Module 9: The role of the teacher (Teacher scaffolding)

Aims of the module

- Introduce participants to sensitive and responsive scaffolding techniques to support independence and extend inquiry as well as foster creativity in science.
- Share and discuss the variety of different roles that the teachers can assume during their interactions with children and the extent of fostering children's agency for each of these roles.
- Identify and discuss challenges involved in balancing intervention and collaboration with children.
- Share strategies on creating and maintaining a learning environment that increases opportunities to foster children's agency.

Links to the Content Design Principles and Outcomes

1. Teacher education should provide content knowledge about science and mathematics, including interesting and current topics, to be used in activities linked with everyday life.

   1.2 Teachers should be able to make children aware of connections between science and mathematics learning and their everyday lives, in order to engage their motivation, interest and enjoyment in science and mathematics and foster curiosity and creativity.

7. Teacher education should familiarise teachers with a range of formal and informal inquiry- and creativity-based learning, teaching and assessment approaches and strategies and their use in relation to authentic problems within the areas of science and mathematics.

   7.7 Teachers should be able to assume a variety of roles in their interactions with the children e.g. allower, leader, afforder, coordinator, supporter, tutor, motivator and facilitator, to support children's creativity and inquiry in science and mathematics.

   7.8 Teacher should be able to use a variety of scaffolding techniques to promote creativity in science and mathematics, from standing back in order to observe, listen and build from the children's interests, to intervening with appropriate questioning to support and extend inquiries.

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 teacher scaffolding important?

- Teacher scaffolding has been considered beneficial for young children fostering their independence as inquirers and problem-solvers, their creativity as possibility thinkers, their conceptual knowledge, and their strategies and meta-cognitive strategies.

- Through scaffolding the learning environment children can be provided with shared, meaningful, physical experiences and opportunities to develop their own questions and ideas about scientifically relevant concepts.

- Teacher scaffolding emphasises the importance of teachers mediating learning to meet children's diverse needs.

- Teachers play a fundamental role in making links between everyday concepts gained through playful interaction and more formal scientific concepts.

- Teachers, who prioritise stopping, observing, listening and noticing the nature of children's engagement, support children's agency and decision-making – utilising time and space available to explore and experiment.

What are the issues for the teachers?
- A number of studies on scaffolding in varied contexts indicate the complexity of the issues involved in relation to the context and purposes of activities.

- Delaying instruction until the learner has had a chance to investigate and inquire on their own or with others could promote innovation and discovery.

- Fostering creativity and problem solving requires professional restraint and well developed skills of close observation. The role of the teacher particularly in this context is dynamic and has to move from 'allower', implying some degree of standing back and avoiding too much intervention, to other roles with varied levels of intervention, collaboration and standing back such as leader, afforder, coordinator, supporter, tutor, motivator and facilitator.

- Structuring the learning environment appropriately by providing children with shared, meaningful, physical experiences to offer them opportunities to develop their own questions and ideas about scientifically relevant concepts can be problematic for early years teachers in science. Teachers should be able to scaffold children's thinking helping them make links between everyday concepts gained through playful interaction and more formal scientific concepts, if they are to provide such a learning environment in science education.
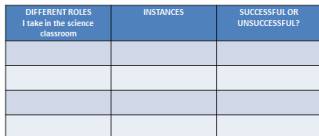
Overview of the module
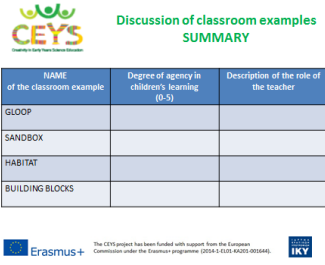The module consists of the following activities:
1. Introduction: An introduction to the significance of teacher scaffolding within both creative and inquiry-based approaches to learning in science.
2. Opportunity for participants to share with the group the different roles they take on as teachers in the classroom – instances which they consider as successful and examples of challenges they have faced. Participants discuss in what ways these different roles may support features of inquiry and creative dispositions.
3. Discussion of classroom examples from Creative Little Scientists project to examine: To what extent is the agency of the children fostered in the examples given? What is the role of the teacher? What are the interactions between teacher and children?
4. Reflection on the role of the teacher for different degrees of children's agency in the classroom examples discussed above. Is it possible to increase opportunities for children's agency in these examples? What could be changed? Discussion of implications about the learning environment in the different examples. Are there any links between the learning environment and children's agency?
5. Reflection on how different teacher roles identified might foster inquiry and creativity. This provides a starting point for an introduction to *key features of the definition of creativity* adopted by the CEYS Project, as well as to *features of inquiry* and *creative dispositions* in the CEYS Conceptual Framework. Possible variations in

the essential features of classroom inquiry in terms of learners' self-direction and corresponding teacher material direction (Barrow, 2010, p. 3) are discussed. Participants are then introduced to different teacher roles and scaffolding techniques.

6. What are the implications for planning? Participants examine and share implications about their own practice and settings in relation to the pedagogical model *Pedagogical interventions in context* (Siraj-Blatchford et al, 2002) from the CEYS Conceptual Framework.

7. Final Reflections. Participants reflect 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	**1. Introduction**: aims and rationale of the module. An introduction to the significance of teacher scaffolding within both creative and inquiry-based approaches to learning in science.	PowerPoint presentation • Aims of the module • Links to Content Design Principles and Outcomes (CLS supporting material) • Links to the synergies, features of inquiry and creative dispositions (CLS supporting material) • Rationale for the module • Outline of the module	Whole group
00.10	**2. Sharing experiences.** What are the different roles you take in the science classroom to foster inquiry and creativity? Provide some examples. Have there been instances when your choice of role was unsuccessful? What were those? Provide some examples. ***As an individual*** - *Write down answers to these questions on separate post its and place on the sheet on the table. Use different colour of post-its for successful and unsuccessful instances.* ***As a group*** – *See if you can sort these – Any common themes or differences?* ***Feedback*** *to the whole group.* In what ways did your different roles support features of inquiry and creative dispositions? Facilitator summarises feedback on flip chart.	A3 recording sheets for groups to share and sort responses Pens Markers Post it notes of different colours Blutak to display the sheets for review at the end of the session. Pre-prepared flip chart: 	Groups of 4 (or more) Followed with feedback with whole class
00.40	**3. Working with classroom examples.** - Present briefly the 4 classroom examples from CLS. - Subdivide each group of 4 into an A and a B group *(2 people in Group A and 2 people in group B).* - Provide a set of 4 different classroom examples (CLS episodes) to each group of 4. Groups A and B receive a pair of different examples each. After 10 mins Groups A and B swap examples. - Ask the A groups to focus on the agency and learning of the children and the B groups to focus on the role of the teacher.	Copies of 4 episodes from CLS for each group: EN Gloop EN Habitat GE Building blocks BE Sandbox Other examples that can be used: GR Building Mr Zip GR Measuring Tables EN Baking BE The giant Large sheet of paper Flip chart	Groups of 4/5 Feedback from A Groups Feedback from B Groups

	Set the following tasks to the groups - For the A group: To what extent is the agency of the children fostered in the examples given? Try to give a number from 0 to 5, where 5 = 'agency is highly fostered', 0 = 'agency is not fostered'. Please explain the basis for your evaluation. - For the B group: Describe in detail the role of the teacher in the different examples used. Focus on interactions with the children; questions used; explanations given; different materials introduced; encouraging the agency of the children; supporting creative thinking; etc. Ask the groups to note their findings on a large sheet of paper. Collect the summary of participants' discussion on flip chart.	Pens Markers Pre-prepared flip chart: 	

01.10	**4. Focus on the interconnections between the role of the teacher, the learning environment and children's agency.**
	- Invite the group to draw on their findings to reflect on connections between the role of the teacher and children's agency using questions such as:
	  o What is the role of the teacher when the degree of child agency = 5?
	  o What are children learning and to what extent are they learning when the degree of child agency = 5?
	  o In the example in which the degree of children's agency is lowest, what is the role of the teacher in this example, and what are children learning?
	- Is it possible to increase opportunities for children's agency in this example? What could be changed?
	- What about the learning environment in the different examples? Is there is any link between high agency and the learning environment?
		Large sheet of paper
		Flip chart
		Pens
		Markers
			Groups of 4
			
			Followed with feedback with whole group

01.30	**Coffee break**		
01.45	**5. Reflection on how different teacher roles identified might foster inquiry and creativity.** Introduce definition of creativity in early years science from CLS and lists of features of inquiry and creative dispositions. Present and discuss possible variations in the essential features of classroom inquiry in terms of learners' self-direction and corresponding teacher material direction (Barrow, 2010, p. 3).	Powerpoint slides of: definition of creativity in early science; lists of features of inquiry and creative dispositions; Barrow's chart; teacher's roles; scaffolding techniques. Powerpoint slides of classroom examples Flip chart and pens	Work in groups of 4. Whole group discussion

	  Introduce participants to different teacher roles and scaffolding techniques. Ask groups of 4 to use their notes from the previous activity to indicate opportunities for fostering inquiry and creativity in the examples examined and link these to teacher's role and scaffolding techniques. Follow with whole group discussion – collect comments from the whole group for each example on flipchart.		
2.15	**6. Implications for planning** Participants examine and share implications about their own practice and settings in relation to the pedagogical model Pedagogical interventions in context (Siraj-Blatchford et al, 2002) from the CEYS Conceptual Framework. Record general implications for planning.	Flip chart and pens	Whole group
2.45	**7. Reflections on what has been gained** from the module: - Look back at your original post its as a group – anything you might add? Add in any additional comments or issues in another colour (pen/post it). - In what ways did the different activities in this workshop help you rethink your role as teacher in the early years science classroom? - In what ways did they help you to reflect on ways of promoting creativity in early years science education? - What impact do you expect this module to have on your future activities? - How far have the aims of the module been met?	Powerpoint slide of take home messages Collect posters from previous activities and return to the groups Pens, post its Flip chart Evaluation form	Groups of 4/5 for activities Sharing with the whole group
3.00	**End**		

Teacher education pedagogy

1. This module draws on the particular theoretical background developed in the Creative Little Scientists project, such as the definition of creativity, the key features of inquiry-based science education and creativity, as well as the synergies between the two. All these

concepts are situated (in the frame of Creative Little Scientists and CEYS) within the framework of the Vulnerable Spider-Web (van der Akker, 2007) as seen below

You may find it useful to provide opportunities for participants to become familiar with these prior to the workshop.

2. This second task provides an opportunity to capitalize on participants' experiences and expertise. The aim of this activity is to allow teachers time to reflect on the different roles they take on in their classroom early in the workshop and try to identify instances of success and failure in order to start them thinking about the learning environment. The use of post-its ensures that all contribute. The recording sheet with the four key questions helps focus discussion and provides a basis for sharing analyses with others. 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 module.

3. 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 under deliverables D4.3 Country Reports.

4. This particular activity is trying to get participants to focus on the interconnections between the role of the teacher and children's agency. Reflecting on the summary chart produced in the previous task will assist participants to identify correlations between the different roles of the teacher and the level of children's agency for each classroom example. The activity will also help participants to consider the relationship between the learning environment and children's agency.

5. In this activity participants reflect on how different approaches to teacher scaffolding might foster children's inquiry and creativity in the science classroom. Barrow's chart (2010) showing how the essential features of classroom inquiry may vary in terms of learners' self-direction and corresponding teacher material direction, will help focus participants' reflections on approaches used in the teaching and learning of science. The activity helps participants, not just to become more familiar with the definitions, but also to consider in more specific terms how these might be evidenced in the classroom. It will thus facilitate them towards establishing explicit connections between their practice and children's creativity in terms of their roles as teachers and teacher scaffolding.

6. It can be useful to relate the feedback from this activity to key points made in relation to task 4 – to provide an overview of implications for the teacher. This helps provide a stimulus for the final task in the module.

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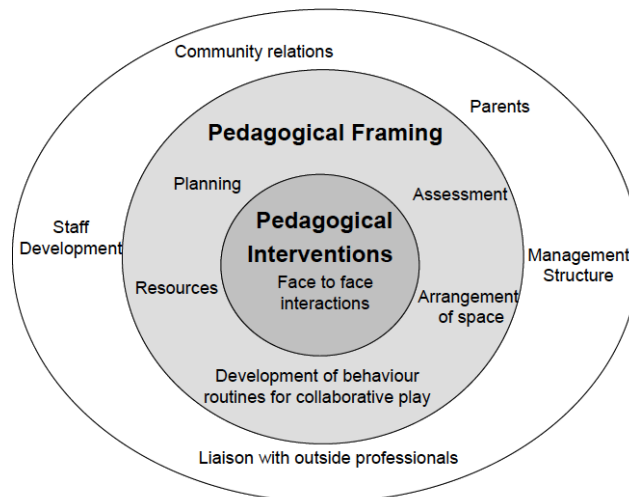
7. The posters produced in task 2, and other recording completed during the session, are designed to provide participants with a starting point for reviewing their discussions and learning across the session and the implications for practice. They encourage consideration of the processes as well as the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

Background reading

Defining creativity in early years science

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

This module draws on both the definition of creativity in early years science developed in the Creative Little Scientists project and adopted by the CEYS 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. These reports from the Creative little Scientists project provide accessible introductions to the definitions of creativity and inquiry used during the session, with illustrations from the classroom. They can be found on the CLS website at http://www.creative-little-scientists.eu/content/deliverables.

Cremin, T. et al (2015) Creative Little Scientists: exploring pedagogical synergies between inquiry-based and creative approaches in early years science. *Education 3-13*, *43*(4), 404-419.

This article built on the work of the Creative Little Scientists Project provides a useful introduction to the pedagogical synergies identified by the project between IBSE and CA to science learning and teaching.

Role and importance of teacher scaffolding in early years science

D2.2 Conceptual Framework

This document, also available on the CLS website at http://www.creative-little-scientists.eu/content/deliverables, describes the Conceptual Framework adopted by the CEYS project.

In it teacher scaffolding and involvement is identified as as one of the synergies between creative and inquiry-based approaches to learning and teaching.

Relevant excerpts from this document:

Notwithstanding the recognition that Inquiry-Based Science Education (IBSE) and Creative Approaches (CA) both include attention to problem solving in exploratory contexts, in which questions, collaboration, motivation and reflection play a significant role, the efficacy of these approaches depend in large part on the teacher's role, scaffolding children's learning. Scaffolding has been considered beneficial for young children fostering their independence as inquirers and problem-solvers (Rittle-Johnson and Koedinger, 2005; Metz, 2004), their creativity as possibility thinkers (Cremin et al., 2006; Craft et al., 2012), their conceptual knowledge (Coltman et al., 2002), and their strategies (Secada et al., 1983), and meta-cognitive strategies (Aleven and Koedinger, 2002).

However, studies of scaffolding in varied contexts indicate the complexity of the issues involved in relation to the context and purposes of activities. For example, in a quasi-experimental study undertaken with pre-schoolers in a science museum, Bonawitz et al. (2011) investigated the implications of explicit instruction on exploratory play. It could be argued such instruction should scaffold learning and enrich their creativity, yet this research suggests that teaching children in this way constrains their exploration and discovery, since even the children not being explicitly taught in this context, extended their assumptions from overhearing adults' comments and demonstrations to other children, and adapted their behaviour accordingly. As a consequence, the researchers suggest that such "pedagogy promotes efficient learning but at a cost: children are less likely to perform potentially irrelevant actions, but also less likely to discover novel information" (2011: 322). Their work on the 'two-edged sword of pedagogy' has considerable implications for the project Creative Little Scientists, and suggests for example that delaying instruction until the learner has had a chance to investigate and inquire on their own or with others could promote innovation and discovery.

In the study the 'House of Little Scientists', already discussed, Kramer and Rabe-Kleberg (2011), in observing teachers and children during their work on a scientific problem, identified two types of teachers' behaviour which emerged naturally: 'ignoring' and 'integrating' interaction with children. The former behaviour involved teachers more or less ignoring the children's ideas and approaches; they tended to tell the children how to do the experiment 'in the correct way'. In contrast, the occasions on which teachers showed more 'integrating behaviours', they tried to incorporate the children's views and foster self-directed inquiry. However two distinct forms of children's reactions to their teachers' behaviour were noted: in the former when their ideas were 'ignored' the children worked together to try to find answers and 'crossed new frontiers' being open to new ideas/approaches, in the latter they sought to conform to the teachers guidance and exercised less agency and problem solving.

This issue of teacher positioning relates to a strategy noted earlier, that of standing back, which has been identified as a core pedagogic strategy nurturing possibility thinking (Cremin et al., 2006). What distinguishes this strategy is the position of the teachers, who prioritise stopping and observing, and listening and noticing the nature of the learner's engagement. By being 'one remove' yet highly attentive, the teachers, it is claimed, were able to notice any unusual or unexpected actions, behaviours or ideas suggested or enacted by the children. Whilst the teachers in the House of Little Scientists study, 'stood back' for other reasons, (often due to lack of assurance and scientific knowledge) the effect appears to have been the same- the young were able to take up positions both as decision-makers and agentic learners, utilising the time and space made available for them to explore and experiment. The work of other scholars also highlights the pedagogic practice of respecting children sufficiently to stand back from their endeavours in order to observe their interests, needs and direction of learning and then build upon this (Fawcett and Hay, 2004; Rinaldi, 2006; Tobin et al., 2011). This suggests that IBSE and CA to fostering creativity and problem solving requires professional restraint and well developed skills of close observation. Hyvönen (2008) too highlights the role of teacher as 'allower', implying some degree of standing back and avoiding too much intervention, though she also mentions other roles: leader, afforder, coordinator, supporter, tutor, motivator and facilitator.

In articulating their theory of early developmental pedagogy, Samuelsson and Carlson (2008) argue that one of the main features is the teacher focusing the child's attention towards problems that

arise. They suggest that at times the teacher is more fully and playfully involved as a fellow collaborator and provocateur. Drawing on the philosophy of Reggio Emilia, others such as Bancroft et al. (2008), and Craft et al. (2012) also highlight the significant role of provocations triggered by adults as supportive scaffolds. In the latter study, the teachers not only stood back from the learners but also at times played alongside them as partners. As such they were often present 'in the moment', and effectively combined observing with intervention (see Figure below which highlights both the features of possibility thinking and the attendant pedagogical strategies which nurture it. This connects to McWilliam's (2008) conception of the 'meddler in the middle' and involves the teachers in working alongside children with intense sensitivity as to appropriate interventions. This positioning of the teacher as a fellow artist or at least fellow collaborator engaged in co-authoring is in contrast to more traditional notions of power relationships in the classroom. Although in early years education the hierarchical model, more common in later primary and secondary education, is less prominent (Smidt, 2006), there is still scope for a closer examination of teachers positioning in IBSE and CA.

Pedagogy nurturing possibility thinking (Craft, MConnon and Matthews, 2012)
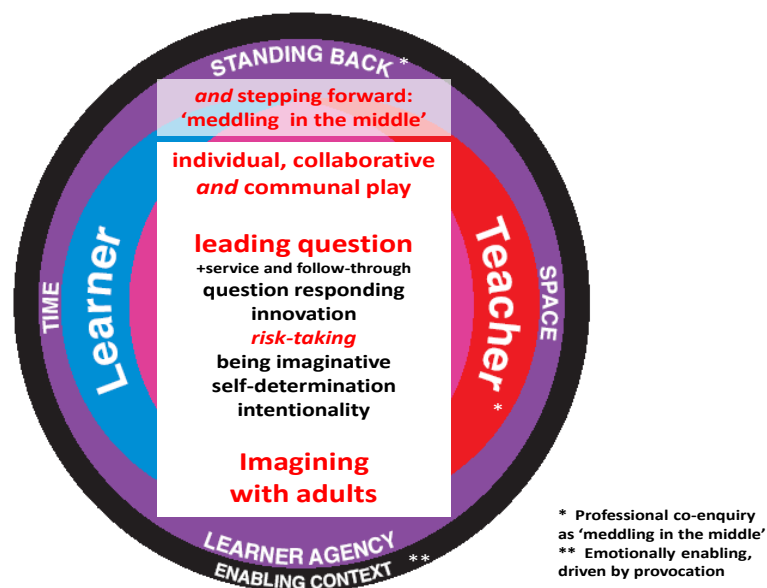
Suggested classroom examples for use during the module
The following classroom examples would act as useful starting points for discussion.

From the *Creative Little Scientists* project at http://www.creative-little-scientists.eu/content/deliverables.
Selected Classroom Episodes: EN Gloop, EN Habitat, GE Building blocks, BE Sandbox, GR Building Mr Zip, GR Measuring Tables, EN Baking, BE The giant in D4.4 Appendix Selected Episodes of Practice

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

Curriculum Materials

Title	Age group	Country
Properties of materials: problem solving and reasoning	4-5	England
Everyday materials	5-6	England
Science from Stories: Investigating materials	4-5	England
An icy adventure	3-4	England
Floating boats	5-6	Greece
Plant and Butterfly Cycles	5-6	Greece

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 2 recording A3 sheet for each group - What are the different roles you take in the science classroom to foster inquiry and creativity? Provide some examples. Have there been instances when your choice of role was unsuccessful? What were those? Provide some examples.
  - Task 3 recording A3 sheets for each Group A and Group B.
  - Task 4 recording A3 sheet for each group - Is it possible to increase opportunities for children's agency in this example? What could be changed? What about the learning environment in the different examples? Is there is any link between high agency and the learning environment?
- Handouts
  - Handout showing definitions of creativity in early years science and Features of inquiry and creative dispositions - for reference during the session
  - Handout showing different teacher roles and scaffolding techniques – introduced in Task 5.
  - Handout Barrow chart of opportunities for children's decision-making within scientific inquiry introduced in Task 5.

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