspective – aiming to provide alternative tool for understanding the 'meaningfulness' for children and teachers.

Harlen, W. and Qualter, A. (2009). Teachers' and Children's questions. *The Teaching of Science in Primary Schools*. Abingdon: Routledge (143-155).

This chapter has useful sections on teachers' questions and ways of fostering and working with children's questions.

Wardle, C. (2004). Asking the right questions: developing children's questioning skills and knowing how to answer. *Primary Science Review* 83, 11-13.

This short paper offers a ten step guide for teachers, classroom assistants and parent helpers to this important aspect of the science curriculum.

Suggested classroom examples for use during the module

The following classroom examples would act as useful starting points for discussion.

From the *Creative Little Scientists* project at <http://www.creative-little-scientists.eu/content/deliverables>.

For Task 3 Evidence of children's ideas and questions

Selected Classroom Episodes: BE Sandbox, GE Water Enquiry in D4.4 Appendix Selected Episodes of Practice

Classroom Templates: UKEN Cars and Ramps, UKEN Sound in Addendum to D5.3.

For Task 5 Analysis of teacher questioning

Selected classroom Episodes: GR Ice Balloons, PT Sun Distance in D4.4 Appendix Selected Episodes of Practice

Classroom Templates: GE Building Blocks, UKEN Beebot in Addendum to D5.3.

For both tasks

From the *Creativity in Early Years Science Project* at <http://www.ceys-project.eu>
Curriculum Materials

Title	Age group	Country
Life cycle of a frog	4-5	England
Living things and their habitats	7-8	England
An icy adventure	3-4	England
Water resistance	5-6	Belgium
On the go	4-7	England
Changing Seasons	3-4	England
Make bread right now	5-6	Romania

However it is important to review and select examples appropriate to your context and audience. Other examples can be found on the CLS and CEYS websites.

Module resources

The following documents are provided as separate files in the Module folder for adaptation and use as appropriate during the module:

- Powerpoint presentation
- Recording sheets for the different activities:
 - Task 3 recording sheet: Discussion of classroom examples: Evidence of children's ideas and questions. This can be reproduced as an A3 sheet for participants to record responses to task 3.
 - Task 5 recording sheet: Analysis of teacher questioning
- Handouts
 - Sheet showing definitions of creativity in early years science and Features of inquiry and creative dispositions - for reference during the session



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