Module 17: Involving children in assessment – types of feedback

Aims of the module:

- Introduce participants to different assessment approaches and strategies, in particular the importance of children making their own decisions during inquiry processes, making their own connections between questions, planning and evaluating evidence, and reflecting on outcomes.
- Share strategies that allow participants to recognize young children's capabilities to engage with processes associated with the evaluation as well as generation of ideas in science.
- Increase awareness of assessment strategies such as peer and self-assessment, dialogue and feedback on progress, in the early years science classroom with processes associated with the evaluation as well as generation of ideas in science.
- Increase awareness of assessment strategies such as peer and self-assessment, dialogue and feedback on progress, in the early years science classroom.

Links to the Content Design Principles and Outcomes

3. Teacher education should advance teachers' understandings about the nature of science and how scientists work, confronting stereotypical images of science and scientists.

    3.2 Teachers should be able to recognize young children's capabilities to engage with processes associated with the evaluation as well as generation of ideas in science and mathematics, since these processes are also important for the development of learner creativity.

    3.3 Teachers should be able to foster the processes of imagination, reflection and consideration of alternative ideas in supporting children's understanding of scientific ideas and procedures and development of creativity.

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

    6.5 Teachers should be able to foster opportunities for children's agency and creativity in learning in inquiry and problem solving – in particular the importance of children making their own decisions during inquiry processes, making their own connections between questions, planning and evaluating evidence, and reflecting on 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.

    7.9 Teachers should be able to use different assessment approaches and strategies and in particular those that involve children in the assessment processes, such as peer and self assessment, dialogue and feedback on progress, in the early years science and mathematics classroom

Rationale for the module

Experiences during the fieldwork of the Creative Little Scientists project (CLS) underlined the need for greater focus on children's active involvement in assessment processes and the value of dialogue with children to gain insights into their learning. Research during CLS provided limited evidence of assessment in inquiry based science education with a creative approach in European preschool and primary education. Assessment practices were

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generally informal and formative based on observation and teacher questioning. Teachers rarely used peer- or self-assessment or summative assessment. Often, potential for inquiry based on children's interests and questions or implicit in children's actions is not recognized. There was limited evidence of involvement of children in assessment, although children were able to reflect on their learning processes when this was asked. However, formative on-going assessment was valued and recognized as important. Creativity was very rarely the explicit focus of assessment or evaluation. (Creative Little Scientists Consortium (2012) D4.4)

What is the role of assessment within inquiry based science education?

- Assessment is a key area for development. Assessment should improve pupil's learning and it should be aligned with the full range of learning objectives. It is used for two main purposes: to help learning and to summarise and report what has been learned (Nuffield Foundatin,2012).
- Assessment of learning can be difficult in a creative environment. If we become too focused on summative assessments, the result will be an arid curriculum with little creativity and poor motivation and development on the part of the children. However assessment is part of a creative approach, but we want to move away from assessing the work children have undertaken to the individual achievements of children. Assessment supports teaching. Creative science does not mean that we do not assess children's needs and play; it does not mean that we have no specific learning objectives. It means we need to be skilful in facilitating children' s learning, and not just organise a 'simple set of experiences' (Johnston, 2005).

What is the importance of involving children in assessment?

- Changes have the most impact on pupil progress in primary science when they are actively involved in the assessment process (Earle et. al., 2016).
- Situations should be provided which allow children to communicate their ideas in a supportive atmosphere, not in a situation where the teacher dominates (Elsgeest et al., 1985). This can be realized by allowing time, during and at the end of scientific explorations, to reflect, interpret and communicate and by encouraging children to share their findings and discuss interpretations with each other, identifying what they have learnt.
- Reflective attitudes involve the child in developing his thinking skills and aid the development of knowledge and understanding. These attitudes help the child to consider the data, interpret evidence and make hypothesis, but remain flexible to change ideas if they are not consistent with the evidence.

What are the challenges for teachers?

- Goldsworthy and Feasey (1997) indicate that young children find it difficult to analyse their ideas. Reflective attitudes involve the child in developing his thinking skills and aid the development of knowledge and understanding. This involves considering the views of others, without total acceptance of other's ideas without consideration of their own. Respect for evidence is crucial for a scientific activity. To reflect critically on a scientific exploration involves a willingness to consider alternative ways of undertaking an investigation to improve the outcome and to evaluate the procedure. It involves consideration of how fair the investigation was. Harlen (2000) indicated that this is a mature activity, difficult for young children. Sharing ideas, planning and interpretations helps to identify different perspectives and gives children access to the ideas of others.

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- Reflection and reasoning in early years science is rarely seen through a creativity lens. Nonetheless, research into inquiry based science education and creative approach suggests that children employ diverse modes to record their ideas, potentially encouraging reflection, discussion and evaluation (Cremin et. al., 2015).
- Capitalising on children's emerging interests relies not just on opportunities to observe and recognize the potential, but the need for effective recording and communication systems and for flexibility so that this can feed into future planning. (Creative Little Scientists (2012) D4.4)

Overview of the module

The module consists of the following activities:

1. An **introduction** to the role of assessment within inquiry based science education within a creative approach.
2. **Practical activity:** science experiment 'chromatography': participants conduct the science experiment.
3. **Reflection on the activity**: opportunities for assessment
4. **How to involve children in science assessment** – focus on clear learning objectives, the use of questioning, feedback, peer- and self-assessment. introduction of the TAPS pyramid model
5. **Analysis of classroom examples**: How does the teacher involve children in assessment? Are there other opportunities for assessment involving children?
6. Discussion of possibilities to **apply insights to own classroom practice**: implications for planning and the teacher's role.
7. **Review** on what has been gained from the module – both content and process, in relation to the aims of the module.

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Module at a glance

Time	Task	Materials	Grouping
00.00	1. **Introduction** Introduction to the CEYS project Introduction to inquiry based science education and creative approaches, and the role of assessment within inquiry based science education within a creative approach	Powerpoint presentation • Aims • Links to Content Design Principles and Outcomes • Session rationale - this could be illustrated by examples from the CEYS project or the CLS Final Reports (see Support Materials below)	Whole group
00.15	Participants individually write down what they hope to learn during this session and what their questions are. Participants exchange their questions with their neighbour, and group the questions (e.g. types of feedback, role of the teacher in assessment, …). The overall subjects of the questions are written on a post-it and collected on a flip chart.	Pens and paper Post-its Flip chart	Individually In pairs
00.25	2. **Practical activity** Science experiment 'chromatograhy' Participants conduct the science experiment.	Step-by-step plan and resources: see task 2 White coffee filters Markers (not water proof) Glasses of water Scissors Powerpoint presentation	Groups of 4/5, based on the age of children they teach (same age groups together)
00.40	3. **Reflection on the activity**: opportunities for assessment Teachers fill out the reflection cloud with following questions: a. "Imagine you would use this science experiment in your classroom. What would you want the children to learn from this experiment?" *(Science content: the ink of a marker is a composition of several colours, self-direction, problem solving skills,…)* b. After some time, prompt the following question: "Can you identify opportunities for fostering inquiry and creativity?" c. "How would you find out what children learnt from this experiment?" d. *On the same reflection cloud with red marker:* "In what ways would you support children themselves in assessing what they have learnt?" e. *On the same reflection cloud with green marker:* "In what ways could you facilitate children assessing each	Reflection cloud 1 (Task 3) Reflection cloud 2 (Task 3) Red pens Green pens Powerpoint presentation with questions	Groups of 4/5, based on the age of children they teach (same age groups together)

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	other?"		
1.10	Exchange of ideas – sharing insights Facilitator writes ideas and insights on the flip chart	Flip chart Marker	Whole group
1.30	Coffee break		
1.40	4. **How to involve children in science assessment** Focus on clear learning objectives, the use of questioning, feedback, peer- and self-assessment. introduction of the TAPS pyramid model. For this phase participants receive examples of assessment involving children. They place them on the matching box in the TAPS pyramid. Whole group discussion on the examples and their place on the pyramid. Let participants look back at the characteristics of creativity in science learning (characteristics IBSE, creative dispositions, synergies between IBSE and CA), and let them reflect on how the examples support the children in terms of creativity in learning.	Powerpoint presentation Task 4: TAPS pyramid model for every participant Each box of the pupil layer of TAPS is printed on an A4, and is placed on the wall. Post-it notes Examples of assessment involving children: ppt slides, a lapbook, drawings from children, a brainstorm made by children, a printed blobtree, a concept cartoon, … Task 4: Characteristics of creativity in science learning	Groups of 4/5 Whole group
2.00	5. **Analysis of classroom examples** How does the teacher involve children in assessment? Are there other opportunities for assessment involving children? The facilitator briefly presents the examples and their context to the whole group. Participants analyse the classroom examples in groups, trying to answer the following questions: • What kind(s) of assessment does the teacher use in the activity? • In what way(s) are the children involved in assessment? • Do you see other opportunities for assessment involving children? • In what ways do these approaches foster inquiry and creativity in learning and teaching? Note down key points on the recording sheet provided. Brief feedback of general comments related to each question.	Examples from CLS/CEYS (e.g. Super Soup - Oxygen - Living things and their habitat) For each group: Paper, pens Copies of 2 examples 2 copies of A3 recording sheets to record responses to the questions listed (Task 5) Powerpoint slides of task and examples	Whole group Groups of 4/5 Whole group
2.30	**6.** Discussion of possibilities to **apply insights to own classroom practice**: implications for planning and the teachers' role • First individually write down 3 examples of scientific activities you use in your own classroom context. • Try to enrich them with ideas about how		Individually

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	to involve children in assessment. • Note down possible difficulties and questions you have when transferring this approach to your own classroom context. • Exchange ideas, discuss questions and possible difficulties. Interesting insights are shared with the whole group.		In groups (4/5) Whole group
2.45	7. **Review** on what has been gained from the module – both content and process • Look back at the original questions – how far have the questions at the start of the session been answered? Facilitator lists key challenges on the flip chart. Participants formulate possible solutions for those issues. • Note 2 actions you will take building on module content record. • In what ways did the different activities support your developing thinking? Fill out evaluation form.	Powerpoint slides of activity and aims Post-its (collected in the beginning of the module) Flip chart Pens, paper Evaluation form	First in groups of 4/5, then the whole group Individually + sharing with the whole group Whole group
3.00	End		

Teacher education pedagogy

1. **Introduction**

This module draws on 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.

The rationale for the module is represented in the slides with several drawings of rainbows. Clearly these children have some ideas of how a rainbow looks like, but they have different opinions when it comes to how it is built. These drawings give the teacher an idea of the prior knowledge of the children. The teacher can use this starting point to explore rainbows together, and focus especially on the colours and how they follow each other.

In the beginning of the module the participants write down what they want to learn and what questions they have. They exchange their questions with their neighbour, and group the questions according to subject. For example some questions can refer to different types of feedback, or to the role of the teacher in assessment. By using this method the facilitator knows how the teachers work now, what they are interested in and what they struggle with. This enables him to focus more explicitly on the problems the participants experience in their practice.

This information will be used at the end of the module, to help participants enrich their current activities to foster more creativity in science.

An alternative can be to present the characteristics of inquiry based science education and creative dispositions after asking the first question of Task 3 (*Imagine you would use this science experiment in your classroom. What would you want the children to learn from this*

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experiment?) Chances are high that participants didn't think of creative skills when answering the first question. This can be confronting, which increases the learning effect.

2. **Practical activity**
Teachers prefer a hands-on activity to activate their thinking. This approach provides an opportunity to explore the possibilities of simple everyday-life materials.
This hands-on instruction can be done with all kinds of science experiments. A chromatography experiment is easy to organise, with easily available materials and a science content that is easy to explain. More information about the experiment can be found in the background materials.

For some groups this experiment might be insufficiently challenging. Alternative science experiments are as useful as the chromatography experiment, and can increase involvement. Some examples of alternative science experiments:

- Experiment with M&M's:
  https://www.youtube.com/watch?v=E8uEmZyy88M
  This is an attractive experiment, and it has a lot of opportunities for further exploration and creativity. Participants can explore with different colours, the position of the M&M's, the effect of different kinds of liquid,… Some inspiration can be found on the following website:
  https://www.acs.org/content/acs/en/education/whatischemistry/adventures-in-chemistry/experiments/dissolving-m-ms.html
  Disadvantage of this experiment is that it requires the use of food in a way it is not meant to be used.
- Colouring water with flowers: let the participants choose plant material (flowers, onion peels, grass, …): cut the materials in small pieces, add water, stir, sieve and look what happens to the water + make adaptations like different kinds of flowers, compare warm and cold water, cut in small or large pieces,…

3. **Reflection on the activity**: opportunities for assessment
This task provides an opportunity to visualize the possibilities for assessment, and the possibilities to involve children in the assessment process, based on the experiences of the participants.
Participants write down the answers to the following questions:

- Imagine you would use this science experiment in your classroom. What would you want the children to learn from this experiment?
  - *Science content: the ink of most markers is a composition of several colours*
  - *Other possible answers: self-direction, problem solving skills,…*
- How would you test what children learnt from this experiment?
  - *Let them explain to each other of the teacher, drawing, writing down, taking pictures,…*
- In which ways would you facilitate that the child itself could assess what he/she has learnt.
  - *Reflection on predictions, using a 'blob' tree (www.blobtree.com),…*
- In which ways would you facilitate children to assess each other?
  - *Discussion with peers, writing down feedback for each other,…*

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4. **How to involve children in science assessment**

This part of the module aims to let participants get more insights in the theoretical background of assessment, and the way children can be involved. It is based on the structure of the TAPS (Teacher Assessment in Primary Science) pyramid model (Earle et. al, 2016). The lower layers of the pyramid model (the pupil layer and the teacher layer, encapsulate the principles of assessment for learning. This is where changes will have impact on pupil progress in science. Several aspects per layer are highlighted, with most attention to the pupil layer (involving children in assessment):

- The pupil layer
  - → Pupils focus on science knowledge, understanding, skills and attitudes in learning objectives and success criteria
  - → Pupils assess their own ideas and work against known criteria
  - → Pupils assess peer's ideas and work against known criteria
- The teacher layer:
  - → Teachers involve pupils in discussing learning objectives and criteria for success
  - → Teachers gather evidence of their pupils' learning through questioning/discussion and observation
  - → Teachers use assessment to advance pupils' learning by giving feedback to students about how to improve.

More information is found in the Support Materials. If participants read English fluently, tablets or computers can be provided so they can explore the interactive resource of the TAPS pyramid.

For this exercise the facilitator provides concrete examples of assessment involving children (a lapbook, drawings from children, a brainstorm made by children, a printed blobtree, a concept cartoon, …). If those are not available, the PPT slides can be used as examples. Participants get the chance to explore the examples in small groups, and discuss where they should be placed on the TAPS pyramid. They write the example on a post-it note and stick it on the matching TAPS box (boxes are on A4 placed on the wall).
This can then be discussed with the whole group, since there will be differences in opinion. A lot of examples match more than one box, so there is no right or wrong answer, but differences in opinion open the debate between participants, and this helps them to see more possibilities to involve children in assessment.

After analyzing the examples, participants take the document with the characteristics of creativity in science learning, and they annotate to indicate opportunities for fostering creativity in their examples. This way they reflect on how the examples support the children in terms of creativity in learning.
(For example: making connections, communicating explanations, sense of initiative, motivation, thinking skills, problem solving & agency, assessment for learning.)

Reflective attitudes involve the child in developing **thinking skills** and aid the development of knowledge and understanding. These attitudes help the child to consider data, interpret evidence and make hypotheses. They help the child to remain flexible to change ideas if they are not consistent with the evidence. When you involve children in assessment, they can be more creative, are able to use their thinking skills, they can make connections, … so this way of assessing has more impact on their learning (=bottom line of TAPS pyramid).

The role of **communication** is highlighted in this phase of the module. Communication is an important skill in science learning and assessment. Communicating helps children to sort out

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what they discovered and what they think. Since formal assessment is difficult in early years education, communicating about their ideas is an important end point in explorations in science. Communication encourages children to clarify and evaluate their ideas in order to communicate them to others. It also gives them access to the ideas of others. Those ideas may conflict with their own, but by communicating children learn to consider their ideas as tentative and subject to change. This if a form of assessing their own and each other's ideas in science. (Johnston, 2005)

5. **Analysis of classroom examples**
The classroom examples have considerable potential to involve children in assessment. However participants may need support initially in engaging with the evidence shown in the classroom examples. It is helpful if the module facilitators are familiar with the background of the materials selected and provide a brief introduction to each one at the start of the activity. Details can be found in the deliverables of CEYS or CLS (D4.3 Country Reports). The recording sheet with the four key questions helps focus discussion and provides a basis for sharing analyses with others. It is helpful to note specific comments about the key questions on a flip chart.

6. Discussion of possibilities to **apply insights to own classroom practice**
The aim of this phase of the module is to highlight implications for planning and the teachers' role. By pointing this out during the module, teachers can ask questions and point out remaining difficulties. This way, chances are higher that they will try to incorporate this approach in their own classroom practice.

7. **Review** on what has been gained from the module
The questions in the beginning of the module, 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. Enough time should be provided to go back to the questions asked in the beginning of the module. For participants it is very important that a facilitator takes these questions into account and tries to answer these questions during or at the end of the session.

Support materials

Background reading

Defining key features of inquiry-based approaches and 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.

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

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

TAPS pyramid model

The Teacher Assessment in Primary Science (TAPS) is developed by the TAPS project team, to provide a TAPS school self-evaluation tool. It aims to develop support for valid, reliable and manageable assessment, which will have a positive impact on children's learning. They developed the pyramid model where assessment flows from classroom practice to whole school reporting. For this module 'Involving children in assessment', we focused on some aspects of the two bottom layers: the pupil layer and the teacher layer. More information on the TAPS pyramid model can be found on: https://pstt.org.uk/resources/curriculum-materials/assessment

TAPS pyramid model: the pupil layer

Pupils focus on science knowledge, understanding, skills and attitudes in learning objectives and success criteria

Examples from the TAPS pyramid model:

- Children actively contribute to the selection of material, which provides opportunities for reflection on learning.
- Discussion or a brainstorm about the science in the activity
- Asking questions and looking for answers
- Choosing criteria

Pupils assess their own ideas and work against known criteria

Children's representations offer valuable contexts for dialogue about their ideas and thinking. There are a lot of ways children can represent their learning process: drawings, photographs, gestures, … There are a lot of tools to be used like a *'blob' tree (www.blobtree.com),…*

Pupils assess peer's ideas and work against known criteria

An example of peer assessment and identifying next steps in the learning from Johnston, (2005):

Start with a whole class introduction, followed by a group of children exploring the materials, making observations and raising questions. This first group of children can communicate their observations and ideas about the materials in a subsequent plenary. The other children can be encouraged to look for interesting anomalies or patterns in the ideas expressed and to analyse them. This can lead to a decision as to what questions can be answered during the next group's exploration and may lead to new investigation. Feedback from the second group's exploration can promote new ideas and discussion which in turn can help another group to plan an investigation.

TAPS pyramid model: the teacher layer

Teachers involve pupils in discussing learning objectives and criteria for success

Clear learning objectives are essential for learning. When children know f.e. what a good observation or a good conclusion looks like, they know what to accomplish, they can assess their own learning process and that of their peers. If they are involved in formulating the learning objectives, they get more ownership on the whole process of scientific inquiry.

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Teachers gather evidence of their pupils' learning through questioning/discussion and observation

Questioning is crucial within inquiry based science education (Cremin et. al, 2015). F.e. teachers who use a lot of open questions often achieve a high level of pupil involvement and promote learning. Module 1: Using questions of teachers and children (CEYS) offers more information on this subject.

Teachers use assessment to advance pupils' learning by giving feedback to students about how to improve.

Feedback from teachers to children is a prime requirement for progress in learning. Hattie & Timperley (2007) investigated the power of feedback. They state that effective feedback answers 3 questions:

- Where am I going? (goals)
- How am I going?
- Where to next?

Each feedback question works at four levels:

- Task level
- Process level
- Self-regulation level
- Self level

More information on the power of feedback can be found in the online version of the article: http://rer.sagepub.com/content/77/1/81

Suggested classroom examples for use during the module

Several episodes and templates act as useful starting points for discussion. They can be selected from deliverables of CLS (D4.4), or from deliverables of CEYS (O2).
It is important to review and select examples appropriate to your context and audience.

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

Title	Age group	Country
Super soup	4-6	Belgium
Oxygen	4-5	Belgium
Living things and their habitats	7-8	England

CLS examples can be found on the CLS website at http://www.creative-little-scientists.eu/content/deliverables
Selected episodes in D4.4 Appendix Selected Episodes of Practice
Templates in D5.3 Addendum to D5.3.

It is interesting to choose activities for different age groups. Assessment is often considered to be more difficult in younger age groups. Examples of younger children will highlight the possibilities.

Module resources

The following documents are provided as separate files:

- Powerpoint presentation
- Resources practical activity:
  - Task 2: chromatography experiment
- Recording sheets for the different activities:

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- Task 3: reflection cloud 1
  This can be reproduced as an A4 sheet for participants to record responses.
- Task 3: reflection cloud 2
  This can be reproduced as an A4 sheet for participants to record responses.
- Task 5: recording sheet analysis of classroom examples
  This can be reproduced as an A3 sheet for participants to record responses.

- Handouts:
  - Task 4: TAPS pyramid
    This can be reproduced as an A3 sheet for participants to use during the exercise with the examples of assessment.
  - Task 4: characteristics of creativity in science learning
    This can be reproduced as an A4 sheet for participants to use during the exercise with the examples of assessment.

Linked modules

This module targets an audience with some experience in creativity in early years science. Therefor it should not be used as an introduction, but it should follow a number of more basic modules like Module 7 (Role of play and exploration), Module 4 (Focus on inquiry-based science – link with creativity) or Module 9 (Role of the teacher).

This module can be combined with Module 16 (Assessment for learning), because they are highly connected.

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