Module 2: Resources and Learning environment as essential context factors for Creativity and Inquiry

Aims of the module:

- Introduce participants to the role of resources and the learning environment in inquiry-based and creative approaches to early years science education.
- Share strategies and experiences for recognizing and building on available resources and the learning environment.
- Increase awareness of the different opportunities that everyday resources and learning environments offer.

Links to the Content Design Principles and Outcomes

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.

7.5 Teachers should be able to use a range of creative contexts and approaches for provoking children's interest, motivation and enjoyment in science and mathematics, such as stories, poems, songs, drama, puppets, games.

14. Teacher education should equip teachers with knowledge and skills to use a range of formal, non-formal and informal learning environments, including the outdoor environment, both the school grounds and the wider environment beyond the school, in their teaching of science and mathematics.

14.1 Teachers should be able to make use of varied settings for science and mathematics learning, including flexible use of the environment both indoors and out.

14.4 Teachers should be able to manage visits with children to the outdoor and wider environment beyond the school, addressing issues of health and safety, liaison with parents, building progression in experience inside the classroom.

17. Teacher education should address with teachers issues in ensuring rich provision, planning and use of resources (including digital resources) in and out of the classroom to support children's inquiry and creativity.

17.1 Teachers should be able to organise and use materials (including everyday materials), resources (including ICT and natural resources) and equipment (including digital equipment and simple laboratory instruments) in the classroom, school and wider environment, both indoors and out, to support independent inquiry and creativity.

17.2 Teachers should be able to recognize the nature and potential of different materials and resources both to constrain and extend children's explorations.

17.3 Teachers should be able to evaluate and select creativity enabling ICT resources for children to use in their inquiry.

Rationale for the module

Rationale for the focus on resources and learning environment

The importance of resources and learning environment is highlighted in the *Conceptual Framework* of the CLS-project (Creative Little Scientists Consortium, 2012).

Shared, meaningful, physical experiences can trigger children to question the world around them and may help in developing insights about scientifically relevant concepts.

Therefore, by providing a meaningful learning environment, children's agency in problem

The project CREATIVITY IN EARLY YEARS SCIENCE EDUCATION has received funding from the European Union Erasmus+ Programme (2014-2017) under Grant Agreement n0 2014-1-EL01-KA201-001644.

finding can be fostered.
Fleer (2009) found that the teacher's role is fundamental when it comes to connecting their concepts gained through playful interaction and more formal scientific concepts.
A rich physical environment, the outdoor environment and the importance of making links with children's everyday lives are essential to engage interest and foster curiosity (French 2004).
Moreover, providing a wide range of materials and resources in the classroom can motivate young children and may offer ways for them to represent their creative ideas and express their thinking.
Besides these more common resources also digital technologies offer opportunities to foster children's creativity, for example, in gaming, in connecting with others and in content generation in particular (Craft, 2011). This may bring about insights and understanding of the natural environment. Moreover, with these tools they can record their learning process and use the digital images to reflect on this process. In this way their knowledge about 'how science works' may grow. And these mobile technologies might even be used to 'measure and analyse' the environment. The interaction with physical materials & the environment however remains the most important resource for children to engage with science.

In a literature review on creative learning environments in education Davies et al. (2013) described different aspects which were found to be important by different researchers (mentioned in this publication) to stimulate creativity:

- **The learning environment** should be capable of being used flexible to promote pupils' creativity. In an early years setting, this can even involve the abandonment of specifically themed role-play areas to give children's imagination greater freedom. There should be a general sense of openness and spaciousness and the sensory qualities in learning environments should be optimal. The display of work in progress in the classroom could also stimulate pupils' creativity.
- Also the availability of a wide range of **appropriate materials, tools and other resources** were shown to be an important stimulating creativity. Case studies described in this review have shown that the availability of lots of light, formless materials which can take on any shape, such as clay, modelling foam, wire, cellophane, tissue paper, etc. can stimulate creativity. Older pupils appear to be stimulated by the access to enhanced or specialist resources (e.g. microscopes, infrared cameras, …) . Also access to new or different media and technologies was widely attributed with stimulating creativity.
- Taking pupils out of the classroom and working in an **outdoor environment** for a part of their time in school can foster their creative development. The reason for this may be that pupils feel as if they own outdoor time more than indoor time. Moreover, pupils link indoor time to individual working. So ownership and collaboration may be enhanced by outdoor education. An initial walk with young pupils can provide a rich context for discovering children's interests on which teachers can build to enhance their creativity.

Why are resources and the learning environment important?

- A rich learning environment stimulates curiosity, and may trigger children to question the world around them.
- A rich learning environment may help in developing insights about scientifically relevant concepts.
- Resources and learning environments can foster children's agency in problem finding and solving

The project CREATIVITY IN EARLY YEARS SCIENCE EDUCATION has received funding from the European Union Erasmus+ Programme (2014-2017) under Grant Agreement n0 2014-1-EL01-KA201-001644.

What are the challenges for teachers?

- The teachers must connect the early scientific concepts of the children with more formal scientific concepts.
- By providing a rich physical environment teachers may engage interest and foster curiosity.
- Teachers need to see the link between the everyday environment and lives of the children and the physical concepts within it.
- Teachers need to see the opportunities that digital technologies may offer.

Overview of the module

0. **Pre-task.** Ask the participants to send some pictures of their classroom to the facilitator of the module.

The module consists of the following activities:

1. **Introduction.** An introduction to the central role of outdoor education, the learning environment and resources to learning in science.
2. **Learning goals of the teachers.** An opportunity for the teachers to clarify their questions and expectations of the module
3. **Connecting to current classroom practices.** Collection of participants existing classroom practice.
4. **Exploring the outdoor environment and Identifying science questions emerging from their outdoor experience.** Opportunities for the participants to explore the outdoor environment,
5. **Characteristics of inspiring materials and environments which promote creativity in science**. Opportunities for the participants to explore the indoor learning environment and the available resources.
6. **Discussion & reflection on classroom examples**. Discussion of classroom examples from Creative Little Scientists project and reflection on how they as a teacher might foster children's creativity.
7. **Connecting their experiences during the module and the classroom examples to their own classroom practice.** Opportunities to link their experiences during the module to how children in their classroom interact with the resources and learning environment and apply insights to their own classroom practice & examples. Discussion of implications for planning both of the resources and learning environment and the teacher's role.
8. **Reflections on what has been gained from the module.** Reflections on what has been gained from the module – both content and process, in relation to the aims of the module & answering of the remaining questions.

Module at a glance

Time	Task	Materials	Grouping
	0. Pre-task: ask the participants to send some pictures of their classroom to the facilitator of the module. These pictures can be used in phase 5.	-	-
00.00	**1. Introduction** to the role of resources and the learning environment as essential context factors for Creativity and Inquiry.	Powerpoint presentation • Aims • Links to Content Design Principles and Outcomes • Session rationale	Whole group
00.15	**2. Learning goals of the teachers**	Post-its	Whole group

The project CREATIVITY IN EARLY YEARS SCIENCE EDUCATION has received funding from the European Union Erasmus+ Programme (2014-2017) under Grant Agreement n0 2014-1-EL01-KA201-001644.

	Teachers write down what they want to learn during this session and what their questions are on post-its. Run over the questions one by one and start clustering them in different emerged categories.	Pens Board or wall	
00.25	**3. Connecting to current classroom practices:** Let the participants write down their existing classroom practice concerning indoor & outdoor practice and the use of materials. Provide enough time to exchange experiences.	Recording sheet: own practice Pens	Individually Whole group
00.35	**4. Exploring the outdoor environment.** Divide the group in subgroups of 4-5. Give them a tablet or let them use their smartphone. Go outside (f.i. to a nearby play ground, park, … If this is not possible, let them look outside the window) and explain the purpose of the exercise. The teachers explore the outdoor environment and take pictures or film situations/objects that raise questions and where they want to know more about (Let them mail their results to the facilitator). If possible, let them explore these situations in detail. Let them think about the use of the tablet. How can this help to understand the natural world? They can also bring in materials that trigger questions.	Tablet or smartphone	Groups of 4-5
01.00	**Identifying science questions emerging from their outdoor experience.** Invite the groups to exchange their images and discuss what situations/objects triggered their own questions. - What aspects are important to trigger their curiosity? - Are there common elements? Are there differences? - Use of tablets/smartphones? Materials? - What would you investigate? What kinds of investigations could you set up? List these on a blackboard, whiteboard or flip chart. - Let them reflect on the science behind these questions. What would they investigate? What kind of experiments could they set up? - Prompt with scientific aspects: movement, nature, chemistry, materials, aspects (color, patchiness, …), particular features, … - Let them reflect on the opportunities the outdoor environment offers to identify scientific insights, questions, … List these on a blackboard, whiteboard or flip chart.	Blackboard, whiteboard or flip chart & pens Recording sheet: Reflection on the use of the outdoor environment	Whole group

The project CREATIVITY IN EARLY YEARS SCIENCE EDUCATION has received funding from the European Union Erasmus+ Programme (2014-2017) under Grant Agreement n0 2014-1-EL01-KA201-001644.

01.15	**5. Characteristics of inspiring materials and environments which promote creativity in science.** Introduce them with the different resources. Let them play/experiment with the materials. What do you think is important for resources to stimulate creativity? Which resources may stimulate creativity? What aspects are important? • Participants write down different characteristics of the materials on the recording sheet. • Record key insights on a blackboard, whiteboard or flip chart. Next give them different pictures of the indoor environment of different classrooms. Let them explore these pictures and question them: Which indoor environments do you think are stimulating? What do you think is important for an indoor environment to stimulate creativity? What aspects in particular? • Let the participants write on the pictures of the indoor environment: what do you consider to be a stimulating environment for creativity? What not? Why? • Record key insights on a blackboard, whiteboard or flip chart. Link the key insights from both questions to each other. What are the similarities? Differences?	Blackboard, whiteboard or flip chart & pens Different resources: The usual resources such as clay, modeling foam, sand, pipe cleaners, tin foil, water, wire, cellophane, tissue paper, books … But also more uncommon materials such as mobile technologies and materials triggering wonder such as plasma spheres, polydensity bottles, … If available you might also supply living organisms. Waste material such as empty bottles, paper, cardboard rolls, … Pictures of different learning environments. Prints of the pictures the teachers mailed before or see at the end of the ppt for inspiration. Recording sheet: Reflection on resources, materials and classroom environments	Groups of 4-5
01.45	Break		
02.00	**6. Discussion & reflection on classroom examples.** Give a short introduction to the context of each template. Let each teacher read one classroom example and let him/her explain it to others • How can the indoor and outdoor environment and resources influence and enhance the science learning of the children? • What is the role of the teacher in the examples? How do they stimulate children to use the resources and to explore the environment? • What would you do (differently) in your classroom? Invite each group to share their insights. • Brief feedback on each example • Record key insights on a blackboard, whiteboard or flip chart. • Introduce insights from literature sources. Highlight the following insights: - Through using resources children can develop their exploration skills and creativity. - Varied resources and a rich learning environment can be/are necessary to provoke	Copies of classroom materials. Choose from the selected materials: Selected episodes and templates from CLS: MA_Class_Minibeasts_Lenvironm UKSC_Class_Forest_School_Child Ideas PT_Class_SwinggameRope_IBSE Selected curriculum materials from CEYS: Bath bombs Skeletons Crime scene investigation Electricity An icy adventure Science from stories: Investigating materials Make bread right now Can water be transferred? Film: if available you could also provide a classroom example. *For each group* Copies of 2 examples Blackboard, whiteboard or flip chart	Groups 4/5 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.) Feedback with whole group

The project CREATIVITY IN EARLY YEARS SCIENCE EDUCATION has received funding from the European Union Erasmus+ Programme (2014-2017) under Grant Agreement n0 2014-1-EL01-KA201-001644.

	the curiosity of children and to foster their ideas, questions and theories. - The materials in the environment offer children opportunities to think about different ideas, to inquire about properties, to have different approaches to the same subject.	& pens Powerpoint slides *For every individual:* Recording sheet: Analysis of classroom examples	
02.25	**7. Connecting their experiences during the module** (the outdoor & indoor environment and resources) **and the classroom examples to their own classroom practice:** • The teachers enrich their classroom examples (see phase 3) with new ideas. • They record general implications for planning. They note 2 actions they will take building on module content. • What approaches would they find useful in stimulating their children to explore the learning environment & resources? What challenges have they faced or would they face? What are possible solutions? Prompt the groups to consider: • Different learning environments • The diversity of the children and how they as teachers might use these learning environments to develop creativity in science. • In what way can digital technology be used to collaborate with others in generating understandings. Exchange ideas, discuss questions and possible difficulties in pairs. • The teachers refine their ideas Interesting insights are shared with the whole group.	Recording sheet: own practice (add ideas) Pens Blackboard, whiteboard or flip chart & pens	Individually & groups of 3-4 & whole group
2.45	**8. Reflections on what has been gained from the module** • In what ways did the different activities support your developing thinking? • How far have the questions at the start of the session been answered? Do you still have questions that need addressing?	Pens, post its Flip chart Evaluation form	Groups of 4/5 for activities. Sharing with the whole group.
3.00	End		

Teacher education pedagogy

Depending on the available time, it may be advisable to cancel some of the phases. In this way some of the other phases can still be handled thoroughly.

0. Pre-task. In case the facilitator is working with in-service teachers he/she might ask the teachers to mail some pictures of their classroom before the module. These pictures might be used during the module. In this way the participants will have more ownership.

The project CREATIVITY IN EARLY YEARS SCIENCE EDUCATION has received funding from the European Union Erasmus+ Programme (2014-2017) under Grant Agreement n0 2014-1-EL01-KA201-001644.

1. Introduction. 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 module. Examples of relevant modules and resources you might utilise are provided in the support materials below (to be added).

In the first phase the aims of the module, the session rationale, the links to the content design principles and the outcomes are clarified. Depending on the prior knowledge of the participants (student teachers or in-service teachers) it might be useful to give more information on what science is (biology, physics, chemistry,...).

2. Learning goals of the teachers. At the start of the module the participants write down their questions and what they want to learn during this module. In this way the module facilitator gets a clear view on the expectations of the participants, and he/she can elaborate more (or less) on these topics during the module. It may be hard for the participants to write down questions at the start of the module. At this moment the facilitator might prompt the participants with questions such as: 'When and why do you chose to go outside with the children? Do you have specific questions about exploring the outdoor environment with the children? When and how do you use resources? Do you have specific questions about the use? How do you use the classroom environment? Do you have questions about this? Or the facilitator could let them discuss their questions in small groups. This might trigger more questions.

3. Connecting to current classroom practices This task provides an important opportunity to capitalize on participants' experiences and expertise. They write down their existing classroom practice concerning indoor & outdoor practice and the use of materials. This information will be used at the end of the module, to help participants enrich their current activities to foster more creativity in science. In this way they also get the opportunity to apply their new insights in a concrete and direct way. Provide enough time to exchange experiences.

4. Exploring the outdoor environment and identifying science questions emerging from their outdoor experience. Teachers consider the outdoor environment as an enriching and inspiring environment for children, although they do not always see how this is connected to science and inquiry. Let them look for triggering situations/objects that raise questions and where they want to know more about (with or without a link to science).

The teachers explore the outdoor environment and take pictures of these situations/objects. They can also choose to bring in materials they find outside. Let them explore these situations in detail. Since close observation may trigger even more questions. In this phase these questions may not be linked (strongly) to science. It is the role of the facilitator to let them think about the science in these observations. The teachers try to capture these triggering situations/objects with their tablet or smartphone. Some environments may offer more easily opportunities for science learning, while in other environments these are harder to discover. However, there are opportunities for science learning in every environment.

Back inside the teachers share their experiences. If necessary, provide some examples of opportunities to identify scientific insights to the participants first. In this way they will be enabled to find examples themselves. Then try to define the similarities and differences between the situations/objects that caught their attention. List these on a blackboard, whiteboard or flip chart and let them reflect on the science behind these questions. Prompt with scientific aspects (movement, nature, chemistry, materials, aspects (color)…). In this way they may get insights on the opportunities the outdoor environment offers to identify scientific insights & questions. These insights are important for them to use the outdoor environment as a catalyst for creativity in science education.

The project CREATIVITY IN EARLY YEARS SCIENCE EDUCATION has received funding from the European Union Erasmus+ Programme (2014-2017) under Grant Agreement n0 2014-1-EL01-KA201-001644.

5. Characteristics of inspiring materials and environments which promote creativity in science. This phase focuses on the indoor environment and the possible resources in this environment.

The participants are introduced to different resources:

- The usual resources such as clay, modeling foam, wire, cellophane, tissue paper, books, waste material (such as empty bottles, paper, cardboard rolls, …),
- Materials triggering wonder such as plasma spheres, polydensity bottles, …
- More uncommon materials such as mobile technologies

They discuss the properties of materials, tools and other resources that may foster creativity. Let them play with/explore these materials, in this way the participants will see the opportunities for creativity more easily.

Key insights: A wide range of appropriate materials, tools and other resources are shown to be important for fostering creativity. The availability of lots of light, formless materials which can take on any shape, such as clay, modelling foam, wire, cellophane, tissue paper, etc. can stimulate creativity. (Older) pupils appear to be stimulated by the access to enhanced or specialist resources (e.g. microscopes, infrared cameras, …) . Besides this, materials triggering surprise and questions (plasma spheres, polydensity bottles), may stimulate scientific curiosity and inquiry. Also access to new or different media and technologies can stimulate creativity. Although some materials may be expensive, also cheap or waste materials can be useful.

Next, the teachers are introduced to pictures of different indoor environments (the arrangement of the classroom, the visibility of materials in cabinets, the amount of material, the visibility of crafts of the children, the presence of plants and animals…). Discuss with them which classroom environment may be more adequate to trigger questions, curiosity, creativity, … In this phase it is important that teacher see the added value of different classroom arrangements, the appreciation of earlier creative work of children, the presence of real life objects.

Key insights: The learning environment should be capable of being used flexible to promote pupils' creativity. In an early years setting, this can even involve the abandonment of specifically themed role-play areas to give children's imagination greater freedom. There should be a general sense of openness and spaciousness and the sensory qualities in learning environments should be optimal. The display of work in progress in the classroom could also stimulate pupils' creativity.

These key insights are recorded on a blackboard, whiteboard or flip chart.

6. Discussion & reflection on 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 under deliverables D4.3 Country Reports.

Let each teacher read one classroom example and let him/her explain it to others. In this way they really read it thoroughly. During their explanation to each other they really focus on the link between creativity and science and the role of the teacher.

The recording sheet helps focus discussion and provides a basis for sharing analyses with others.

7. Connecting their experiences during the module and the classroom examples to their own classroom practice. The aim of this phase of the module is to stimulate teachers to adapt their activities based on the content of the module. Link their experiences during the module (the outdoor & indoor environment and resources) and the classroom examples to their own classroom practice. In service teachers can create a link more easily, while student

The project CREATIVITY IN EARLY YEARS SCIENCE EDUCATION has received funding from the European Union Erasmus+ Programme (2014-2017) under Grant Agreement n0 2014-1-EL01-KA201-001644.

teachers might need extra support from the module facilitator to link this to (future) classroom examples. Let them enrich their own classroom examples (see phase 3) with new ideas and general implications for planning. In this way the teachers will get ideas that build on their current classroom practice which have a realistic chance to be actually implemented. Moreover, they will get an insight in the added value of the module. By prompting them with different aspects (different learning environments, diversity of the children, digital technology) they may get new or more concrete ideas.

Let them exchange ideas, discuss questions and possible difficulties in pairs. This will give them input to refine or adapt their ideas. Provide enough time for this phase!

8. Reflections on what has been gained from the module. The final phase evaluates the module. There is a possibility to address remaining questions.

They review 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 module 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 module. 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.

Role and importance of resources and the learning environment in early years science

In the extensive review of Davies (2013) a vast number of literature sources are identified which stress the importance of the **outdoor environment** to promote creativity in early years education (p. 84-85):

"There is reasonable evidence across several studies that taking pupils out of the classroom and working in an outdoor environment for part of their time in school can foster their creative development (Addison et al., 2010; Bancroft et al., 2008; Borradaile, 2006; Dillon, Craft, Best, Rigby, & Simms, 2007). The reasons for this may be connected with ownership and collaboration. In a case study of a primary school which worked with landscape architects to transform its outside space, Dillon et al. (2007) found that, whilst each teacher felt ownership of particular spaces indoors, once outdoors, time and space was seen as more owned by pupils. Inside, work tended towards being individually focused, whereas outside, learning activities were more likely to involve collaboration. In the context of early years education, Bancroft et al. (2008) recommend taking an initial walk, whether in urban or rural

The project CREATIVITY IN EARLY YEARS SCIENCE EDUCATION has received funding from the European Union Erasmus+ Programme (2014-2017) under Grant Agreement n0 2014-1-EL01-KA201-001644.

neighbourhoods, which can provide a rich context for the purpose of discovering children's schemas and interests on which teachers can build to enhance their creativity. Forest School is an approach to outdoor education which offers an alternative teaching environment, to complement the indoor curriculum. Following three field visits each to two forest schools in Scotland, gathering interview and self-evaluation data from staff and pupils, Borradaile (2006) concluded that the characteristics of forest schools as 'creative environments' include:

- *Use of a local woodland (therefore 'wild') setting.*
- *Regular, frequent contact in the same setting over a significant period of time.*
- *Providing freedom to explore using multiple senses and intelligences.*
- *Time and space for individual learning styles to be recognised and nurtured.*
- *A low pupil:adult ratio.*

These characteristics may be transferable to work in other outdoor environments"

In the same review of Davies (2013) also sums up a vast number of literature sources which stress the importance of the **physical environment** to promote creativity in early years education (p. 84):

"There is reasonable evidence across a number of studies that the space within a classroom or workshop should be capable of being used flexibly to promote pupils' creativity (Addison, Burgess, Steers, & Trowell, 2010; Bancroft, Fawcett, & Hay, 2008; Jeffrey, 2006). In the context of early years settings, this can involve the abandonment of specifically themed role-play areas and props (Bancroft et al., 2008; Davies, 2011) to give children's imagination greater freedom. Children and their parents should be involved as much as possible in planning and resourcing these spaces (Davies, 2011). There should be a general sense of openness and spaciousness (Bancroft et al., 2008), removing as much furniture as possible to enable pupils to move around the space, making use of different areas to support the growth of ideas (Gandini, Hill, Cadwell, & Schwall, 2005). There is a note of caution here, however, in that students whose home environments are not conducive to study can find themselves alienated by too much flexibility in the school environment (Jeffrey, 2006). From a series of case studies in schools in Reggio Emilia, Vecchi (2010) has demonstrated the importance of sensory qualities in learning environments – light, colour, sound, micro-climate – and how these influence children's and young people's perceptions of how creative they are able to be within them. She recommends the use of small spaces ('mini ateliers'), acoustically but not visually separate from the rest of the class (Vecchi, 2010) to enable pupils to work quietly in groups. Another important feature of the visual environment to stimulate pupils' creativity is displays of work in progress (Addison et al., 2010)."

Lastly, in this review also numerous literature sources are identified which stress the importance of the **availability of resources/materials** to promote creativity in early years education (p. 84):

"In the context of learning activities involving the making of artefacts (for example during art and design or design and technology) there is strong evidence across a number of studies that providing a wide range of appropriate materials, tools and other resources can stimulate creativity (Addison et al., 2010; Bancroft et al., 2008; Gandini et al., 2005; Gkolia, Brundett, & Switzer, 2009; Grainger, Craft, & Burnard, 2007; Halsey et al., 2006; Robson & Jaaniste, 2010). From case studies in a number of early years settings and primary schools in the 5 × 5 × 5 = creativity project, Bancroft et al. (2008) emphasise the availability of lots of light, almost formless materials which can take on any shape, such as clay, modelling foam, wire, cellophane, tissue paper, etc. For older pupils, access to enhanced or specialist resources appears to stimulate creativity. From a study of five NESTA-funded projects for socially excluded young people Halsey et al. (2006) found that access to new or different media and technologies was widely attributed with stimulating creativity by staff members

The project CREATIVITY IN EARLY YEARS SCIENCE EDUCATION has received funding from the European Union Erasmus+ Programme (2014-2017) under Grant Agreement n0 2014-1-EL01-KA201-001644.

and young participants alike. In the context of secondary art and design education, Addison et al. (2010) identify the importance of a range of material, technical and reference resources, available outside timetabled hours. From interviews with 16 arts organisations in Australia and the UK, Robson and Jaaniste (2010) found that such organisations could provide young people with access to, and experimentation with, new media technologies and a range of other innovation products and processes. ICT resources such as the interactive whiteboard (IWB) can be used to support visual learners in developing their creative skills (Wood & Ashfield, 2008). Through observations of whole-class lessons – five each in literacy and numeracy – in five primary schools in Surrey, they identified pupil interactions with the IWB and opportunities for exploring and imagining."

Fostering creativity in early years science education, the role of resources and the learning environment

Bilton H. (2010) Outdoor Learning in the Early Years: Management and Innovation (3rd edn). London: David Fulton Publishers.

This a complete guide to creating effective outdoor environments for young children's learning. *It* contains a range of practical ideas and activities for working outdoors in the early years and provides a framework within which professionals can analyse and develop their outdoor provision and environment.

Davies, D., Jindal-Snape, D., Collier, C., Digby, R., Hay, P., Howe, A. (2013) Creative learning environments in education-A systematic literature review. Thinking Skills and Creativity 8: 80-91. Available online: http://ac.els-cdn.com/S187118711200051X/1-s2.0-S187118711200051X-main.pdf?_tid=552b93b0-7f06-11e6-8751-00000aab0f02&acdnat=1474357765_6baeabaef4bcba12fc075ead2f9eaf4c

This paper reports on a systematic review of 210 pieces of educational research, policy and professional literature relating to creative environments for learning in schools. The importance of the following factors in supporting creative skills development in children and young people are described flexible use of space and time; availability of appropriate materials; working outside the classroom/school; 'playful' or 'games-bases' approaches with a degree of learner autonomy; respectful relationships between teachers and learners; opportunities for peer collaboration; partnerships with outside agencies; awareness of learners' needs; and nonprescriptive planning. The review also found evidence for impact of creative environments on pupil attainment and the development of teacher professionalism.

Davies, D., McGregor D. (2016) Teaching Science Creatively (Learning to Teach in the Primary School Series). London: Routledge.

This book offers innovative starting points to enhance your teaching and highlights curiosity, observation, exploration and enquiry as central components of children's creative learning in science. This book is illustrated with examples from the classroom and beyond, the book explores how creative teaching can harness children's sense of wonder about the world around them.

Neill, P. (2008) Science and the Outdoor Classroom. Curriculum Newsletter of the High/Scope Foundation 22(5). Available online: http://www.highscope.org/file/pdfs/kescienceneillmj08.pdf

In this publication you can find some very concrete examples how the outdoor environment can be used to practice the following scientific skills: observing, classifying, experimenting, predicting, drawing conclusions and communicating ideas

The project CREATIVITY IN EARLY YEARS SCIENCE EDUCATION has received funding from the European Union Erasmus+ Programme (2014-2017) under Grant Agreement n0 2014-1-EL01-KA201-001644.

Suggested classroom examples for use during the module

The following episodes and templates 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: MA_Class_Minibeasts_Lenvironm; UKSC_Class_Forest_School_Child Ideas in D4.4 Appendix Selected Episodes of Practice. The pdf is available online: http://www.creative-little-scientists.eu/sites/default/files/D4.4_Appendix_3_Selected_Episodes.pdf

Classroom templates: PT_Class_SwinggameRope_IBSE in Addendum to D5.3. Templates can be found on http://www.creative-little-scientists.eu/TeacherTrainingMaterials

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

Title	Age group	Country
Bath bombs	3-5	England
Skeletons	7-8	England
Crime scene investigation	7-8	England
Electricity	4-5	England
An icy adventure	3-4	England
Science from stories: Investigating materials	4-5	England
Make bread right now	5-6	Romania
Can water be transferred?	4-5	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: This provides some suggested slides and a possible script to be adapted to suit particular audiences. At the end of the presentation a suggestion of pictures of classroom environments is provided.
- Recording sheets for the different activities:
  - Task 2 & 7 recording sheet - Own practice. This can be reproduced as an A3 sheet for participants to record responses to phase 2 and 7.
  - Task 5 recording sheet - Reflection outdoor environment, resources and environment
  - Task 6 recording sheet - Analysis of classroom examples
- Handouts
  - Task 5: Pictures of different learning environments. Prints of the pictures the teachers mailed before or see at the end of the ppt for inspiration.

Linked modules

It might be useful to provide opportunities for participants to become familiar with the definitions of creativity in early years science and key features of inquiry-based approaches to science education prior to the module. For example both:

The project CREATIVITY IN EARLY YEARS SCIENCE EDUCATION has received funding from the European Union Erasmus+ Programme (2014-2017) under Grant Agreement n0 2014-1-EL01-KA201-001644.

- 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.

References

Craft, A. 2011. *Creativity and education futures*. Stoke on Trent: Trentham Books.

Creative Little Scientists Consortium (2012) Enabling Creativity through Science and Mathematics in Preschool and First Years of Primary Education. D2.2 Conceptual Framework. Available online: http://www.creative-little-scientists.eu/sites/default/files/CLS_Conceptual_Framework_FINAL.pdf

Davies, D., Jindal-Snape, D., Collier, C., Digby, R., Hay, P., Howe, A. (2013) Creative learning environments in education-A systematic literature review. Thinking Skills and Creativity 8: 80-91.

Ferrari, A., Cachia, R., Punie, Y. (2009) Innovation and Creativity in Education and Training in the EU Member States: Fostering Creative Learning and Supporting Innovative Teaching. Literature review on Innovation and Creativity in E&T in the EU Member States (ICEAC). European Communities, Luxemburg, 64 pp

Fleer, M. 2009. Supporting scientific conceptual consciousness or learning in a roundabout way' in play-based contexts. *International Journal of Science Education, 31*(8), 1069-1089.

French, L. 2004. Science as the center of a coherent, integrated early childhood curriculum. *Early Childhood Research Quarterly, 19*(1), 138-149.

Manches, A., O'Malley, C. and Benford, S. 2010. The role of physical representations in solving number problems: A comparison of young children's use of physical and virtual materials. *Computers and Education, 54*(3), 622-640.

The project CREATIVITY IN EARLY YEARS SCIENCE EDUCATION has received funding from the European Union Erasmus+ Programme (2014-2017) under Grant Agreement n0 2014-1-EL01-KA201-001644.