Report O1-A1
CEYS Training Needs Analysis

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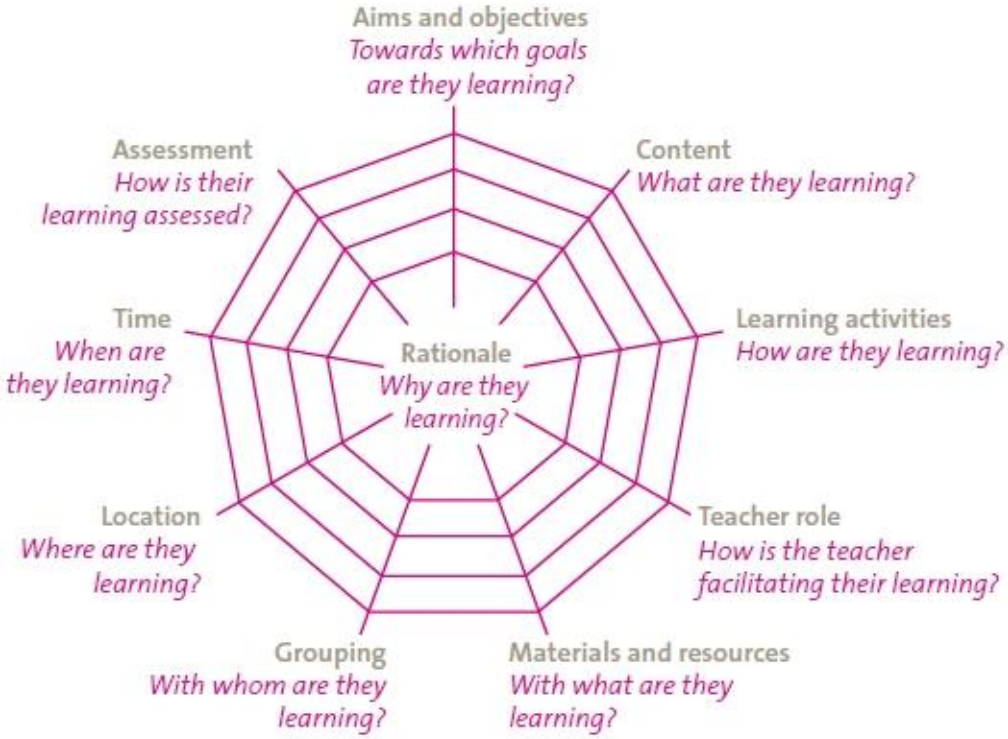
The project CREATIVITY IN EARLY YEARS SCIENCE EDUCATION has received funding from the European Union Erasmus+ Programme (2014-2017) under Grant Agreement no: 2014-1-EL01-KA201-001644.

Erasmus+

ΙΔΡΥΜΑ ΚΡΑΤΙΚΩΝ ΥΠΟΤΡΟΦΙΩΝ IKY

1. Introduction

Focus groups are a carefully planned series of discussions designed to obtain perceptions on a defined area of interest in a permissive, nonthreatening environment (Krueger & Casey, 2009).
The focus groups reported here refer to the needs for teacher training of the target user groups in the areas of early years science and creativity education which have been recognised in the Curriculum Design Principles of the Creative Little Scientists project (D 5.2), in the four European partner countries. This report presents the outcomes of the focus group discussions with stakeholders (training educators and practitioners) across the four participating countries (the United Kingdom, Greece, Romania and Belgium) in terms of knowledge and competences required to use creativity and inquiry-based approaches in the teaching of science to young children, and formulate these as training requirements.
The needs for training were discussed using the spider web model of Jan van den Akker (*in* Plomp & Nieveen, 2007). To provide a framework to the participants, two documents were sent to them in advance: 1) the executive summary of the Final Report on Creativity and Science and Mathematics Education for Young Children (D6.5b); 2) the list with items that were negotiated during the focus group. The key expectations for the focus groups were to comment on the training requirements in relation to the different components of the spider web discussed and used in the former two documents.



The curricular spider web (van den Akker, 2007)

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2. Focus group methodology

The **central question of the focus group** was: What are the training needs of in-service and/or pre-service teachers in order to acquire knowledge and competences to use creativity and inquiry-based approaches in the teaching of science to young children (3-8yr)?

To answer this question the vulnerable spider web of van den Akker was used to define the key questions listed below in Table 1.

Welcoming	1. Permission for audio recording of participants' inputs. Teacher educator in the field of ...?/Teacher of .. year olds at .... Name and institution you are working for.
Introduction	2. What do you think are important features of creativity and inquiry-based approaches in the teaching of science to young children?
Key Questions	3. What should be the main **aims and objectives** of the training course? What competences and skills do you think teachers would need in order to effectively use creativity and inquiry-based approaches in the teaching of science to young children (3-8yr)? 4. What should be the **content** of this training course? Which content of the training course would particularly foster the use of creativity and inquiry-based approaches in the teaching of science to young children (3-8yr)? 5. According to you, which **learning activities** can encourage teachers to use creativity and inquiry in science activities in schools? 6. What should be the **role** of the facilitator (trainer/coach) of the training course? 7. What could be the added value of **assessment** of these workshops in order to be in line with the training needs of teachers. How should these assessments be organised? 8. What are the needs of the teachers concerning the practical organisation of this training course? Considering **location**, **time**, **grouping** and **materials and resources**.
Ending questions	9. What would be your advice to the organizer of the training course? What are essential features of a training course that stimulates creativity in science education? 10. Is there anything that we missed? Is there anything you want to say that you didn't get the chance to say?

***Table 1**: The focus group planned activities.*

Planning & organisation of the focus group

Practical organisation

There are three options to organise this focus group:

- A face-to-face focus group
- A Skype focus group
- An online survey

Depending on the local context one of the above options may be preferred. The script below is developed for a face-to-face focus group. Depending on the chosen option, this script should be adapted.
Because of the tight time frame, it may be difficult to cover all the items in one focus group. If it is not possible to handle all the subjects in one focus group, we suggest covering the missed items by e-mail or in the second focus group. The same applies for the Skype focus group and online survey.

Invitation letter & informed consent

See annex 1 and 2.
We suggest providing the participants with two documents to read beforehand:

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- The executive summary of the CLS-project: http://www.creative-little-scientists.eu/sites/default/files/Creativity_in_Science_and_Mathematics_Education.pdf
- The list with items that will be negotiated during the focus group: annex 3 to 8 (p. 3-11)

Privacy

Personal data provided by participants will only be used for research purposes and are protected according to the EC directive 95/46/EC. All data gathered during the project will be stored in a secure location accessible only to the researchers. In the final research reports no real names or information will be included that can identify comments of particular participants.

Timing

- November/December 2014: Participants of the focus group are invited
- December 14th 2014: Final documents relevant to data analysis will be distributed
- January 2015: Preferably 2 repeated focus groups are organized. Each focus group will last maximum two and a half hours.
- February 8th 2015: Each partner reports to AUC in English.

Selection of the participants

The participants of the focus groups are carefully recruited. Each focus group consists of 5 to 10 participants, 7-8 preferred. The aim is to gather a heterogeneous group consisting of the following members (compulsory members in bold):

- **Teacher educators (>= 3)**
- **Early years teachers and primary school teachers (>= 4)**
    - Preferably a mix of experienced and less experienced teachers or student teachers (pre-service) from primary education and pre-school.
    - They have preferably responsibilities in CPD, mentoring or leadership
- Policy makers in education or teacher advisor (1)
- Elementary school staff member

Logistics

Provide a comfortable room where participants are sitting in a circle with a table in front of them. Provide refreshments for participants.

Materials:

- Recording material
- Flip chart
- Name cards
- Per participant:
    - Post-it pad
    - Writable stickers (red, orange, green)
    - Pen & marker
    - Prints of:
        - Informed consent (annex 2, phase 1)
        - List with aims and objectives (annex 3, phase 3)
        - List with selected content items (annex 4, phase 4)
        - List with learning activities (annex 5, phase 5)
        - List with teacher educator roles (annex 6, phase 6)
        - List with process items of assessment (annex 7, phase 7)
        - List with the items concerning time, location, materials and resources and grouping & reduced spider web (annex 8, phase 8)
        - Certificate of participation in the EC-funded research project Creativity in Early Years Science Education (annex 9, phase 9)

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- Optional: Executive summary of the Final Report on Creativity and Science and Mathematics Education for Young Children
- Optional: The curricular spider web (annex 10)

Characteristics of the moderator

The moderator is skilful in group discussions. He/she establishes a warm, friendly and permissive environment, exercises a mild unobtrusive control and has adequate knowledge of the topic. Preparations for CEYS partners involve intensive reading of deliverable 5.2 and 5.3 of the CLS-project. The specific role of the moderator is further specified in the script of the face-to-face focus group.

General tasks & characteristics of the moderator:

- Facilitate the discussion
  - Verbal and nonverbal
    - Head nodding
    - Short verbal responses (avoid "that's good", "excellent")
  - Pauses and Probes
    - 5 second pause: The five second pause is most effective after a reaction of a participant. This invites other participants to respond and often provides additional perspectives. The pause also ensures that the moderator is doing too much of the talking
    - Probes are a technique to clarify vague statements and comments. Useful questions are: Would you explain a little further? Could you give me an example? Can you say something more about it? Please describe what you mean? I do not quite understand ... Applying this technique in an early stage of the focus group prevents a vague group discussion.
- Maintain subtle group control
  - Encourage quieter and shy participants
  - Respond to dominant talkers and ramblers

Recorder (Assistant Moderator) Skills

- Help to host: Welcome participants as they arrive
- Handle logistics: Equipment & refreshments, arrange the room, consent forms
- During discussion
  - Take careful notes throughout the discussion
  - Monitor recording equipment
  - Do not participate in the discussion
  - Ask questions when invited
  - Give an oral summary when invited
  - Keep track of time
- Debrief with moderator
- Give feedback on analysis and reports

Data collection, analysis and reporting

Depending on the way the focus group is organised, the data will be gathered in different ways:

- Face-to-face focus group: audio recording, real time transcription and pictures/scans of the results;
- Skype focus group: audio recording and real time transcription;
- Online survey: written answers of the participants.

Since the data analysis of the face-to-face and Skype focus group relies on transcripts, it is important to consider the following recommendations:

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- It is important that the transcribed data reflects the actual meaning (humour and irony often say the opposite of what is intended). It is the task of the reporter to present the views of the participants accurately.
- Nonverbal communication can be overlooked in the transcripts. Spontaneous comments (without the need of probing), may signal interest of the participants. Enthusiastic responses should be factored into statements of the findings. However, a conservative approach in the interpretation of body language should be favoured, because this can often be interpreted in different ways.
- The moderator and/or assistant moderator should do the transcription. Since they were actually present, they can interpret and transcribe the nonverbal communication.
- Transcribe only the comments that are useful to the analysis. Don't type the introduction (only names and occupation/role of the participants are needed) or irrelevant answers.
- If responses under a certain question belong to another question, move these responses to the right question.

The partners gather the data in the excel file provided by AUC. The following data is needed:

- Data about the participants;
- Short transcripts and preliminary analysis of the focus group results;
- Selection of training needs recognised in the Curriculum Design Principles of the Creative Little Scientists project (D5.2);
- Examples of practice;
- If valuable for the report, pictures and/or scans of the results of the brainstorms are also supplied to AUC.

All data is sent to AUC by the 8th of February 2015.

The systematic analysis will be done by AUC by verifiable procedures and will lead to appropriate reporting. The analysis will be done question-by-question of the questioning route. Local differences will be considered during data analysis.

Research aims, prior knowledge of the participants & role of the moderator

THEME	CEYS – TASK O1-A1: Focus group: **training needs for teacher training** in the areas of early years science and creativity education
Research aims	Per CEYS partner: 1. Participants actively participate in the method of curriculum design for the training courses. 2. Participants negotiate the training needs for teachers in the areas of early years science and creativity education in a face-to-face focus group from the viewpoint of initial teacher training (ITT) and continuous professional development (CPD). 3. Participants formulate their personal opinions and participate in debate on the training needs for teacher training in initial teacher education or continuous professional development. 4. Participants share examples of (good) practices related to their experiences and personal thoughts with regard to training courses. 5. Teacher educators comment on the given content of the training courses. 6. Participants set priorities for the curriculum decisions with regard to the training courses
Prior knowledge of the participants and role of the	Participants have experience with early years science education and have been encouraged to read the CLS executive summary in advance. Preparations for CEYS partners involve intensive reading of deliverable D5.2 and D5.3 of the CLS-project. During the kick-off workshop a first selection of the content was debated and will be used in this focus group.

moderator	CEYS partners have experience with acting in the role of moderator (e.g. CLS-project) and subscribe to the method of curriculum/educational design. Pre-announcement by AUC on November 30th 2014
Resources	Bloor, M. *et al*. (2001). Focus Groups in Social Research: London: Sage. van den Akker, J. (2007). Curriculum design research *in* Plomp, T., Nieveen, N. (Eds.) An introduction to Educational Design Research. Enschede, The Netherlands: SLO. Krueger, R.A. (1998) Developing Questions For Focus Group *in* The Focus Group Kit 3. London: Sage Publications. Krueger, R.A. (1998) Moderating Focus Groups *in* The Focus Group Kit 4. London: Sage Publications. Krueger, R.A., Casey, M.A. (2009) Focus groups: a practical guide for applied research. Los Angeles: Sage publications.

3. Focus group findings

In Table 2 the number of participants and the methodology applied in gathering data by the different partners are specified.
As can be deduced from this table there were some differences in data collection methodology. This means that data analysis should be treated with caution.

	Number of participants	Methodology
AUC	11	Face-to-face
EA	14	11 face-to-face & 3 Skype
INFLPR	57	Digital questionnaire
IOE	15	Face-to-face
OU	11	Face-to-face
Total	**108**	

***Table 2**: The number of participants in the focus groups and the methodology used in each country*

Since it was practically impossible to organise face-to-face focus groups in Romania considering the spread of interested parties across the country, an online questionnaire was distributed to the participants. Consequently, a larger number of participants could be reached and the data was processed differently, e.g. the data resulted in bar charts and written answers to open questions. These graphs supplied quantitative information, while the other focus groups resulted only in qualitative information. Since the participants in Romania selected all the training needs mentioned in the questionnaire at least once, it was decided to discriminate between the most important and less important training needs by choosing thresholds. These thresholds are mentioned in the text below the tables. When a comment was repeated several times by different members of the focus groups, the number is mentioned between brackets together with a multiplication sign.

The results for each of the key questions are discussed in the paragraphs below. Each paragraph consists of 4 subsections:

1. A summarizing table with the training need priorities per partner. The last column in each table represents the number of partners to whom this specific need was considered a priority need;
2. A summary about the priority needs including insights from the 5 partners;
3. A summarizing paragraph on effective and ineffective examples of practice;
4. Analysis of the focus groups outcomes per partner.

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3.1. Aims and Objectives: Towards which goals are teachers learning?

Aims and Objectives: Towards which goals are teachers learning?	AUC	EA	INFLPR*	IoE	OU	# institutes
Competences for (student) teachers						
In teacher education teachers should:						
1.1 Acquire secure content knowledge of science and mathematics ideas and processes, as well as the skills and competences to carry out inquiries.	X	X	X	X	X	5
1.2 Acquire the pedagogical content knowledge to foster inquiry and creativity in early years science and mathematics, including the use of inquiry approaches.	X	X	X	X	X	5
1.3 Become confident and develop positive attitudes towards learning and teaching science, mathematics using inquiry and creativity based approaches.	X	X	X	X	X	5
1.4 Acquire the skills to act as researchers and reflective practitioners in learning and teaching science and mathematics, and should become able to discern and reflect on innovative ideas.	X	X		X	X	4
1.5 Acquire the knowledge and skills to support the diverse interests and needs of young children in engaging creatively within the fields of science and mathematics.	X	X	X			3
Foci of teacher education.						
Teacher education should:						
1.6 Emphasise the importance of science and mathematics education for personal and society development by advocating its role in the preparation of scientific and mathematic literate citizens as well as the role of creativity in these domains and in human development.		X	X			2
1.7 Emphasise the pedagogical synergies between IBSE and creative approaches in both science and mathematics learning and teaching.	X	X	X	X	X	5
1.8 Foster teacher learning outcomes aligned with creative science and mathematics teaching strategies and assessment methods.	X	X	X			3
1.9 Foster teachers' creativity and their potential to be creative in science and mathematics.	X	X	X		X	4

* total importance>70%

Summary about priority needs

The results of the 5 partner institutes indicate that the main aims of the training modules are:

- Teacher confidence (1.3).
- Subject knowledge, pedagogical content knowledge and synergies between IBSE and creative approaches (1.1; 1.2; 1.7)

How this can be achieved is often subject for discussion. Teacher confidence could contribute to the other aspects or vice versa. The pedagogical synergies between IBSE and creative approaches are mentioned by all the partners, although partners often stress that these synergies are not yet or too little implemented in training courses.
The aims and objectives highlighted by all the institutes are:

1.1 Acquire secure content knowledge of science and mathematics ideas and processes, as well as the skills and competences to carry out inquiries.
1.2 Acquire the pedagogical content knowledge to foster inquiry and creativity in early years science and mathematics, including the use of inquiry approaches.
1.3 Become confident and develop positive attitudes towards learning and teaching science, mathematics using inquiry and creativity based approaches.
1.7 Emphasise the pedagogical synergies between IBSE and creative approaches in both science and mathematics learning and teaching.

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Effective/Ineffective examples of practice

Beneath you can find suggested approaches and effective or ineffective examples of practice, considering the aims between brackets:

Practices at the kindergarten & primary school

- Confidence can be gained by doing **small inquiry activities in the classroom**. Teachers can realise that it isn't that complicated to do and they can gain confidence (1.3)(AUC)
- Training using **iterative process** with the aim of **transforming science content to educational science content**. This is important at the beginning to create positive attitudes towards science, choose few topics to address, present educational materials that evidence the transformation of science content, allow time, go back and assess the lesson for improvement and try again. This process also fostered reflection and allowed participants to move past learning content and go into curriculum development (not only producing but choosing as well). The training was aimed at exercising teachers to carry out activities using scientific methodology (transformed for educational purposes - Inquiry-based science education is an example of this) (http://research.flo.uowm.gr/sted/ Greek research program website reference is in Greek)(1.2; 1.4)(EA)

Other contexts and environments

- Visiting auto services, building sites, factories to observe concepts they learned about in the classroom (1.6)(INFLPR)

Activities with the teachers

- Training can be started with instruction on the **theoretical background**. When teachers **identify their weaknesses**, this can be hard, but for some teachers this can be motivating to start "searching like a student". The training continued with **practical activities** that built on the background and evidenced real life conditions in the classroom " after you have the background you have to let go and trust children as co-creators". Finally, reflection on practice was important to conclude the training "you have to know and want to reflect on what you did, I usually do it at night". (1.1)(EA)

Designing & distributing good practices

- Share experiences through a **teacher's portal** where they can post materials, during symposia, by benchmark teams of educators or by watching demo lessons. Furthermore, project design contests or nominating the most creative schoolteacher can encourage teachers. Providing schools with creative teaching materials and adequate means for science teaching. Poorly equipped laboratories with appropriate materials and training aids constitutes the black hole of present education system (1.9)(INFLPR)

General remark on aims & objectives:

- The aims of objectives can only be acquired if these are in line with the school curricula. Therefore, the local institutes deciding on the school curricula should be consulted in order to make the aims and objectives mentioned here more explicit and more feasible. (INFLPR, AUC)

Results of the focus groups of the individual institutes

AUC (Belgium)

All the goals were considered a priority, except for goal 1.6. This aim is already part of the curriculum in Belgium, where there is already an emphasis on working in an integrated way. The main issue discussed during both focus groups was about the confidence of the teachers, which is often lacking, and should be fostered. The main issue besides this is the need for IBSE skills (e.g. observing) and the need for insights into the Nature of Science. Knowledge is also important, but skills and attitudes prevail. More time should be spent on IBSE activities during the training of the teachers. The synergies are a nice framework but not yet integrated in the guidelines.

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EA (Greece)

The participants accepted the importance of all the goals & objectives mentioned.
Issues raised during the focus groups are the fact that:

- There is a strong interrelation between the different aims & objectives
- Trainees (in ITT and CPD) should get the opportunity to go through iterative processes during the training (build, improve, test).
- Reflection is considered to be crucial to all teachers regardless of experience and content knowledge.
- The following question was raised: does 'becoming' come before 'acquiring' or do you have to acquire in order to become (first word of each outcome)? There was a discussion whether acquiring knowledge, PCK, etc. would result in becoming confident or should the starting point be increasing the confidence and this may help teachers to acquire knowledge and skills. Both approaches were seen as valid.

INFLPR (Romania)

The online questionnaire clearly pointed out that there is especially a strong need for CPD. All the above-mentioned aims and objectives where considered to be important. ITT was considered also important, but the need was less pronounced than for CPD, except for 1.6.
The main issues raised during the online questionnaires are:

- The need for self-confidence was raised several times. Workshops that promote inquiry are considered to be helpful to acquire confidence.
- The need for training courses, which allow active experimenting, and which are aimed at enhancing both knowledge and skills are considered to be very helpful.
- More time should be spend on new innovative approaches which put children at the centre of the educational process where they can investigate, run experiments, discover, collaborate, brainstorm and communicate.
- Teachers should consider their pupils as a subject of their investigation, in order to discover their interests, needs, limits, and skills and in order to assist them in developing individual competences.
- Fostering teachers' creativity and their potential to be creative in science and mathematics is mentioned most frequently in the questionnaire.

IoE (UK)

Across both focus groups, the aim that participants thought should be given priority was that of teacher confidence (1.3). On the one hand, this was discussed in terms of subject knowledge (1.1). Confident, secure content knowledge was seen as important to understand how to support, guide and extend children's thinking. It seems that participants understood that teaching creatively posed greater cognitive demands than just teaching facts. At another point in the discussion, the low priority for science in ITT and in schools was mentioned and this may contribute to the perceived sense of lack of security in science subject knowledge. Alternatively, the idea of developing teacher confidence related more to pedagogical strategies for teaching science, for example, using practical, hands-on activities and cooperative learning (1.2 and 1.3). The lack of practical science in classrooms was linked to this lack of confidence and a fear of 'messy' learning.

OU (UK)

The main aim both groups mentioned was subject knowledge (1.1). A few teachers referred to teaching science to young children as more demanding than teaching science to older learners as "young children are naturally inquiring and creative and they are more likely to ask all the big questions". They also thought that subject knowledge might be less of a goal in the CPD programmes, as they believe that subject knowledge develops and can be gained. The second group, on the other hand, was more concerned with teachers' pedagogical skills as well as with their knowledge and understanding of developmental psychology as they believed that it is important to focus on 'synthesizing [teachers'] knowledge of child development with the knowledge of science…[teachers] need to know how children develop… as there are many abstract concepts'. Again it might be relevant for the project team to consider whether training/teaching materials might need to include a section on 'age-appropriate' explanations of abstract concepts.

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3.2. Content: What should be the content of the training courses? What are teachers learning?

What should be the content of the training courses? What are teachers learning?	AUC*	EA*	INFLPR**	IoE***	OU***	# institutes****
3 The training courses should advance teachers' understandings about the nature of science and how scientists work, confronting stereotypical images of science and scientists.						
3.1 Teachers should be able to advance children's understanding about the nature of science and how scientists work, confronting stereotypical images of science and scientists.	1H	2V 2H 1M	M			1
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.		1V 1H	V	V		3
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	1H 2M	2V 2H	V	V	V	4
4 The training courses should promote understandings about the nature and framings of creativity, characteristics of creative teaching and learning, and how creativity is manifest in early years science and mathematics.						
4.1 Teachers should be able to recognize how creativity is manifest in early years science and mathematics and have knowledge of distinctions between features of creative teaching and creative learning.	1M	4V 2H 1M	V	V	V	4
5 The training courses should provide knowledge about how children's creativity development could be enhanced and assessed within science and mathematics education.						
5.1 Teachers should have detailed knowledge about the synergies between inquiry and creativity, such as play and exploration, motivation and affect, dialogue and collaboration, problem solving and agency, questioning and curiosity, reflection and reasoning; and teacher scaffolding and involvement, to support children's creative learning and advance their creativity within science and mathematics education	1H 1M	3V 1H 2M	H	V	V	3
6 The training courses should provide pedagogical content knowledge to stimulate inquiry and problem solving in science and mathematics education.						
6.1 Teachers should have knowledge of all essential features of inquiry and problem solving (questioning, designing or planning investigations, gathering evidence, making connections, explaining evidence, communicating and reflecting on explanations), their different purposes, degrees of structure and guidance (including open, guided and structured inquiries), and varied opportunities they offer for creativity.	2M	2V 2H	H	V	V	3
6.2 Teachers should be able to open up everyday learning activities to allow greater opportunities for inquiry, problem solving and scope for creativity.	1V 3H 2M	3V 1H	H	V		3
6.3 Teachers should be able to recognise the key roles of children's questioning and existing ideas (both implicit and explicit) of science and mathematics.	2H	2V 2H	H			1
6.4 Teachers should be able to use a variety of strategies for eliciting and building on children's questions and ideas during inquiry processes (before, during and after explorations and investigations).	1H 3M	1V 2H	V	V		3
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.	4H 1M	3V 1H	V		V	3
7 The training courses 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.						
7.1 Teachers should have knowledge of a range of formal, non- formal and informal learning, teaching and assessment approaches and strategies to promote creativity in their early years science and mathematics classroom.		5V 2H	V			2
7.2 Teacher should be able to use a range of strategies both formal and informal for supporting children's extended engagement with an area of study and progression in learning in science and mathematics.	1H	2V 1H	V			2

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7.3 Teachers should be able to recognize and exploit the value of play and exploration in science and mathematics for fostering and extending inquiry and creativity, by for example prompting questions, eliciting ideas, providing opportunities for consideration of alternative strategies during children's familiarisation with phenomena and events.	1V 3H 1M	2V 2H	V	V	V	5
7.4 Teacher should be able both to build in new and to make the most of existing opportunities for child-initiated play, recognising and capitalising on the potential of children's explorations beyond the teacher's original intentions.	1V	1V 2H	V	V		4
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 and games.	1V 3H 1M	2V 2H 1M	V	V	V	5
7.6 Teachers should be able to use strategies for making and building on science and mathematics real life connections and applications for engaging creatively young children in science and mathematics learning.	2V 1H	2V 2H	V		V	4
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.	2V 1H 1M		M			1
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.	2V 1H		V	V		3
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.	V	4H	H		V	2
7.10 Teachers should value and be able to make use of varied forms of assessment evidence (including children's portfolios, individual or group records of activities), both to promote creative learning, through reflection and discussion in science and mathematics, and explicitly to inform teaching and longer term planning.	1V 1H	1H	V			2
9 The training courses should enable teachers to make best use of and assess the various modes of expression and representation of science and mathematics learning to support inquiry and the development of creativity.						
9.1 Teachers should be able to recognize and value children's various forms of expression and representation of their ideas and learning in science and mathematics.	1V	1V 2M	H		V	3
9.2 Teachers should be able to make best use of children's preferred forms of expression and representation of their science and mathematics ideas to support inquiry and their creativity development.		1V 2M	H			1
9.3 Teachers should be able to select and use different approaches for and forms of recording children's ideas and learning in science and mathematics at different stages of the learning process and for various purposes, including to support children's reflection and reasoning processes.	1V	1V	H		V	3
9.4 Teachers should be able to use the various modes of children's expression and representation of science and mathematics ideas (e.g. pictures, graphs, gestures, physical activities) for assessment purposes.	1V	4M	V			2
10 The training courses should enable teachers to recognize and build on children's ideas, theories and interests for the teaching of science and mathematics.						
10.1 Teachers should be able to use a range of strategies for picking up on children's ideas, theories and interests.	1V 1H	1M	V			2
10.2 Teachers should be able to build flexibility into planning to take advantage of unexpected events, children's interests and questions.	1V 2H 1M	1V 1H 1M	V		V	4
11 The training courses 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.	2V 1H	1V 1H	H		V	3
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.	2V		V		V	3
14 The training courses 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.						

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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.	3V 1H 1M	1V 2M	V		V	4
14.2 Teachers should be able to recognise and build on opportunities for informal learning in science and mathematics within the school environment, for example within day to day routines or child-initiated games and other activities in school classrooms or outdoor play areas.	2V 1M		H		V	2
14.3 Teachers should be able to elicit and build on children's informal learning of science and mathematics outside school, at home or in the wider environment.	2H		H			2
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.			V			1
15 The training courses should promote teachers' use of group work to support children's inquiry processes and creative learning.						
15.1 Teachers should have knowledge of the value of collaboration for inquiry and creative thinking and learning.		1V 1M	H		V	2
15.2 Teachers should be able to purposefully use a variety of patterns of collaboration, shifting between individual and collaborative activity over time, to support children's inquiry processes and creative learning.		1H	V		V	2
15.3 Teachers should be able to organize group work, aligning ways of grouping children, task design, teaching and assessment strategies in different ways to promote collaboration amongst children in science and mathematics.		1H 2M	V		V	2
15.4 Teachers should be able to use resources and teacher intervention appropriately to foster collaboration in science and mathematics.			H			0
15.5 Teachers should be able to assess group work.		1H 1M	H			0
15.6 Teachers should be able to use effective strategies for sharing ideas and discussions from different groups.			H			0

* V (very high importance), H (high importance), M (medium importance)
** V>90%; H=80-90%; M=70-80%
*** Only the data for Very High importance was reported
**** Number of institutes were this aim was rated with 'Very high importance'

Overall conclusion 'What should be the content of the training courses? What are teachers' learning needs?'

The data analysis should be treated with caution since IoE and OU only reported the aims, which were assumed to be of very high importance, while for INFLPR thresholds were selected to discriminate between the different levels of importance. It is clear from the table above that members of the focus groups have picked all the aims mentioned in the above table at least once. The priorities identified by the different institutes were spread across the content items. Nevertheless, it is still possible to identify training priorities. These are aims concerning the importance of asking questions (for both the teachers and the children), the synergies between inquiry and creativity, the importance of game and play, and the need of opportunities for informal learning.
The aims prioritised by all the institutes are:

- 7.3 Teachers should be able to recognize and exploit the value of play and exploration in science and mathematics for fostering and extending inquiry and creativity, by for example prompting questions, eliciting ideas, providing opportunities for consideration of alternative strategies during children's familiarisation with phenomena and events
- 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 and games.

The aims highlighted by four out of five institutes:

- 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

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- 4.1 Teachers should be able to recognize how creativity is manifest in early years science and mathematics and have knowledge of distinctions between features of creative teaching and creative learning.
- 7.4 Teachers should be able both to build in new and to make the most of existing opportunities for child-initiated play, recognising and capitalising on the potential of children's explorations beyond the teacher's original intentions
- 7.6 Teachers should be able to use strategies for making and building on science and mathematics real life connections and applications for engaging creatively young children in science and mathematics learning
- 10.2 Teachers should be able to build flexibility into planning to take advantage of unexpected events, children's interests and questions
- 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

Effective/Ineffective examples of practice

Below you can find suggested approaches and effective or ineffective examples of practice:

Practices at the kindergarten & primary school

- **"**From my personal experience everything starts with **eliciting my curiosity** through interesting, thought-provoking content/activities. This gets my curiosity going which motivates me to acquire limited content knowledge. Feeling like I know more I started to try out some things in my classroom and that led me to gain some confidence. This in turn **triggered/fed into my need to learn more**. This back and forth allows me to **move upwards one step at a time** (in the classroom) and slowly allows me to have a better perception/understanding to identify the opportunities for creativity. If I don't have the content knowledge (Not formulas, but plausible explanations about phenomena), I won't have the perception (mental, visual, etc.) to grab opportunities in the classroom." (3 & 6)(EA)(EA: ***This is more of a description of the desired learning path for a teacher during a successful training (linked to content) rather than an example of specific content. This is an important quote in my opinion.***)

Activities with the teachers

- "Using interactive methods and teamwork within a project contributes to the fulfilment of learning tasks (15.3)." (INFLPR)
- "Teachers working in group and then assessing their own results (15.5)." (INFLPR)
- How to ask the right question at the right moment? This can be achieved by an **empathizing activity**, which is doing an activity as you would do it in the classroom and experience yourself what effect certain questions have on you e.g. by working in pairs. Cfr. Microteaching. An added value is: an outsider who observes and has an objective view on the situation. It is also about training certain skills such as learning to observe nature, the landscape, ...This can be a trigger to see opportunities for inquiry. (11)(AUC)
- Not only focus on one part (either method or phenomena/science content). "Its crucial to have **balance** between the **method** that produces scientific knowledge **and** the **phenomena**. There are examples of training that failed because it focused only on presenting experiments to teachers to replicate in their classroom." (6.1)(EA)

Observing good practices

- Present instances of opportunities for creativity and ways that teachers can take advantage of them in their classroom. What I do is **record** such **lessons** and show them to the teachers and have an open discussion. After that it is very useful for them to carry out similar learning activities as learners and experience unexpected situations that might arise. That lived experience is a very useful tool to transfer in their teaching because it allows them to identify such opportunities and tackle them effectively (4.1)(EA)

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Multiple intelligences

- "The **theory of multiple intelligences** developed by Howard Gardner indicates that each person has a type of intelligence which is more pronounced and natural that the other, and each person has to be encouraged to express itself creatively". (INFLPR)

Children's products

- "Organization of the first and the second edition of the National Symposium "Together for a better environment" which was attended by teachers from 21 counties. In the frame of the symposium was organized an exhibition of children products based on recyclable materials under the title "Art from the waste". Both editions were preceded by the **distribution of a valuable teaching guide**. Or: "To Initiate and **organize exhibitions with children products**, in the frame of educational projects at local/ county level, products based on natural and reusable materials. Editing of a CD containing the description of these results (9.2)(INFLPR)

Teaching strategies

- "Teachers should be able to use a **wide range of strategies** to select children's ideas, theories and interests. I guide students in preparing art and literary works during the classes for technological education, art education, and science, using various techniques, and the results were presented at school competitions, such as: *Ecoexploratorii*, *Martisoare verzi*, *Chemistry and Life*. Each month, I train students in the development of interdisciplinary group projects on various subjects, in order to capitalize on multiple intelligences approach (10.1)."(INFLPR)
- **Interactive learning activities**, using methods such as: learning circle, mysterious journey, aquarium technique, technique 6-3-5 (Brainwriting) (15.6) (INFLPR)

Other contexts and environments

- "I always had in mind the effective use of **non-formal and informal contexts** occasioned by visits natural science museum, trips, activities in the environment, so that students observe some phenomena, plants, animals in their natural environment, and ask additional questions to find answers. Such activities provide opportunities for practicing some elements of applied mathematics, i.e. grouping objects, distribution and use of resources, accounting the results, etc." (14.1) (INFLPR)
- "More activities and projects in the external environment, in order to stimulate creativity and diversification of factors that may influence its development (14.1)." (INFLPR)

Results of the focus groups of the individual institutes

AUC (Belgium)

In both focus groups asking questions, both by the teacher and by the children, are considered to be very important:

- By the teacher: emphasis should not be on the form of the question, but on the intention of the question. How do you construct something and how do you guide the students through the process. This is discussed during the training of the teachers, but still not enough. How can you ask the right question at the right time?
- By the children: investigating their own questions gives them ownership. Students should experience this sense of ownership during their training. Often they are not used to work in this way and they ask for guidelines on how to perform the task.

Seeing inquiry opportunities in daily activities is also considered to be very important. Students should get enough time to observe the children in the class to be able to foster opportunities for children's agency and creativity.

EA (Greece)

Issues raised during the focus groups are:

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- The participants of the focus group find it difficult to prioritise content in science. Teachers are often intimidated by the content of science.
- Content knowledge should exemplify that science is an everyday activity not just school science.
- It is important to show that science is a creative endeavour. Content needs to evidence how teachers can take advantage of opportunities arising during lessons.
- Content should promote questioning (both from teachers and children) as an important method.
- Science education should promote children's choices in what they want to learn.
- Informal learning is missing from Greek primary education.

INFLPR (Romania)

The online questionnaire clearly pointed out again that there is especially a strong need for CPD. All the above-mentioned aims and objectives where considered to be important. ITT was considered also important, but the need was less pronounced than for CPD, except for 3.1 and 7.1.

The content priorities explicitly mentioned during the online questionnaire:

- 7.4 Teacher should be able both to build in new, and to make the most of existing opportunities for child-initiated play
- 9.2 make best use of children's preferred forms of expression and representation of their science and mathematics idea (2x)
- 10.1 Teachers should be able to use a range of strategies for picking up on children's ideas, theories and interests
- 11.2 Building on children's questions
- 14.1 Varied settings for science and mathematics learning (2x)
- 14.3 Teachers should be able to elicit and build on children's informal learning of science and mathematics outside school
- 14.4 Teachers should be able to manage visits with children to the outdoor and wider environment beyond the school
- 15.2 Teachers should be able to purposefully use a variety of patterns of collaboration, shifting between individual and collaborative activity over time
- 15.3 Organisation of group work
- 15.5 Teachers should be able to assess group work
- 15.6 Teachers should be able to use effective strategies for sharing ideas and discussions from different groups.

IoE (UK)

The content priorities given greatest priority across the focus groups were:

- 5.1 Synergies between inquiry and creativity (10/15 votes)
- 7.3 Exploit the value of play and exploration (4/15 votes)
- 6.2 Open up everyday learning activities (3/15 votes)
- 11.2 Building on children's questions (3/15 votes)
- 14.1 Varied settings for science and mathematics learning (3/15 votes)
- 15.3 Organisation of group work (3/15 votes)

OU (UK)

Priorities identified by participants were spread across the content items. High priority was given by both focus groups to the value of play and exploration, fostering opportunities for children's agency and creativity and to synergies between inquiry and creativity

- 7.3 Exploit the value of play and exploration (7/11 votes)
- 5.1 Synergies between inquiry and creativity (5/11 votes)
- 6.5 Foster opportunities for children's agency and creativity (7/11 votes)
- 3.3 Foster the process of imagination, reflection and consideration of alternative ideas (4/11 votes)

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- 11.1 Should be able to use different forms of questioning (4/11 votes)
- 14.2 Should be able to build on opportunities for informal learning (4/11 votes)

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3.3. Learning activities: How are teachers learning?

Learning activities: How are teachers learning?	AUC	EA	INFLPR*	IOE	OU	# institutes
Teacher education should provide learning activities in science and mathematics which:						
3.1 Are inquiry-based, addressing all essential features of inquiry (questioning, designing or planning investigations, gathering evidence, making connections, explaining evidence, communicating and reflecting on explanations), and their various purposes and degrees of structure and guidance (including open, guided and structured inquiries).	X		X	X	X	4
3.2 Bring out the synergies between inquiry-based science and mathematics and approaches directed at developing learner creativity.				X	X	2
3.3 Are interactive, within a rich, motivating context, and should encompass a range of formal and informal learning approaches and strategies. Examples of such activities include lesson planning, discussions focused on fostering creativity; demonstrations of good practice; outdoor learning; field trips; project work.	X	X	X	X	X	5
3.4 Integrate science and mathematics learning, making use of real life, meaningful and interactive contexts, and illustrating the potential of such interdisciplinary approaches for inquiry and creativity.		X	X	X	X	4
3.5 Provide teachers with opportunities to recognize and better understand both young children's learning of science and mathematics and the role of creativity within this, through for example classroom observations, collection and analysis of evidence, talking to children.	X	X	X	X	X	5
3.6 Attend to teachers' different approaches to their own learning and encourage their expression and representation of scientific and mathematics ideas in various modes.	X	X3		X	X	4
3.7 Help teachers reflect on their own prior knowledge, (mis)conceptions (incl. stereotypical images) beliefs and attitudes about science, mathematics and creativity, using a variety of approaches, such as microteaching, peer-observations, learning journals.	X	X	X	X	X	5
3.8 Support teachers' learning, by providing them with illustrative examples of diverse practices for them to critically examine opportunities for creativity and inquiry in learning, teaching and assessment.	X		X	X	X	4
3.9 Are a variety of individual and collaborative to promote teachers' creative thinking skills and dispositions	X		X	X	X	4

* total importance>80%

Overall conclusion: How are teachers learning?

It is clear from the table above that members of the focus groups have picked all the aims mentioned in the above table at least once.

All the focus groups mentioned the importance of sharing experiences with other teachers and having in-depth discussions and reflection after their experiences in the classroom. Besides this, observing other teachers in their classrooms was considered to be a valuable way to learn.

The aims highlighted by all the institutes: Teacher education should provide learning activities in science and mathematics which:

- 3.3 Are interactive, within a rich, motivating context, and should encompass a range of formal and informal learning approaches and strategies. Examples of such activities include lesson planning,

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discussions focused on fostering creativity; demonstrations of good practice; outdoor learning; field trips; project work.

- 3.5 Provide teachers with opportunities to recognize and better understand both young children's learning of science and mathematics and the role of creativity within this, through for example classroom observations, collection and analysis of evidence, talking to children.
- 3.7 Help teachers reflect on their own prior knowledge, (mis)conceptions (incl. stereotypical images) beliefs and attitudes about science, mathematics and creativity, using a variety of approaches, such as microteaching, peer-observations, learning journals.

Effective/Ineffective examples of practice

Beneath you can find suggested approaches, and effective or ineffective examples of practice, considering the following aims:

Practices at the kindergarten & primary school

- In a collaboration between teacher educators and schoolteachers, the **educators visit schools** to **structure activities for the children**. "The teacher wanted the children to cultivate edible olives (October was the time of year where olives are picked from the trees) from the olive trees in the school garden." The teacher educator suggested that an additional activity would be for children to use their own system to measure the area needed to carry out this task. The teacher educator offered some instruction to the teacher and observed. After the conclusion she offered comments and advice. The activity went very well as children were immersed in the activity and showed interest. *Reference to Regio emilia example of building a working water turbine.*(3.4)(EA)
- "Important for teachers to **go and see other teachers'** (and experienced teachers/teacher educators) lessons. They want this and they find it very useful". **Collaboration between teachers** is crucial to the majority of participants and was mentioned as an example. (3.8)(EA)
- Visit each other's classroom. Observe the reactions of the children. (AUC)
- Giving an **assignment**: e.g. book with pictures which can be a starting point for an activity in the classroom. (AUC)
- **Team teaching** (AUC)

Observing good practices

- Teacher educator "I bring in the **classroom recordings from a kindergarten class** (or the transcript) and give it to my students. I, then, ask them questions such as: Does the teacher communicate with children? In what way do the children communicate their explanations in regard to science? We need to identify children's "crazy ideas" and motivate the teacher to take advantage of such opportunities. Using imagination (and characters children create with their imagination) is the best way to foster children's ideas and you have to know and take advantage of that. Kindergarten teachers are the best group to work with in order to use imagination instead of cold hard facts (which are not useful in school contexts a lot of the time". (3.5)(EA)
- "It is important for teachers to **watch best practice examples** (EA, AUC, INFLPR) that have been validated in the classroom. That way they can evidence instances of opportunities for creativity and ways that they can take advantage of them in their classroom. What I do is record such lessons and show them to the teachers and have an open discussion. After that it is very useful for them to carry out similar learning activities as learners and experience unexpected situations that might arise. That lived experience is a very useful tool to transfer in their teaching because it allows them to identify such opportunities and tackle them effectively." (3.5 & 3.8)(EA, AUC, INFLPR)
- **Demo sessions** (3x INFLPR; IoE)
- Best practices, to emphasize strengths and weakness (INFLPR)
- **Videos with good & bad practices**, which are discussed together. Discussing their own activities with arguments why they did certain things, so formulating their own thinking process (meta-level). (AUC, INFLPR)
- **Record activities** and watch them afterwards (AUC, INFLPR, IoE):

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    - Stimulated recall interviews (when the teacher trainer chooses the fragments).
    - Critical incident review (you discuss critical/dilemma points during the activity).
- Keeping blogs, video material, pictures. (AUC)

Activities with the teachers

- "**Create working groups between teachers and researchers** where equality is crucial. The teacher through collaboration and debate manages to understand their process using reflection as well. We have very good results." (3.6)(EA, INFLPR)
- **Discussions** in groups about activities. A moderator moderates the discussion. (AUC)
- **Empathy game**: empathizing in the way the toddler thinks and reacts. Act as the child would act. (AUC)
- **Letter carousel**: teachers write letters to each other about their practices. (AUC)
- **Pecha kucha**: the teachers talk about their practice in a limited amount of time. So they can only present the essential part. E.g. talk about their favourite experiment that they have been doing in the classroom with their children. (AUC)
- **World café** in conference style (everybody visits the stand they are interested in. (AUC)
- **Call to action**: write down 3 things you recall from this session and choose one you would like to try out next week. (AUC)
- Workshops with the participation of different **experts** (INFLPR)
- **Experience the activity themselves** on their own level. E.g. build a wall themselves + **debriefing** after the activity. (AUC)
- Simulations of lessons/activities carried out by experienced project leaders (INFLPR)
- **Micro-teaching** (AUC)

Design & distributing good practices

- Manufacture of illustrative teaching; design of teaching aids (PPP's, composition of sheets highlighting the results of an experiment) curriculum design elements for interdisciplinary activities (i.e. an option lesson, a club for children). (INFLPR)
- Lesson study was mentioned by a couple of participants in terms of planning a lesson with colleagues, teaching that lesson and then talking about it afterwards. This was also mentioned in relation to the experience of being video-recorded, which was seen as useful. (IoE)

Other methods

- A teacher gave an example of an assignment during her ITT where she had to **read up, translate and work** on analysing an example of science teaching through history through **an academic article**. "It motivated me to try out similar activities and I had it always on my mind" (3.8)(EA)
- "Comparison to a class where this method is applied and one class where does not apply the method." (INFLPR)
- **Workshops with the children, in-service and pre-service teachers**: children visit different stands with IBSE activities (e.g. led by student teachers). In-service teachers observe the reactions of the children & observe the activities. They see the enthousiastic reactions of the children. This is also interesting for the student teachers: they can discuss and interact with in-service teachers. (AUC)
- Teachers have to know **effective classroom methods** such as method of the quadrants; text maps; the gallery tour; role play; cooperative learning methods; active participative methods; brainstorming; differentiation; see alternative view points; not fearing making mistakes the predictions method which are more often used, with good results (INFLPR)
- Teacher talked about experience of **outdoor learning** she had enjoyed.
- Give students the opportunity to **choose** their own science subjects or museums (ITT). They learn that this can also be motivating for children, if they get the opportunity to choose. (AUC)

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- One example was of how the sudden occurrence of two rainbows was used as learning experience by taking children outside and 'trying to run under both rainbows'. The teacher who mentioned this referred to it as **'spontaneous learning'** and 'being in the moment', real-life learning. (OU)
- **Cartoons** (e.g. concept cartoons). (AUC)

Ineffective methods:

- Ineffective experiences of learning were connected to being 'lectured' and having little involvement. (IoE)

Results of the focus groups of the individual institutes

AUC (Belgium)

The activities that were discussed and appreciated the most during the focus groups were:

- Experiencing inquiry principles themselves on their own level and then apply these principles to level of children. Debriefing after the activity is important! Reflecting about the thinking process of the teacher during the activity (meta).
- Visiting each other's classroom (2x). You learn the most when you visit a classroom and look at the reactions of the children.
- Blogs, video or photo material can help. An in-depth analysis of the video material is necessary.
- Panel discussions where teachers discuss and share their experiences.
- The CPD should get some kind of permanency. It should not end after a few sessions, establishing permanent networks is important

EA (Greece)

Participants agreed that collaboration between teachers is very helpful for teachers in CPD/ITT in more than one ways (reflection, exchange opinions, using/transforming colleagues' work). Another important issue mentioned was the importance of providing meaningful experiences during teacher training that on one hand place the teacher in the shoes of the learner (gain personal experience) and help them to transform this experience into their teaching.

Short-term planning is important for trainees (and in CPD) and should be followed by a presentation in front of colleagues and a thorough discussion with colleagues and the teacher educator.

Observing colleagues' lessons can also bring insights. Training activities that assist teachers in transforming the knowledge gathered during training to classroom instruction. Having a variety of teaching approaches presented in CPD/ITT is crucial for each teacher to find their path according to their personality.

INFLPR (Romania)

The online questionnaire clearly pointed out again that there is especially a strong need for CPD. All the above-mentioned aims and objectives where considered to be important. ITT was considered also important, but the need was less pronounced than for CPD, except for 3.1.

The ways teachers learn mentioned several times during the online questionnaire:

- Demo lessons by experienced teachers
- Having the opportunity to experiment
- Illustrative teaching material such as videos
- Opportunities for cooperative learning, sharing opinions
- Workshops with experts and student teachers
- Mentoring for early stage teachers

IoE (UK)

Across the focus groups there was strong support for all dimensions of learning activities.

Particularly favourable were activities that emphasised hands-on learning in a meaningful context (3.3) and where there was a strong collaborative element (3.9)

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The positive experiences of learning that were cited included joint lesson planning, watching video-excerpts of own teaching, self-reflection, team-teaching and going on courses that required some kind of action back in school. What these activities had in common was the element of challenge, collaboration and community. The teachers were being required to do something with an element of risk, but this was in the context of an investment in long-term relationships with other learners/mentor.

OU (UK)

Across the groups there was strong tendency towards 'action-oriented' learning including 'trying things out', exploring, 'having a go' etc.
Watching videos of children's inquiry and self-reflection were also mentioned.
The participants emphasized the value of 'coming back to the 2nd session' after having tried things out.
The participants valued attending training with a colleague as they believe that would provide conditions for reflecting together and sharing. The concepts of collaboration and sharing experiences seem to be important for majority of participants.

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3.4. Teacher Role: How is the teacher educator facilitating learning?

How is the teacher educator facilitating learning?	AUC	EA	INFLPR*	IOE	OU	# institutes
Teacher educator role						
Teacher educators should:						
2.6 Take into consideration teachers' prior knowledge, skills, attitudes, beliefs, fears, preconceptions (incl. stereotypical images), learning styles and experiences associated with learning and teaching science, mathematics, and creativity, and organize appropriate learning activities.	X	X		X	X	4
2.7 Make explicit connections among content knowledge, pedagogical content knowledge and teaching practice of science and mathematics, as well as between these and the development of creativity.	X	X	X	X	X	5
2.8 Practically demonstrate a variety of roles in their interactions with teachers e.g. facilitator, supporter, coordinator, leader, motivator, role model.		X	X		X	3
2.9 Model inquiry- and creativity-based learning, teaching and assessment practices, by for example encouraging teachers' decision making during inquiry processes, and sharing, evaluating and reflecting on outcomes.	X	X	X	X	X	5
2.10 Model how teachers should select science and mathematics materials and resources for fostering creativity in mathematics and science.		X		X		2

total importance>80%

Overall conclusion: How is the teacher educator facilitating learning?

It is clear from the table above that members of the focus groups picked all the aims mentioned in the table above at least once.

The following characteristics of the teacher trainers were mentioned:

- He/she should be able to stimulate reflection and have good communication skills
- He/she should stimulate the confidence of the teacher and should be able to build a relationship of trust
- The facilitator has different roles as motivator, leader
- He/she should display enthusiasm, should motivate and give guidance

The aims highlighted by all the institutes: Teacher educators should

- 2.7 Make explicit connections among content knowledge, pedagogical content knowledge and teaching practice of science and mathematics, as well as between these and the development of creativity.
- 2.9 Model inquiry- and creativity-based learning, teaching and assessment practices, by for example encouraging teachers' decision making during inquiry processes, and sharing, evaluating and reflecting on outcomes.

Effective/Ineffective examples of practice

Beneath you can find suggested approaches and effective or ineffective examples of practice:

Teacher trainer role

- The range of roles of facilitator was exemplified by one school's practice of classroom observations. Before the observation, the observer meets with the teacher to talk through the lesson and suggest

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changes; afterwards, the observer leads the discussion and facilitates points for action. This role encompasses both challenge and support. (2.8)(IoE)

Teacher trainer skills

- Preferably somebody who is experienced in teaching children. Somebody who can **inspire** teachers to reflect instead of telling them how to do something. (AUC)
- "A well prepared trainer is able to **tolerate and accept different opinions**, to **listen actively**, to **pick up good ideas**, and to **coordinate** a training activity that trigger audience interest." (INFLPR)
- "The trainer has the role to **mediate** between student's **previous knowledge** and the knowledge the teacher wants to transmit. A person who has teaching experience, able to create a pleasant atmosphere." (INFLPR)
- "The trainer is of course a **moderator**, but he also creates contexts in which students can build-on their teaching skills and share their experiences. The trainer in ITT envisages the reduced teaching experience of those to be trained, and the need to discuss theoretical aspects (teaching strategies, children mental development, peculiarities of the cognitive processes at school age)." (INFLPR)
- "The trainer should **encourage initiative** and should support those trained to look themselves for solutions to the problems under discussion, to **create a stimulating environment** which facilitates the involvement of the trainees in their training." (INFLPR)
- "The trainer has prepared **training sessions fit to** the characteristics of the course, the target group, the topic, in such a way that group work sessions alternated with games, the discussions of an issue with the explanation of the theory, by putting lessons learned to practice. He facilitated, coordinated, managed, motivated and supported the work of the students." (INFLPR)
- "A trainer from whom I learned a lot made clear from the beginning that we are able to provide solutions which can be applied in the class. He created contexts in which we could build our own strategies, gave us practical examples of teaching strategies with new elements that we integrated into our activities. He placed us in a position of a reflexive attitude towards our previous work." (INFLPR)
- "University Professor dr. E.V. who delivered the ZEP course. A memorable experience. An outstanding teacher, a nice presence, delivering an **interactive course** (2x) engaging the students, as the evaluation was a formative one. You have to illustrate on the spot by an "exercise" what you "learned" until that moment." (INFLPR)
- It was an interactive course with many examples of **practical applicability**. By attending this course I understand that the game is the main way of learning for pupils and which is the approach of a high quality education in the preparatory class (INFLPR)
- "The trainer **gave me confidence** that I can do things as well, his approach triggered learning experiences for me. What was memorable and I remember, was the model he offered: punctuality, honesty, tolerance, learning capacity, creativity, teaching experience, safety, ..." (INFLPR)
- Attitude of the teacher educator: **positive, showing appreciation**, and letting the teachers know that you as a teacher educator know that they already know a lot and are able to do a lot. It is about creating a **positive atmosphere**. Don't give them the feeling that you are teaching them something new. Use humour & give confidence to the teachers. (AUC)
- "**Calm, charm, tolerance**", "a trainer who knows how to **empathize** with the audience" "the trainer was a nice presence" (INFLPR)
- "The trainer has to be a **charismatic** person, with **confidence** and **high self-esteem**, with many specialized courses in education in his / her portfolio, with many practical examples, not only theoretical ones." (INFLPR)

Ineffective methods

- One teacher talked about her own learning experience when she took a course in drawing. The course facilitator was 'too quick' and wanted all the course participants to finish their drawings faster than they could - the teacher shared with us how uncomfortable and disrespected she felt as the course facilitator did not motivate her but rather **'demotivate'** her to pursue drawing. (2.8)(OU)

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- "I do not want any more to participate in classes where **teachers read from the computer screen** and participants loss their attention." (INFLPR)

Results of the focus groups of the individual institutes

AUC (Belgium)

The focus group members stressed that it is important that the trainer should be experienced in teaching children. Besides this, he/she should stimulate reflection by asking questions. The trainer should have a positive attitude towards the teachers, stimulate their confidence and appreciate the knowledge of the teachers.

EA (Greece)

Participants began by stressing the need for the educator to have content knowledge and a multitude of experiences to share with teachers. A summary of the preferred approach was presented (3 points reported in the right cell here) which other participants agreed. Overall, the discussion focused on the importance of building a relationship of trust between the educator and teachers, with the former being able to provide guidance in improving content knowledge, providing examples of a multitude of teaching approaches while displaying the passion/enthusiasm asked from teachers and being able to provide guidance in real world classroom situations.

INFLPR (Romania)

The online questionnaire clearly pointed out that there is especially a strong need for CPD. All the above-mentioned aims and objectives where considered to be important. ITT was considered also important, but the need was less pronounced than for CPD, except for 2.6 and 2.7.
The content priorities explicitly mentioned during the online questionnaire:
The trainer should be able to facilitate, mediate, coordinate, encourage, motivate and monitor the process. He should have communication skills, listening skills, leading skills. He should be able to demonstrate on how theory applies in practical situations. He should be able to devise appropriate training programmes according to the teachers needs.

IoE (UK)

The first focus group emphasised the role of the teacher educator in taking teachers' prior knowledge, school context, attitudes and fears into consideration (2.6). Perhaps these features were salient because the participants were aware that learning involves risk, challenge and discomfort and they want an educator who will support this process. Creating an atmosphere of trust and confidence was mentioned a number of times (which links back to participants' discussion about the aims of the course). Another important aspect was that of 'relationship'. Here, and in other sections of the discussion, participants talked about the importance of building networks and on-going relationships with other teachers, either locally or on-line. Part of the role of the educator is seen as facilitating the establishment of these longer-term relationships.

The second group focused more on how the facilitator might help teachers notice what is happening when observing another's practice. The examination of episodes of teaching was understood to require this guidance to pick out interesting and significant features.
This was talked about at a general level, rather than in specific relation to creativity and inquiry-based teaching and learning. The issue of 'noticing' perhaps links to the wider problem of providing subject-specific feedback when observing teachers and the need for guidance to support this process.
This is the important role of the educator in making connections about content knowledge, pedagogical knowledge and teaching practice of science (2.7)

Modelling how teachers might use a resource was also mentioned (2.10).

OU (UK)

The first group focused mostly on course facilitator's multi-layered roles as motivator and leader though his/her own passion and enthusiasm for subject (2.8). The second group emphasised taking prior knowledge into

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consideration and establishing 'common ground' (2.6). Participants mentioned a number of times the importance of having a relationship with learners, being able to be honest and not be afraid that you will make a mistake, to feel free to learn, to take risks. Meaning-making seems to be expected of course facilitators as well as organised and accessible resources (2.10).

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3.5. Assessment: How to measure how far teachers' learning has progressed?

How to measure how far teachers' learning has progressed? How is assessment information used to inform planning and develop practice?	AUC	EA	INFLPR*	IOE	OU	# institutes
Focus of assessment						
In teacher education:						
4.1 Teachers' acquisition and development of science/mathematics content and pedagogical content knowledge, skills and attitudes should be assessed.	X		X		X	3
4.2 The development of teachers' inquiry and creativity-based teaching and assessment approaches should be assessed.	X	X	X			3
4.3 Teachers' acquisition and development of understanding about what it is to foster children's creativity in science and mathematics should be assessed.	X		X			2
4.4 The development of teachers' abilities to plan for, foster, reflect upon and assess children's creativity in science and mathematics education should be assessed.	X	X	X			3
Process of assessment						
Teacher education should:						
4.5 Promote teachers' independence and responsibility in identifying their own progress and areas for development both in the fields of science and mathematics education and in the fostering of creativity within these fields.	X	X	X	X	X	5
4.6 Use different assessment strategies in order to assess holistically cognitive, social and affective aspects of science and mathematics learning, as well as tap into the potential for peer and self-assessment.		X	X	X	X	4
4.7 Use different forms of evidence (e.g. portfolios, teacher diary, observation lists, tests, essays, project work, teaching practice) for assessment purposes.	X	X	X	X	X	5

* total importance>80%

Overall conclusion: How is the teacher educator facilitating learning?

It is clear from the table above that members of the different focus groups picked all the aims mentioned in the table above at least once.

The following characteristics of the teacher trainers were mentioned in different focus groups:

- (Self)-reflection is considered to be one of the most effective assessment methods for teachers.
- The use of formative assessment is widely supported
- Formal assessment is considered appropriate for ITT, but not for CPD
- It is important that assessment is personalised to the needs of the learner and/or the school
- The opinion about the use of a portfolio differ between focus groups: some or in favour, others are against it (time-consuming)
- Assessment of process and progress is considered to be most relevant

The aims highlighted by all the institutes: Teacher education should:

- 4.5 Promote teachers' independence and responsibility in identifying their own progress and areas for development both in the fields of science and mathematics education and in the fostering of creativity within these fields

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- 4.7 Use different forms of evidence (e.g. portfolios, teacher diary, observation lists, tests, essays, project work, teaching practice) for assessment purposes.

Effective/Ineffective examples of practice

Beneath you can find suggested approaches and effective or ineffective examples of practice:

Assessment at the start of the training

- Try to assess the **starting knowledge and skills** of the (student) teachers. This makes it possible to differentiate during the course (AUC)

Practices at the kindergarten & primary school

- Coaching in the classroom (feedback) (AUC)

Designing & distributing good practices

- "All teachers have to prepare a project, showing clear what they learned. These teaching projects will gathered as educational material for a best practice guide, to be published later. So we learn from the experience of others." (INFLPR)
- "Everybody makes a good practice, which is then bundled and shared." (AUC)

How to assess

- Teachers **portfolio** (3x)(INFLPR)
- **Self-evaluation** (AUC, INFLPR)
- **Visual feedback** & assessment: evaluation not only by talking but also by the use of visual representations e.g. cartoons, poster, smiley, drawing. (AUC)
- "Important to have assessment during the learning process/training. It helps me as a teacher educator." "We need **continuous assessment**" "Assessment is part of CPD and not the same as we all think about it" (4.2)(EA)
- ON ITT: "even though student teachers are very well prepared during their practical exercise in the classroom, they cannot identify things that have not gone so good during their teaching. That is why we are there to discuss this with them. After a while they can do it themselves but it is crucial that they **learn how to reflect** on their teaching and accept assessment, as a way to improve not punish. It is important for assessment to promote self-assessment through reflection as well. Ultimately, assessment should allow the teacher to identify the learning process during their lessons." (4.5)(EA)
- One teacher talked at length about the positive impact of writing a **reflective summary of learning** and also of keeping an on-going personal learning journal. (4.5)(IoE)
- "The trainer has to prepare a **progress map** for each student (for the entire period of the respective course) and has to make public the results on the group or user account, as a feedback for each student (4.7)." (INFLPR)

What to assess

- We need a process that shows our **progress** and where we stand (4.2)(EA)
- **Affective** dimensions of learning (4.2)(EA)
- We need to devise a tool that contains **all the elements of curriculum development and classroom practice** (4.2)(EA)
- The effectiveness of using case study material was voiced, in terms of tracking **the progress of one or two children**, including conversations with them about their learning. (4.7)(IoE)
- "Practical training, demo lessons (4.7)." (INFLPR)
- "Evaluation of the activities' expectations versus achievements (personal contract, tree expectations...) (4.7)." (INFLPR)

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Ineffective methods

- Teachers' **portfolio**: "Do not use a portfolio: this can be considered to be an extra assignment." (AUC)
- Assessment of teachers as carried out in Greece (particularly the last year) was referenced as a very bad example of assessment. "It is **only done to label** us and not in a good way. It is not useful at all to only point out my shortcomings (most of which I already know). We need a process that shows our progress and where we stand, but not in the strict way done now. Assessment needs to help me move forward" "Assessment only looks at understanding of concepts and **not on process and method**. Also affective dimensions of learning are not anywhere in assessment. We need to devise a tool that contains all the elements of curriculum development and classroom practice" "Summative assessment is a totally different thing than assessing the learning process" (4.2)(EA)
- The ineffectiveness of **one-off lesson observations** was mentioned. (4.1)(IoE)

Results of the focus groups of the individual institutes

AUC (Belgium)

The participants focussed particularly on the following ways of assessment: immediate feedback in the classroom, stimulating reflection during debriefing and discussing the products (fi lesson plans) the teachers create for each other. The use of portfolio is not supported. It is often considered as an assignment.

EA (Greece)

There is a need (raised by the majority of participants) for proper training in assessment because teachers need to realise the framework for assessing teaching/learning. A need for Greek teachers to start building a culture for assessment (change the way the term is used) and believe that assessment is used for improving not punishing. Formative assessment plays a crucial part in this particular age group. Self-assessment was mentioned as a very useful approach that is missing in Greece, the same was said about assessment of process. There is a need for a template/rubric for teachers to debrief after every day (self-assessment). Assessment procedures formulate learning processes. Assessment should point the way towards when and how teachers should react in the classroom. Reflection is crucial to assessment. Assessment should help when and how teachers should react in the classroom assist in limiting missed opportunities.

INFLPR (Romania)

The online questionnaire clearly pointed out again that there is especially a strong need for CPD. All the above-mentioned aims and objectives where considered to be important. ITT was considered also important, but the need was less pronounced than for CPD, except for 4.1.

The ways evaluation should be organised explicitly mentioned in the online questionnaire:

- Some correspondents mention that there is a difference between ITT and CPD-assessment:
    - A difference in form and content
    - For ITT there are two different views among the participants on assessment:
        - Oral & written exams, more theoretical knowledge
        - Practical activities & demonstrations, design & preparation of some experiments,
    - For CPD the views are more aligned amongst the participants: they should be focused on the study of each trainee, practical applications, and application of the knowledge accumulated during the course
- Also the use of portfolios has been discussed: some consider it to be a useful tool, others see it as too time consuming
- Other assessment methods mentioned: projects and debates, round table, continuous monitoring over time, following the evolution, evaluating skills

IoE (UK)

Both groups focused their discussions on the processes of assessment (4.5-4.7) rather than what should be the focus of the assessment.

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The first focus group talked about the importance of assessment that was personalised to the needs of the learner and/or the school. A range of evidence was considered important, as too were a range of perspectives (4.7). For example, subjective responses to classroom observations were seen as an opportunity for dialogue and the co-construction of meaning. One-off assessments were not considered useful, but those that were built up over time and gave a sense of the 'journey'.
Where the focus of assessment was mentioned, it was felt it should be towards the children's learning (4.4). The use of case-study was cited as an example of this. Conducting discussions with the children about their learning was mentioned; the concern was that these were not used to judge how good the teacher was, reflecting perhaps the current 'performativity' climate in schools.
The second focus group spent time going into more depth about how teachers identify their own progress and areas for development (4.5). Participants emphasised the difficulties of authentic reflection; they acknowledged that it was an uncomfortable process and one that was often resisted. However, the potential for reflection to transform practice and children's learning was recognised. One participant felt it was the thing that made a biggest difference to her teaching, although she did not understand this until sometime afterwards. Importance was accorded to having someone with whom to discuss progress and time and space to reflect. Writing up reflections was seen as a large part of this process of thinking, perhaps supported by having some sort of dedicated learning journal or 'scrap book'. The importance of working on one learning goal at a time was discussed.

OU (UK)
Both groups talked about the level of engagement and shifts in confidence level as important notions to assess (4.1). Reflection came up as important and useful for identifying own progress and development (4.5). It was suggested that any formal assessment for CPD could 'put teachers off' and one-off CPD programmes were considered difficult to assess whereas modular CPD course was mentioned as providing opportunities for reflection and sharing what has been done differently in-between modules.
Informal chats and 'self-evaluation' were referred to as more valuable than formal assessment, which was otherwise suggested for ITT University-based accredited modules. Talking, photos and videoing were suggested as 'tools' for documenting and assessing children's learning, as the participants were aware of potential barriers to children's learning that assessment may cause.

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3.6. Materials and resources

Materials and resources	AUC	EA	INFLPR*	IOE	OU	# institutes
With what are teachers learning?						
Teacher education should:						
6.1 Provide ICT infrastructure and logistical support to teachers to access diverse learning materials and resources, which may include web-based resources, social media, videogames, online academic journals and databases, as well as other digital technologies, such as cameras, tablets, and other digital devices.	X	X	X	X	X	5
6.2 Facilitate and promote access to a variety of early years science and mathematics curriculum materials and resources fostering inquiry and creativity. These should be both for indoor and outdoor use and include everyday materials, picture and story books, building blocks, equipment for hands-on exploration.	X	X	X	X	X	5
6.3 Facilitate and promote access to materials and resources (including everyday materials) fostering inquiry and creativity in early years science and mathematics.	X	X	X	X	X	5

total importance>80%

Overall conclusion: Materials and resources

It is clear from the table above that members of the different focus groups picked all the aims mentioned in the table above at least once.

The following characteristics of the materials & resources frequently mentioned in different focus groups:

- An abundance of sources & materials should be available which is accessible to all teachers (preferably online)
- The use of everyday resources that are readily accessible

The aims highlighted by all the institutes concerning materials & resources:
Teacher education should:

- 6.1 Provide ICT infrastructure and logistical support to teachers to access diverse learning materials and resources, which may include web-based resources, social media, videogames, online academic journals and databases, as well as other digital technologies, such as cameras, tablets, and other digital devices.
- 6.2 Facilitate and promote access to a variety of early years science and mathematics curriculum materials and resources fostering inquiry and creativity. These should be both for indoor and outdoor use and include everyday materials, picture and storybooks, building blocks, equipment for hands-on exploration.
- 6.3 Facilitate and promote access to materials and resources (including everyday materials) fostering inquiry and creativity in early years science and mathematics.

Effective/Ineffective examples of practice

Beneath you can find suggested approaches and effective or ineffective examples of practice:

Characteristics of the materials & resources

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- "I have seen it with my trainee teachers that they need **simple materials**, not complicated ones. In the past I have tried to find materials that are hard to find in other examples of teacher education and built lessons around them but the result was not good in the end. That is why simple everyday materials have a lot of potential to promote creativity." (6.3)(EA)

Multimedia & online/digital materials

- **Social media**: can be used as a forum to keep in contact. To exchange materials & post materials. The teacher educator should also be part of the forum. (AUC)
- "Development of projects of TCV type (Virtual Classroom Tour), blogs, the magazine of class, hand-outs, even in electronic format. The use of **educational platforms**, forums, in order to exchange ideas, to evaluate students and to maintaining contact with trainers (6.3)." (INFLPR)
- "I my opinion it is very useful a course which provides an **on-line (educational) platform** where teachers can find theoretical materials, examples of good practice, questionnaires, tutorials; it can help a lot persons involved in distance learning." (6.1) (4x)(INFLPR)
- "Children need to observe, practice and certainly they will learn from their own experience. If funds are not available for equipment, the teacher struggles to find materials or methods that facilitate teaching of concepts. I think that would be welcome some guides or **forums covering examples of good practice** where teachers can find some ideas or examples for their work." (INFLPR)
- "In the school where I teach every classroom is equipped with a computer, a projector, a mobile screen, Internet connection, so you can access information you are interested in, at any time. You are able to pick up info from **useful sites** (www.didactic.ro, for example) and you can post information on you activities in the classroom (6.1 and 6.2)." (INFLPR)
- "It would be ideal if, during the classes, teachers should have access to some **databases** where they can access information they need in order to clarify certain concepts and improve online their knowledge (6.1)." (INFLPR)
- "I attended a training course operating the iTeach platform with Digital Classic subjects; I familiarized myself with **on-line tools** that target specific collaborative work. The course was structured so that tasks can be adapted and solved, according to your needs if you are working with pre-school or high school students." (INFLPR)
- **Video material** with good/bad practices + video of interview with the teachers: you acted in this way? why? (AUC)
- **Movies** with good & achievable practice (AUC)

Hardcopy & concrete materials

- **Demonstration suitcase**: the teachers bring concrete materials with them; they can inspire each other in this way. (AUC)
- Posters, quick sheets; demo-lesson material; conclusions should be bundled; materials to do experiments; interesting books; (AUC)
- "The publication of the **magazine of the primary and pre-school school** from Rugineşti, which includes course auxiliary materials, dedicated papers, example on the use of educational software, PowerPoint materials, media coverage in the local press and on various websites of activities run at class/ school, the school website (6.2)." (INFLPR)

Accessibility & abundance of the materials and resources

- **Access** to sources & materials (2x)(AUC)
- **Abundance** of sources, materials & possibility to fix knowledge; (AUC)
- Providing a lot of materials, even **too much materials**: they need to think about what is valuable material & what not. Teachers should be taught what is good material & what not. (AUC)

Ineffective methods

- "Unfortunately we have **no computer** in the classroom (6.1)." (INFLPR)

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- "There are schools which do **not have a computer lab** equipped accordingly. Some multimedia offices or classrooms are not connected to the Internet (6.1)." (INFLPR)

Results of the focus groups of the individual institutes

AUC (Belgium)
An abundance of sources & materials should be available. Besides this also materials to do experiments & videos with good and achievable practices are needed. This should be available to all the teachers.

EA (Greece)
During the discussion participants focused on the practical issues in Greece that make it difficult to carry out CPD. The ITT approach used in Universities was not criticized as an overall method of teacher education. It is important to motivate participants through materials and locations of training.

INFLPR (Romania)
The online questionnaire clearly pointed out again that there is especially a strong need for CPD. All the above-mentioned aims and objectives where considered to be important. ITT was considered also important, but the need was less pronounced than for CPD.
The content priorities explicitly mentioned during the online questionnaire:
Materials & resources:

- Need for access to a variety of curricular material & resources, everyday material, posters & story books
- Need for a platform where these materials can be accessed
- Need for training to use information technologies & access to ICT infrastructure

IoE (UK)
The importance accessibility was emphasised in both groups - using everyday resources that are readily accessible and having teacher materials available online. Reference was made to the need for varied resources to support differing needs and interests with directions for follow up. Provision of a discussion forum was also mentioned. On a practical level participants suggested that sessions should include practical hands on training with a range of resources including appropriate use of ICT - and that they would appreciate equipment lists, access to video recordings of practice and an equipment loan system.

OU (UK)
The participants supported the use of everyday accessible resources, online materials as well as key readings, visual prompts such as films and hands-on tasks.

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3.7. Grouping

Grouping	AUC	EA	INFLPR*	IOE	OU	# institutes
With whom are teachers learning? How are they allocated to various learning trajectories? Are they learning individually, in small groups, or whole-class?						
Teacher education should:						
7.1 Provide a range of learning trajectories to teachers to choose from according to their needs and preferences.	X		X	X	X	4
7.2 Promote collaborative learning practices, including peer learning, in science and mathematics education in order to foster creativity and inquiry.	X	X	X	X	X	5
7.3 Promote team teaching and working in the fields of science and mathematics education.	X	X	X	X	X	5
7.4 Support teacher collaboration, including at a distance through digital media and other ICT tools that make this possible.	X	X	X	X	X	5
7.5 Provide interaction and interdisciplinary collaboration opportunities amongst student teachers, in-service teachers, science experts, research scientists, teacher educators, children, and educational establishments and organizations.	X	X	X	X	X	5

* total importance>80%

Overall conclusion: grouping

It is clear from the table above that members of the different focus groups picked all the aims mentioned in the table above at least once.

The following characteristics of 'grouping' frequently mentioned in different focus groups:

- Small groups were preferred (6-10 participants) although some suggest that groups up to 20 persons are still feasible
- Mixed groups of primary and early years practitioners and others involved in education are considered to be interesting
- Opportunities for long-term collaboration and reflection were seen as important both face-to-face and online.
- The value of two participating teachers per school is mentioned frequently. It is important 'not being the only one' in the whole school who is willing to experiment with new approaches.
- Teachers feel the need for collaboration & partnerships between teachers

The aims highlighted by all the institutes concerning grouping:
Teacher education should:

- 7.2 Promote collaborative learning practices, including peer learning, in science and mathematics education in order to foster creativity and inquiry.
- 7.3 Promote team teaching and working in the fields of science and mathematics education.
- 7.4 Support teacher collaboration, including at a distance through digital media and other ICT tools that make this possible.
- 7.5 Provide interaction and interdisciplinary collaboration opportunities amongst student teachers, in-service teachers, science experts, research scientists, teacher educators, children, and educational establishments and organizations.

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Effective/Ineffective examples of practice

Beneath you can find suggested approaches and effective or ineffective examples of practice:

Online networks

- An inspiring **learning network** should be formed. (AUC)
- Other teachers mentioned courses that had resulted in **local networks** being established that continued through email contact. (7.4)(IoE)
- "**On-line meetings** and the exchange of best practices using the Internet are extremely useful" (INFLPR)
- "Unlike would-be teachers, the teachers in service have less time available, so I believe that distance learning, especially the **on-line platforms** are more than welcome." (INFLPR)
- "An example of good practice can be the creation of **on-line learning** journals, of blogs, etc. (7.4)." (INFLPR)
- "An example of (7.4) is the on-line training "the **digital class**" (7.4)." (INFLPR)
- "For example, if a group of teachers from a town are working on a biology experiments, another in another city on physics or chemistry projects, they can share their conclusions and can compare the ups and downs of their activities, and conclusions can posted and discussed on a **platforms** (7.4)." (INFLPR)
- "As a teacher, often I collaborate on projects with colleagues from other parts of the country; we share ideas, experiences, even teaching materials, I encounter news in the field. In this way, I learned about your work and projects (7.4)." (INFLPR)

Structure of the group

- "Trainees should be divided in **2 groups** that tackle different issues and then **exchange experiences** and views. It would offer variety and open up new opportunities for discussion and reflection." (7.1)(EA)
- "Important to have a **varied group of people** (teachers, counsellors, educators) in the groups. It is crucial to get a holistic view and it would provide more opportunities for discovery if you are a participant" (7.5)(EA)
- I think that a **mixed group** is OK, so that they learn each from another (INFLPR)
- "**Differentiated learning** is important as it is used to be applied in contemporary school education, and it should be applied to teachers training, too. Like the students, teachers have different learning performances. The course should be set in various forms of organization, both individually or in groups, but also with the whole class." (INFLPR)
- **Homogeneous or heterogeneous groups** based on their fore knowledge; **differentiation** between different teachers based on their pre-knowledge. (AUC)
- "Establishing partnerships with **teachers in the country and abroad** using the **platform** of e-twinning. I am the founder of the international project "Let's protected nature" developed in partnership on e-twinning platform together with a teacher from UK. Within this partnership we organized virtual exhibitions, video and photos sessions with pupils, they are posted on the project website, by me and the other partners involved in the project (7.4)." (INFLPR)
- "In the pedagogical high schools teaching, practice takes place in a team. Team members are: a teacher trainer, a lecturer and a coach, a mentor for teacher education." (INFLPR)

Size of the groups

- It is better to do more training sessions with **smaller groups** than one training session with too many people. (AUC)
- Create a save environment e.g. by working in small **groups of 4**. (AUC)
- "Grouping in teams of **4-5 people** to meet face-to-face." (INFLPR)
- "Learning is more effective in the group; probably the ideal size of a group of **6-8 people**." (4x) (INFLPR)
- Small groups; groups of 6 teachers & trainer; **maximum 10 teachers** (AUC)
- "The appropriate size of the group has to be **10 to 15 trainees**." (INFLPR)
- "I believe that the most effective learning occurs with the entire class, **16-20 people**, because participants

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interact easily with the trainer, can debate important issues and all participants are trained." (5x) (INFLPR)

- "I think to be very effective the learning in **small groups** or individually, but there are situations such as conferences, festivals when the group is **larger**, the more positive accumulated experience comes as the group is larger." (INFLPR)

Members of the groups

- **Motivated** people from both pre-primary & primary schools (2x) (AUC)
- A number of teachers talked about how valuable it had been to attend training with **others from their school** in terms of being able to continue the conversations and implement change. (7.2) (IoE)
- Each **school** should be represented by **at least 2 teachers** (for transfer and sharing knowledge & school development) (AUC)
- One teacher shared with us how she felt more motivated to introduce changes in her teaching after having attended a course with **two of her colleagues** (7.2) (OU)
- "a project developed jointly with colleagues." (7.2) (INFLPR)

Ineffective methods & issues

- "Its not part of the Greek culture. **Teachers find it difficult to collaborate**. I have found it difficult as well when I try it with both trainees and experienced teachers. It takes a lot of time and effort to get them going" (7.2 & 7.3) (EA)

Results of the focus groups of the individual institutes

AUC (Belgium)

***Grouping*:** at least 2 motivated teachers from 1 school (for transfer and sharing knowledge). The groups shouldn't be bigger than 6 - 10 teachers

EA (Greece)

During the discussion participants focused on the practical issues in Greece that make it difficult to carry out CPD.

INFLPR (Romania)

The online questionnaire clearly pointed out again that there is especially a strong need for CPD. All the above-mentioned aims and objectives where considered to be important. ITT was considered also important, but the need was less pronounced than for CPD, except for 7.4 & 7.5.

The content priorities explicitly mentioned during the online questionnaire:

- Need for collaboration & partnerships between teachers, both face-to-face and online, where there is a possibility for permanent exchange of best practices

IoE (UK)

Small groups were emphasised alongside the idea of mixed groups of primary and early years practitioners and others involved in education. Opportunities for long-term collaboration and reflection were seen as important both face-to-face and online. The value of two teachers from a school participating was noted (and there were two cases of this in the focus groups and the teachers concerned felt this would be very supportive in taking ideas forward.

OU (UK)

Both focus groups preferred small groups (6 participants) as well as collaborative learning by having at least one more colleague either from the same school or the same Key Stage. The participants particularly emphasized the importance of 'not being the only one' in the whole school that is willing to experiment with new approaches. When prompted whether they would be willing to share with their colleagues from the same school what they have learned or developed during CPD workshops they replied that they would certainly do that but that would

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not be the same as experiencing the CPD programme together and consequently introducing the creative and inquiry-based approach together.

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3.8. Location

Location	AUC	EA	INFLPR*	IOE	OU	# institutes
Where are teachers learning? Are they learning in class, in the library, at home or elsewhere? What are the social/physical characteristics of the learning environment?						
Teacher education should:						
8.1 Take place in a variety of learning environments (formal, non- formal and informal, indoor and outdoor), including e.g. science museums, science research centers, natural habitats, etc., modelling their subsequent use for inquiry and creativity in the classroom.		X	X	X	X	4
8.2 Facilitate access to industries and research centres of science and mathematics to promote collaboration, sharing, visiting, and networking of teachers.			X	X	X	3
8.3 Provide opportunities for place-independent and collaborative learning, i.e. flexibility and variety of teaching locations.	X	X	X	X	X	5

* total importance>80%

Overall conclusion: location

It is clear from the table above that members of the different focus groups picked all the aims mentioned in the table above at least once.
The following characteristics of 'location' mentioned in different focus groups:

- There should be opportunities to practice in their own classrooms.
- Visiting other teachers at other schools is also considered valuable
- Need for opportunities to learn independently of the location

The aims highlighted by all the institutes concerning Location:
Teacher education should:

- 8.3 Provide opportunities for place-independent and collaborative learning, i.e. flexibility and variety of teaching locations

Effective/Ineffective examples of practice

Beneath you can find suggested approaches and effective or ineffective examples of practice:

Variety of locations

- There were no specific examples apart from **including informal learning** in training (Either CPD or ITT), this was a point that all participants agreed on (EA)
- "To be organized in a **variety of learning environments** (5x) (formal, non-formal and informal, indoor and outdoor), including, for example science museums, research institutions, natural environment, etc., in order to be able to use the acquired expertise in applying inquiry and a creativity in the classroom." (INFLPR)
- Outdoor activities (2x) (INFLPR)

Characteristics of the location

- Adults need more **comfort** (i.e., good lighting, comfortable tables, chairs with backs). (INFLPR)
- **Accessible** with public transport; central location (AUC)
- Training at campus **where sources are available**; (AUC)

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At the kindergarten & primary school

- Opportunities to **practice in classrooms** (2x);
- "I recommend training teachers at their school …" (INFLPR)

Results of the focus groups of the individual institutes

AUC (Belgium)
There should be opportunities to practice in classrooms. Besides this a central location for discussions in group is needed.

EA (Greece)
It is important to motivate participants through materials and locations of training. Follow-up to training is crucial.

INFLPR (Romania)
The online questionnaire clearly pointed out again that there is especially a strong need for CPD. All the above-mentioned aims and objectives where considered to be important. ITT was considered also important, but the need was less pronounced than for CPD.
The content priorities explicitly mentioned during the online questionnaire:

- Preference for the school where they teach (if it has the necessary resources)
- Opportunities for learning independent of the location

IoE (UK)
Importance of accessibility - either in a central location or located in school clusters in a specific local area. It is important to use varied locations and illustrating how these might be used with children. Having an online community to facilitate contact between sessions, and the value of opportunities to visit other schools.

OU (UK)
Shorter sessions were preferred to be delivered in settings/schools whereas longer ones (1-day long) were seen as opportunity to 'go outside' provided that 'outside locations' are not too far to travel. Web-based sessions were also considered.

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3.9. Time

Time	AUC	EA	INFLPR*	IOE	OU	# institutes
When are teachers learning? How much time is available for various subject matter domains? How much time can be spent on specific learning tasks?						
Teacher education should:						
9.1 Provide time for teachers to interact with colleagues: e.g. collegial consultation/reflection, teamwork, mind mapping, vision- building.	X	X	?	X	X	4/5
9.2 Allow sufficient time for teachers to explore opportunities for creativity in learning and teaching in early science and mathematics and to gain confidence through the process.	X	X	?	X	X	4/5
9.3 Provide opportunities for time-independent (distance) learning.	X	X	?	X	X	4/5
9.4 Model different approaches to timetabling science and mathematics education, encouraging interdisciplinary and project work.		X	?			1/2

* No results available

Overall conclusion: time

It is clear from the table above that members of the different focus groups picked all the aims mentioned in the table above at least once.

The following characteristics of 'time' frequently mentioned in different focus groups:

- Importance of a sequence of training (not just one session) with on-going opportunities for review and further input
- A preference for training in school time where possible but also after school sessions to make the training accessible for those not able to be released in school time

The aims highlighted by all the institutes concerning materials & resources:

Teacher education should:

- 9.1 Provide time for teachers to interact with colleagues: e.g. collegial consultation/reflection, teamwork, mind mapping, vision- building.
- 9.2 Allow sufficient time for teachers to explore opportunities for creativity in learning and teaching in early science and mathematics and to gain confidence through the process.
- 9.3 Provide opportunities for time-independent (distance) learning.

Effective/Ineffective examples of practice

Beneath you can find suggested approaches and effective or ineffective examples of practice:

Number & length of sessions or courses

- "I would like to attend **at least 4 courses per year**; a training session lasting between 3 and 7 days. Each day a specific subject might be taught." (INFLPR)
- "I think **1-2 courses per year** are sufficient to stimulate the interest and to guide the teaching process. Such a session can last a semester to make possible to evaluate the practical aspects of a teacher's classroom activity." (INFLPR)
- "**One course per semester**, each of **40 hours**, 24 hours to meet face-to-face (in two weekends, not close to religious holidays when people have other concerns) and the rest for individual study or for topics debated on a forum." (INFLPR)
- "The time allocated to certain topics should be proportional to its complexity. In a school year, I think it would be ideal, especially for CPD, to have **2-3 sessions, of at least three days each**. **A training session per semester** I think is enough." (INFLPR)

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- "I believe that each teacher has to attend **no more than 2 courses per year**. It should be prohibited the practice of some teachers who "hunt" courses, attending several courses at once. For studying a particular topic it is needed to allocate at least 8 hours. A training session should last at least a week." (INFLPR)
- "I enjoy courses there containing **1-2 meetings** "face to face", **followed by practical activities** and **posting the results on-line**. Time is money ... In addition to attending course, besides the teaching duties, we have to "play" other roles in society. If a course takes too long, there are "holes" in other activities (i.e. family, health, preparation for school)." (INFLPR)
- "Time must **not** be **too long or too short**. I remember trainings that were just one-off and did not allow to follow up on issues that were mentioned and others that they were too tiring to stay with them due to the length and commitment they required" (EA)
- It is better to organise **special moments**: nocturne or during lunch: this takes less time, but can be more powerful. (AUC)
- "I prefer **short sessions** (1-2 days) alternated with practical sessions. The time allocated to sessions depends on the subject - whether it is wider or narrower. I think that it be adjusted according to individual needs, experience and interest." (INFLPR)
- "4-5 hours daily during the course, so I think it is enough to keep the attention of the participants and do not become boring or less pleasant." (INFLPR)
- Not just one day; there is a **need for several half days** (2x); (AUC)
- **It depends on each situation**. I do not think it is good to have a minimum or maximum number of courses / year. Every teacher has to be able to make an analysis of his/ her needs and to choose courses according to these requirements." (INFLPR)
- "The time spent dealing with different subjects should be determined **according to the subject matter**, the complexity, the need for practical applications. I think that it is enough to have **two trainings per year**. A training session (understood as a daily activity) to last up to **6 hours**." (INFLPR)

Continuation of the training

- There is a need for **networking** & sharing experiences (3x); (AUC)

Ineffective examples

- Sometimes trainings take too long (e.g. due to a lengthy welcome). (AUC)

Results of the focus groups of the individual institutes

AUC (Belgium)

There is a need for several workshops on different days and a need for networking & sharing experiences.

EA (Greece)

Not during school year, difficult to find teachers in Greece willing. Mentor/coaches need to be officially established by the Greek ministry.

INFLPR (Romania)

No information available

IoE (UK)

Important dimensions across the groups included: the need for school support and investment, importance of a sequence of training with on-going opportunities for review and further input, need for training in school time where possible but also provision for twilight sessions to make the training widely accessible for those not able to be released in school time.

OU (UK)

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Both after and in school time were suggested although majority of participants claimed that would depend on whether their schools could provide cover supply. The preferred format included sessions 'spaced out in time' regardless of their length that ranged from short sessions to 1-day long ones.

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4. Overall conclusion of the focus groups

Although there exist some large differences in the educational system in the different countries, it was still possible to derive training needs, which apply to all the partners. Some partners reported a stronger need for CPD training sessions than for ITT.

4.1. Aims & objectives:

The training modules should focus on two important aims and objectives: 1) teacher confidence is of uttermost importance together with 2) subject knowledge, pedagogical content knowledge and the synergies between IBSE and creative approaches. What is the cause and what is the effect is subject for debate and might influence the structure of the training sessions.

4.2. Content of the training course

The content suggested by most partners during the focus groups was: the importance of asking questions (for both the teachers and the children), the synergies between inquiry and creativity, the importance for game and play, and the need of opportunities for informal learning.

4.3. Learning activities

All the focus groups mentioned the importance of sharing experiences with other teachers and having in-depth discussions and reflection after their experiences in the classroom. Besides this, observing other teachers in their classroom was considered to be a valuable way of learning.

4.4. The role of the facilitator

The role of the facilitator is diverse and demanding. The following characteristics of the teacher trainers were mentioned:

- He/she should be able to stimulate reflection and have good communication skills
- He/she should stimulate the confidence of the teacher and should be able to build a relationship of trust
- The facilitator has different roles as motivator, leader, …
- He/she should display enthusiasm, should motivate and give guidance

4.5. Assessment

The following characteristics of assessment were mentioned in different focus groups:

- (Self)-reflection is considered to be one of the most effective assessment methods for teachers.
- The use of formative assessment is widely supported
- It is important that assessment is personalised to the needs of the learner and/or the school.
- The opinion about the use of a portfolio differ between focus groups: some or in favour, others are against it (time-consuming)
- Assessment of process and progress is considered to be most relevant;

4.6. Practical organization: location, time, grouping and materials and resources

During the focus groups different aspects of the practical organization were discussed. Below you can find the main results:
The following characteristics of **'location'** mentioned in different focus groups: opportunities to practice in their own classrooms; visiting other teachers at other schools; opportunities to learn independently of the location.
The following characteristics of **'time'** frequently mentioned in different focus groups: a sequence of training with on-going opportunities for review and further input; training in school time but also after school sessions.
The following characteristics of **'grouping'** frequently mentioned in different focus groups: Small groups were preferred (6-10 participants) although some suggest that groups up to 20 persons are still feasible; mixed groups of primary and early years practitioners and others involved in education; opportunities for long-term collaboration and reflection; two participating teachers per school.

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The following characteristics of the **'materials & resources'** frequently mentioned in different focus groups: an abundance of sources & materials (preferably online) & the use of everyday resources that are readily accessible.

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Appendix A: Focus group methodology annexes

The script for running a face-to-face focus group has been distributed to CEYS partners in December 2014 (Task O1-A1). The AUC team has developed the instrument.

Legend of symbols per phase:

Title of phase		
Timing	Research aim	Materials needed
Projection or notes on flip chart	Important reminder for (assistant) moderator	

SCRIPT

1. Welcoming		
10’	/	Name cards; Annex 2: informed consent
	Registration of data collection. Informed consent.	

Aim

The first few moments in a focus group discussion are critical. In a brief time the moderator must create a thoughtful, permissive atmosphere, provide ground rules, and set the tone of the discussion. Much of the success of group interviewing can be attributed to the development of this open environment.

Role of the moderator

Make a smooth & snappy introduction. The introduction by the moderator includes:
(1) Welcome
(2) Overview of the topic
(3) Ground rules
(4) Participants introduce themselves.

Here is an example:
(1) Welcome

‘Good afternoon everyone and welcome to this focus group! Thanks for taking the time to join us for this focus group. My name is … and assisting me is …. We're employees of the University of ….

(2) Overview of the topic

For our Erasmus+ project CEYS (Creativity in Early Years Science education) a training framework will be developed, tested, implemented and disseminated. The goal of the training framework is to provide teacher trainers with materials to train preschool and first years primary teachers (teaching children aged 3 to 8 years old) in such a way that these teachers can use creativity and inquiry in science activities in school. This focus group is the first step in this process. During this meeting we would like to get to know your views on the training needs of the teachers. We would like to know your ideas about how, where and when these training sessions/workshops should be organized and what they should be about. We are having discussions like this with two groups in this country and several groups around Europe.

You were invited because you are pre-service or in-service teachers, teacher educators or have in some way experience with organizing or attending training courses for teachers.

(3) Ground rules

There are **no wrong answers** but rather differing points of view. Please feel free to share your point of view even if it differs from what others say. Keep in mind that we're just as interested in negative comments as positive comments, and at times the negative comments are the most helpful. Since, we **have limited time** for a delimited number of questions, **time for responding can be restricted**.

You've probably noticed the **microphone**. We would like to tape the session because we don't want to miss any of your comments. People often say very helpful things in these discussions and we can't write fast enough to get them all down. Is it OK for you if we tape this session?

We will be on a first name basis, and we won't use any names in our reports. You may be assured of complete **confidentiality**. The reports will be used only for the Erasmus CEYS project to help us plan future workshops.

(4) Participants introduce themselves.

Well, let's begin. We've placed name cards on the table in front of you to help us remember each other's names. Let's find out some more about each other by going around the table. Please tell us your name and occupation/role.

Organisation

The tables are setup in a circle. The participants are sitting. Each participant introduces him-/herself.

Questioning

Permission for audio recording of your input? Teacher educator in the field of ...?/Teacher of .. year olds at .... Name and institution you are working for?

2. Activate prior knowledge about creativity in early years science		
10’	1	
ppt	Probe for prior knowledge about creativity in early year science	

Aim

The aim of this phase is two-fold:

- Activate prior knowledge of the participants (reading the CLS executive summary should have activated prior knowledge too);
- Reveal participants' ideas about creativity and inquiry-based approaches in the teaching of science to young children.

Role of the moderator

Ask the introductory question: What do you think are important features of creativity and inquiry-based approaches in the teaching of science to young children, according to you? Point out to the participants; this is an introductory question that we will answer by a short ‘wave’ around the group. A ‘wave’ is a short answer round about the central topic of the focus group. Probe for ideas, do not correct ideas you do not agree with. Participants can react briefly to each other.

Organisation

Participants comment freely on the question. Every participant gives a short answer. It is not the aim to discuss the topic.

Questioning

What do you think are important features of creativity and inquiry-based approaches in the teaching of science to

young children, according to you?

3. Aims and objectives of the training course		
15’	1	Annex 3: List with aims and objectives
ppt	Prioritize the content items	

Role of the moderator

Point out that the main question of the focus group is: “What should be the main aims and objectives of the training course? What competences and skills do you think teachers would need to be trained in in order to effectively use creativity and inquiry-based approaches in the teaching of science to young children (3-8yr)?” The main objectives of this focus group will be to point out the priority needs of the teachers and share known concrete ways to handle these needs. Point out that this key question will be answered step by step by the use of the spider web model (possible use of ppt or prints). The spider web is introduced (perhaps even earlier) so that the participants know the overall structure/big picture of the whole process of questioning. Prints of the spider web could be made available on the table.

Explain that during the CLS project already a lot of work has been done to answer the questions in the spider web. These results will be used throughout the focus group. If participants feel that certain aspects are missing, they are invited to share this valuable information with us.

The first topic of the spider web: **aims and objectives**. Provide the list of aims and objectives defined during the CLS-project (see annex 3).
Ask the question: “Seeing this list, what should be, according to you, the main aims and objectives of the training course? Where do you feel there is a training need for in-service and pre-service teachers?” Asking for good practices in this phase, will probably lead to other aspects of the spider web. You can decide to let the discussion evolve naturally in this direction and let them discuss other aspects of the spider web here because time wise it will be tight to manage to discuss all the elements of the spider web. On the other hand you can choose returning to the main items discussed here at the end of the focus group (see * phase 9 in the script))

Organisation

Participants comment freely on the question.

Questioning

Seeing this list, what should be the main aims and objectives of the training course? What competences and skills do you think teachers would need to be trained in in order to effectively use creativity and inquiry-based approaches in the teaching of science to young children (3-8yr)?

4. Set content priorities of the curriculum of the workshops		
25’	1, 5, 6	Annex 4: list with selected content items; 3 writable stickers with different colours (e.g. red, orange, green); a pen; flip chart with numbered items
	Prioritize the content items	

Role of the moderator

In this phase the content of the training courses will be discussed. Point out that a list of content items was already developed and will be used to prioritize the content of the training course. Explain that the CEYS project

partners already made a first selection of the prime needs, but that we need the input of the participants to make a priority list.

Hand out the list with the selected items (annex 4). Ask the participants to read the list and write down the answer to the last question (Are some content items missing according to you? What is missing?). Ask for input. Let participants react. Aim for information-exchange and co-construction of knowledge on given content items.

Ask the participants to prioritize the list. Let them write the number of the content item on the stickers.

- Red sticker = highest priority
- Orange sticker = high priority
- Green sticker = medium priority

When everybody is ready, let him or her put the sticker next to the number on the flip chart.
Discuss the 5 items with the highest number of red and orange stickers. Ask for situations where they experienced this training need. Ask for good training examples to acquire this content. Are some items more important for ITT or for CPD?

Organisation

Participants receive the list. They read the list and answer the question on the last page. They discuss the last question. Interaction is of importance.

They individually prioritize the list by the use of the sticker method. They discuss the content items with the highest priority. Interaction is of importance.

Question

What should be the content of this training course? Which content of the training course would particularly foster the use of creativity and inquiry-based approaches in the teaching of science to young children (3-8yr)?

5. Learning activities & examples of practice		
20'	2, 3, 4	Post-it pads; marker; Annex 5: list with learning activities
Ppt	Probing for effective/ineffective examples	

Role of the moderator

Provide the participants with the list. Ask the central question of this phase: "According to you, which learning activities during the training course will encourage preschool and first years primary teachers to use creativity and inquiry in science activities in school?" Let them read the list and chose important characteristics. Encourage the participants to think about learning activities that worked for them in the past.

Let them write down these ideas on post-its (1 post-it = 1 idea) during 2 minutes.

Then probe the brainstorm by presenting (e.g. with images in ppt or questions) some ideas (extra 2 minutes of brainstorm). The moderator shows the different images or suggests different options: "According to you, could … be helpful?", "Do you know good examples of …?" In this way, the moderator tries to inspire the participants (If the participants haven't come up with these ideas yet).

- Meta discussion / self reflection
- Films /multimedia

- Interviews
- Examples of effective/ineffective practices

- Job Shadowing
- Homework
- …

Let them present their ideas. Interaction is of importance. Ask for effective/ineffective examples and strength and weaknesses of the examples.

Organisation

Participants write down their ideas on post-its (2x2'). Let them read and exemplify their ideas. Interaction is of importance.

Questioning

According to you, which learning activities during the workshops will encourage preschool and first years primary teachers to use creativity and inquiry in science activities in school?

Could you give an example currently demonstrated in ITT or CPD? Explain the strength/weaknesses of this learning activity. If you do not find a good example, what type of learning activity do you feel is needed?

6. Role of the training course facilitator		
20'	2, 3, 4	Annex 6: List with characteristics of the teacher educator (facilitator of the training course)
	Guidance of moderator is crucial to keep discussion ongoing.	

Role of the moderator

Hand out the list with role of the teacher educator (annex 6). Put forward the next question: What should be the role of the facilitator (trainer/coach) of the training course? Let the participants point out most important characteristics.

Probe by referring to characteristics of the best teacher or workshop facilitator the participants remember. What was his/her role? What were his/her characteristics that he/she triggered a true and lasting learning experience?

Organisation

Participants talk about the characteristics of their teacher/trainer/coach. Interaction is of importance. Max. 2 minutes talk per participant on the question.

Questioning

What should be the role of the facilitator (trainer/coach) of the training course? What are the characteristics and what is the role of a facilitator that triggers a true and lasting learning experience? Give concrete examples. Are different characteristics required for ITT or for CPD?

7. Assessment		
15’	2, 3, 4	Annex 7: List with process items of assessment
	Guidance of moderator is crucial to keep discussion ongoing.	

Role of the moderator

Hand out the list (annex 7) and ask the next question: ”What could be the added value of assessment of these workshops in order to be in line with the training needs of the teachers. How should these assessments be organised?” (The added value for the project should not be discussed. Only the added value for the teachers is of importance). Examples of effective/ineffective practices are requested from participants.

Possible probes: formative assessment, portfolio, plenary group discussions, …

Organisation

Participants share ideas about possible ways to organise assessment.

Questioning

What could be the added value of assessment of this training course in order to be in line with the training needs of the teachers? How should these assessments be organised? Should assessment be different in ITT or in CPD? If so, how is it different?

8. Practical organization of the trainings		
20’	1, 2, 3, 4	Annex 8: list with items concerning time, location, materials and resources and grouping & A4 with the 4 remaining aspects of the spider web
	Guidance of moderator is crucial to keep discussion ongoing.	

Role of the moderator

Hand out the list with the items concerning time, location, materials and resources and grouping. How should this training course be organised practically? Think about location (where), time (when, how long, frequency), grouping (group size, mixed groups) and materials and resources (ICT, experimenting materials, booklets, …)

Ask for practical examples and good practices.

Organisation

Participants read the list and write down individually their ideas about these 4 topics. Participants share ideas. They exemplify their ideas.

Questioning

What are the needs of the teachers concerning the practical organisation of these workshops? Differences for ITT or for CPD?

- Grouping: Should there be various learning trajectories (e.g. differentiation)? Are teachers learning individually, in small groups, or whole-class? What is the ideal size of the group? What about the added value of larger learning communities?

- Location: Should teachers be learning in their own school, at the University (College), at home, or elsewhere? What are the social/physical characteristics of the learning environment?
- Time: How much time is available for various subjects? How much time can be spent on specific learning tasks? What should be the frequency of the training courses (how many/year; how many in total)? How long should one session take?
- Materials and resources: What could be the added value of ICT/media/forums? Is there a need for specific materials (e.g. for experimenting, course material, …)

9. Group conclusions		
15’	1, 6	Certificate of participation in the EC-funded research project Creativity in Early Years Science Education
	Formulate conclusions	

Role of the moderator

Moderator asks assistant moderator to summarize the previous discussion. Let participants react to this summary.

Review the purpose of the focus group and ask if anything has been missed (f.i. link with national curriculum?). Is there anything you came wanting to say that you didn’t get the chance to say?

What would your main advice be to the organizer of the training workshops? What are the priorities according to you?

Thank the participants for their valuable contributions and hand over a certificate of participation in the EC-funded research project Creativity in Early Years Science Education (see annex).

Role of the assistant moderator

Assistant moderator summarizes previous discussions.

Organisation

Participants co-construct conclusions. Participants help by adding, reformulating, … issues.

Questioning

*Do you feel we covered everything to reach the aims and objectives discussed at the start of this focus group? What would your advice be to the organizer of the training workshops? What are the priorities according to you? Is there anything we missed? Is there anything you came wanting to say that you didn’t get the chance to say? THANK YOU!!

ANNEXES

Dear …,

We believe you have valuable expertise in early science education in country and consequently, we would like to invite you to participate in a focus group. More particularly this focus group is part of the Creativity in Early Years Science project and aims to draw upon the expertise of experts in early years teaching, initial teacher education or continuous professional development. In the focus group the training requirements for early years teachers in order to foster creativity in their science education practices will be discussed.

The **Creativity in Early Years Science** (CEYS) project is a European Erasmus+ project that aims at the development of a teacher development course and accompanying materials to be used in European professional development to promote the use of creative approaches in teaching science in preschool and early primary education (up to age of eight). The goal is to disseminate the main outcomes of the Creative Little Scientists project (www.creative-little-scientists.eu), to propose concrete training materials that can be used in teacher education for early years and primary teachers. The project brings together academics and researchers from 4 European countries (Greece, Romania, Belgium and the UK) and comprises expertise of the highest level and quality in the areas of science and mathematics education in early childhood, creativity in education, cognitive psychology, comparative educational studies, and teacher training.

One of the first objectives of the project is to define the **training needs for teacher training** in the areas of early years science and creativity education, which have been recognized in the Curriculum Design Principles of the Creative Little Scientists project.

As a part of the research, we wish to discuss the training needs using a focus group in the different partner countries. The design principles for teacher education, developed in het Creative Little scientists project, will be used as guidance. Hence our letter to you, where we feel your knowledge and experience would be very valuable.

Each **focus group** will compose of teacher educators, childhood educators and policy makers. The focus groups will take place in January, and will last about two and a half hours.

As mentioned above, we would like to invite you to engage in the focus group for *the country/Community*. We think your expertise and opinions will be of enormous value in the refinement of the training requirements to use creativity in the teaching of science to young children for the Creativity in Early Years Science project.

As a small token of our appreciation, all participants will receive:

- A certificate of participation in the EC-funded research project *Creativity in Early Years Science Education.*
- All educational and scientific material generated by the project in English.

Thank you very much,

…… (Name of a partner member/country)

Members of the *Creativity in Early Years Science* consortium

e-mail

Informed Consent

Personal data provided by participants will only be used for research purposes and are protected according to the EC directive 95/46/EC. All data gathered during the project will be stored in a secure location accessible only to the researchers. In reports of the research no real names or information will be included that can identify comments of particular participants.
If you are willing to be involved, please could you sign the consent form attached and return it to Name and e-mail
If you require any further information about the focus groups or the project, please contact Name and e-mail

Creativity in Early Years Science

Focus Groups: Training requirements for teachers to foster creativity in early years science education

When you are willing to participate in this research project, we kindly ask you to fill in following form.

I **am/am not willing** to participate in the focus groups **(Delete as appropriate)** and I agree that this focus group will be audio recorded.	
Name	
Organisation	
Contact details	
Signed	
Date	

Aims and Objectives: Towards which goals are teachers learning?

Competences for teachers.

In teacher education teachers should:
1.1 Acquire secure content knowledge of science and mathematics ideas and processes, as well as the skills and competences to carry out inquiries.

1.2 Acquire the pedagogical content knowledge to foster inquiry and creativity in early years science and mathematics, including the use of inquiry approaches.

1.3 Become confident and develop positive attitudes towards learning and teaching science, mathematics using inquiry and creativity based approaches.

1.4 Acquire the skills to act as researchers and reflective practitioners in learning and teaching science and mathematics, and should become able to discern and reflect on innovative ideas.

1.5 Acquire the knowledge and skills to support the diverse interests and needs of young children in engaging creatively within the fields of science and mathematics.

Foci of teacher education.

Teacher education should:
1.6 Emphasise the importance of science and mathematics education for personal and society development by advocating its role in the preparation of scientific and mathematic literate citizens as well as the role of creativity in these domains and in human development.

1.7 Emphasise the pedagogical synergies between IBSE and creative approaches in both science and mathematics learning and teaching.

1.8 Foster teacher learning outcomes aligned with creative science and mathematics teaching strategies and assessment methods.

1.9 Foster teachers' creativity and their potential to be creative in science and mathematics.

What should be the content of the training courses? What are teachers learning?
3 The training courses should advance teachers' understandings about the nature of science and how scientists work, confronting stereotypical images of science and scientists.
3.1 Teachers should be able to advance children's understanding 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
4 The training courses should promote understandings about the nature and framings of creativity, characteristics of creative teaching and learning, and how creativity is manifest in early years science and mathematics.
4.1 Teachers should be able to recognize how creativity is manifest in early years science and mathematics and have knowledge of distinctions between features of creative teaching and creative learning.
5 The training courses should provide knowledge about how children's creativity development could be enhanced and assessed within science and mathematics education.
5.1 Teachers should have detailed knowledge about the synergies between inquiry and creativity, such as play and exploration, motivation and affect, dialogue and collaboration, problem solving and agency, questioning and curiosity, reflection and reasoning; and teacher scaffolding and involvement, to support children's creative learning and advance their creativity within science and mathematics education
6 The training courses should provide pedagogical content knowledge to stimulate inquiry and problem solving in science and mathematics education.
6.1 Teachers should have knowledge of all essential features of inquiry and problem solving (questioning, designing or planning investigations, gathering evidence, making connections, explaining evidence, communicating and reflecting on explanations), their different purposes, degrees of structure and guidance (including open, guided and structured inquiries), and varied opportunities they offer for creativity.
6.2 Teachers should be able to open up everyday learning activities to allow greater opportunities for inquiry, problem solving and scope for creativity.
6.3 Teachers should be able to recognise the key roles of children's questioning and existing ideas (both implicit and explicit) of science and mathematics.
6.4 Teachers should be able to use a variety of strategies for eliciting and building on children's questions and ideas during inquiry processes (before, during and after explorations and investigations).
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 The training courses 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.
7.1 Teachers should have knowledge of a range of formal, non- formal and informal learning, teaching and assessment approaches and strategies to promote creativity in their early years science and mathematics classroom.
7.2 Teacher should be able to use a range of strategies both formal and informal for supporting children's extended engagement with an area of study and progression in learning in science and mathematics.
7.3 Teachers should be able to recognize and exploit the value of play and exploration in science and mathematics for fostering and extending inquiry and creativity, by for example prompting questions, eliciting ideas, providing opportunities for consideration of alternative strategies during children's familiarisation with phenomena and events.
7.4 Teacher should be able both to build in new and to make the most of existing opportunities for child-initiated play, recognising and capitalising on the potential of children's explorations beyond the teacher's original intentions.
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 and games.
7.6 Teachers should be able to use strategies for making and building on science and mathematics real life connections and applications for engaging creatively young children in science and mathematics learning.
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.
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.
7.10 Teachers should value and be able to make use of varied forms of assessment evidence (including children's portfolios, individual or group records of activities), both to promote creative learning, through reflection and discussion in science and mathematics, and explicitly to inform teaching and longer term planning.

9 The training courses should enable teachers to make best use of and assess the various modes of expression and representation of science and mathematics learning to support inquiry and the development of creativity.
9.1 Teachers should be able to recognize and value children's various forms of expression and representation of their ideas and learning in science and mathematics.
9.2 Teachers should be able to make best use of children's preferred forms of expression and representation of their science and mathematics ideas to support inquiry and their creativity development.
9.3 Teachers should be able to select and use different approaches for and forms of recording children's ideas and learning in science and mathematics at different stages of the learning process and for various purposes, including to support children's reflection and reasoning processes.
9.4 Teachers should be able to use the various modes of children's expression and representation of science and mathematics ideas (e.g. pictures, graphs, gestures, physical activities) for assessment purposes.
10 The training courses should enable teachers to recognize and build on children's ideas, theories and interests for the teaching of science and mathematics.
10.1Teachers should be able to use a range of strategies for picking up on children's ideas, theories and interests.
10.2 Teachers should be able to build flexibility into planning to take advantage of unexpected events, children's interests and questions.
11 The training courses 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.
14 The training courses 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.
14.2 Teachers should be able to recognise and build on opportunities for informal learning in science and mathematics within the school environment, for example within day to day routines or child-initiated games and other activities in school classrooms or outdoor play areas.
14.3 Teachers should be able to elicit and build on children's informal learning of science and mathematics outside school, at home or in the wider environment.

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.

15 The training courses should promote teachers' use of group work to support children's inquiry processes and creative learning.
15.1 Teachers should have knowledge of the value of collaboration for inquiry and creative thinking and learning.
15.2 Teachers should be able to purposefully use a variety of patterns of collaboration, shifting between individual and collaborative activity over time, to support children's inquiry processes and creative learning.
15.3 Teachers should be able to organize group work, aligning ways of grouping children, task design, teaching and assessment strategies in different ways to promote collaboration amongst children in science and mathematics.
15.4 Teachers should be able to use resources and teacher intervention appropriately to foster collaboration in science and mathematics.
15.5 Teachers should be able to assess group work.
15.6 Teachers should be able to use effective strategies for sharing ideas and discussions from different groups.

Are some content items missing according to you? What is missing?

……..

……..

……..

……..

Learning activities: How are teachers learning?

Teacher education should provide learning activities in science and mathematics which:

3.1 Are inquiry-based, addressing all essential features of inquiry (questioning, designing or planning investigations, gathering evidence, making connections, explaining evidence, communicating and reflecting on explanations), and their various purposes and degrees of structure and guidance (including open, guided and structured inquiries).

3.2 Bring out the synergies between inquiry-based science and mathematics and approaches directed at developing learner creativity.

3.3 Are interactive, within a rich, motivating context, and should encompass a range of formal and informal learning approaches and strategies. Examples of such activities include lesson planning, discussions focused on fostering creativity; demonstrations of good practice; outdoor learning; field trips; project work.

3.4 Integrate science and mathematics learning, making use of real life, meaningful and interactive contexts, and illustrating the potential of such interdisciplinary approaches for inquiry and creativity.

3.5 Provide teachers with opportunities to recognize and better understand both young children's learning of science and mathematics and the role of creativity within this, through for example classroom observations, collection and analysis of evidence, talking to children.

3.6 Attend to teachers' different approaches to their own learning and encourage their expression and representation of scientific and mathematics ideas in various modes.

3.7 Help teachers reflect on their own prior knowledge, (mis)conceptions (incl. stereotypical images) beliefs and attitudes about science, mathematics and creativity, using a variety of approaches, such as microteaching, peer-observations, learning journals.

3.8 Support teachers' learning, by providing them with illustrative examples of diverse practices for them to critically examine opportunities for creativity and inquiry in learning, teaching and assessment.

3.9 Are a variety of individual and collaborative to promote teachers' creative thinking skills and dispositions

How is the teacher educator facilitating learning?

Teacher educator role

Teacher educators should:

2.6 Take into consideration teachers' prior knowledge, skills, attitudes, beliefs, fears, preconceptions (incl. stereotypical images), learning styles and experiences associated with learning and teaching science, mathematics, and creativity, and organize appropriate learning activities.

2.7 Make explicit connections among content knowledge, pedagogical content knowledge and teaching practice of science and mathematics, as well as between these and the development of creativity.

2.8 Practically demonstrate a variety of roles in their interactions with teachers e.g. facilitator, supporter, coordinator, leader, motivator, role model.

2.9 Model inquiry- and creativity-based learning, teaching and assessment practices, by for example encouraging teachers' decision making during inquiry processes, and sharing, evaluating and reflecting on outcomes.

2.10 Model how teachers should select science and mathematics materials and resources for fostering creativity in mathematics and science.

How to measure how far teachers' learning has progressed? How is assessment information used to inform planning and develop practice?

Focus of assessment
In teacher education:

4.1 Teachers' acquisition and development of science/mathematics content and pedagogical content knowledge, skills and attitudes should be assessed.

4.2 The development of teachers' inquiry and creativity-based teaching and assessment approaches should be assessed.

4.3 Teachers' acquisition and development of understanding about what it is to foster children's creativity in science and mathematics should be assessed.

4.4 The development of teachers' abilities to plan for, foster, reflect upon and assess children's creativity in science and mathematics education should be assessed.

Process of assessment
Teacher education should:

4.5 Promote teachers' independence and responsibility in identifying their own progress and areas for development both in the fields of science and mathematics education and in the fostering of creativity within these fields.

4.6 Use different assessment strategies in order to assess holistically cognitive, social and affective aspects of science and mathematics learning, as well as tap into the potential for peer and self-assessment.

4.7 Use different forms of evidence (e.g. portfolios, teacher diary, observation lists, tests, essays, project work, teaching practice) for assessment purposes.

Materials and resources

With what are teachers learning?

Teacher education should:

6.1 Provide ICT infrastructure and logistical support to teachers to access diverse learning materials and resources, which may include web-based resources, social media, videogames, online academic journals and databases, as well as other digital technologies, such as cameras, tablets, and other digital devices.

6.2 Facilitate and promote access to a variety of early years science and mathematics curriculum materials and resources fostering inquiry and creativity. These should be both for indoor and outdoor use and include everyday materials, picture and story books, building blocks, equipment for hands-on exploration.

6.3 Facilitate and promote access to materials and resources (including everyday materials) fostering inquiry and creativity in early years science and mathematics.

Grouping

With whom are teachers learning? How are they allocated to various learning trajectories? Are they learning individually, in small groups, or whole-class?

Teacher education should:

7.1 Provide a range of learning trajectories to teachers to choose from according to their needs and preferences.

7.2 Promote collaborative learning practices, including peer learning, in science and mathematics education in order to foster creativity and inquiry.

7.3 Promote team teaching and working in the fields of science and mathematics education.

7.4 Support teacher collaboration, including at a distance through digital media and other ICT tools that make this possible.

7.5 Provide interaction and interdisciplinary collaboration opportunities amongst student teachers, in-service teachers, science experts, research scientists, teacher educators, children, and educational establishments and organizations.

Location

Where are teachers learning? Are they learning in class, in the library, at home or elsewhere? What are the social/physical characteristics of the learning environment?

Teacher education should:

8.1 Take place in a variety of learning environments (formal, non- formal and informal, indoor and outdoor), including e.g. science museums, science research centers, natural habitats, etc., modelling their subsequent use for inquiry and creativity in the classroom.

8.2 Facilitate access to industries and research centres of science and mathematics to promote collaboration, sharing, visiting, and networking of teachers.

8.3 Provide opportunities for place-independent and collaborative learning, i.e. flexibility and variety of teaching locations.

Time

When are teachers learning? How much time is available for various subject matter domains? How much time can be spent on specific learning tasks?

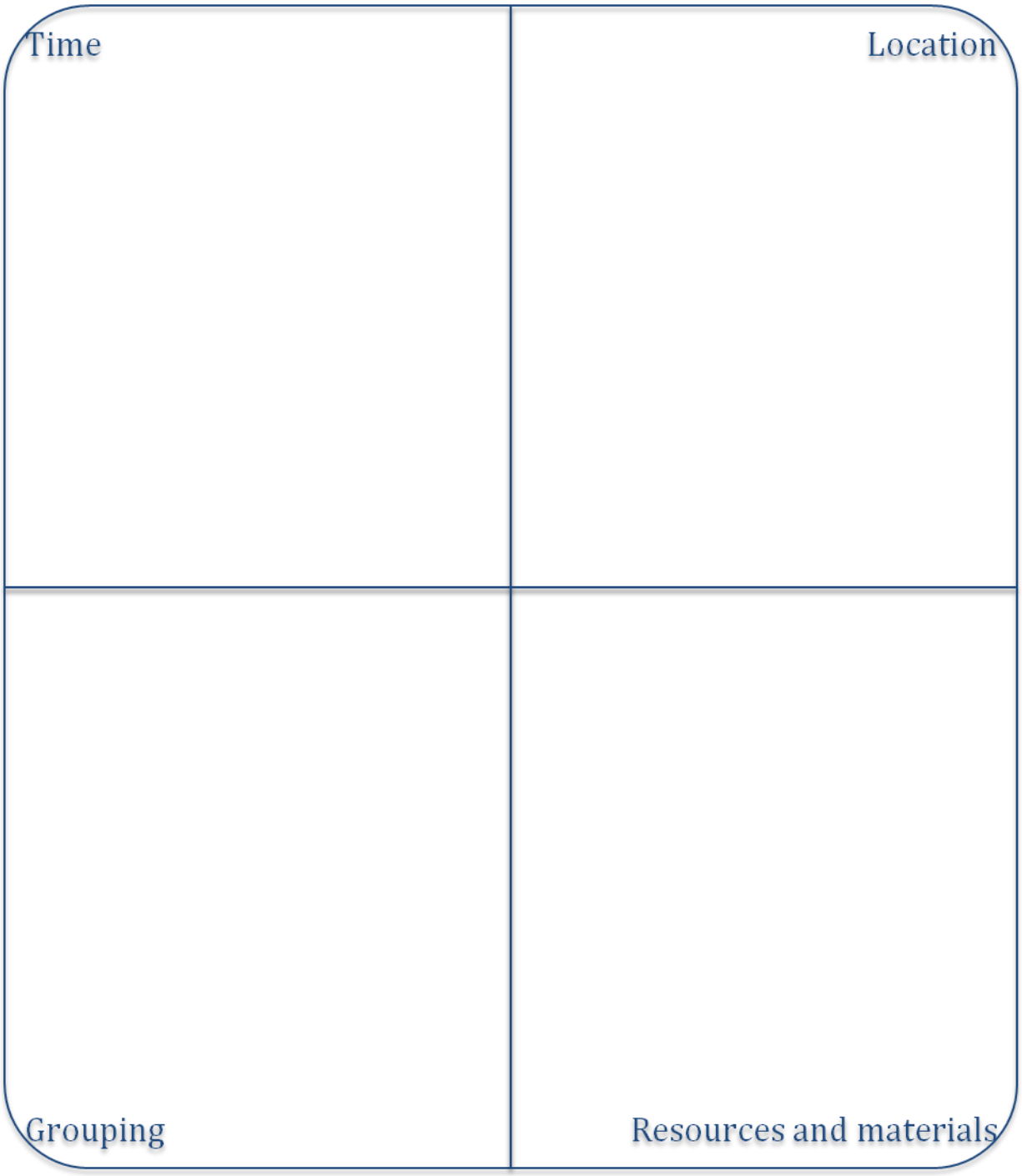
Teacher education should:

9.1 Provide time for teachers to interact with colleagues: e.g. collegial consultation/reflection, teamwork, mind mapping, vision- building.

9.2 Allow sufficient time for teachers to explore opportunities for creativity in learning and teaching in early science and mathematics and to gain confidence through the process.

9.3 Provide opportunities for time-independent (distance) learning.

9.4 Model different approaches to timetabling science and mathematics education, encouraging interdisciplinary and project work.


Time
Location
Grouping
Resources and materials

Creativity in Early Years Science Education

Certificate of participation in the EC-funded research project Creativity in Early Years Science Education

This is to certify that Mr./Mrs. …….. participated in the focus group on training needs of in-service and pre-service teachers to acquire knowledge and competences to use creativity and inquiry-based approaches in early years science education held on ……..

Thank you for your participation in this research focus group and for giving your time, effort, ideas and knowledge.

Name
Institute

Name
Institute

Erasmus+

Project funded by Erasmus+, EU programme for education, training, youth and sport

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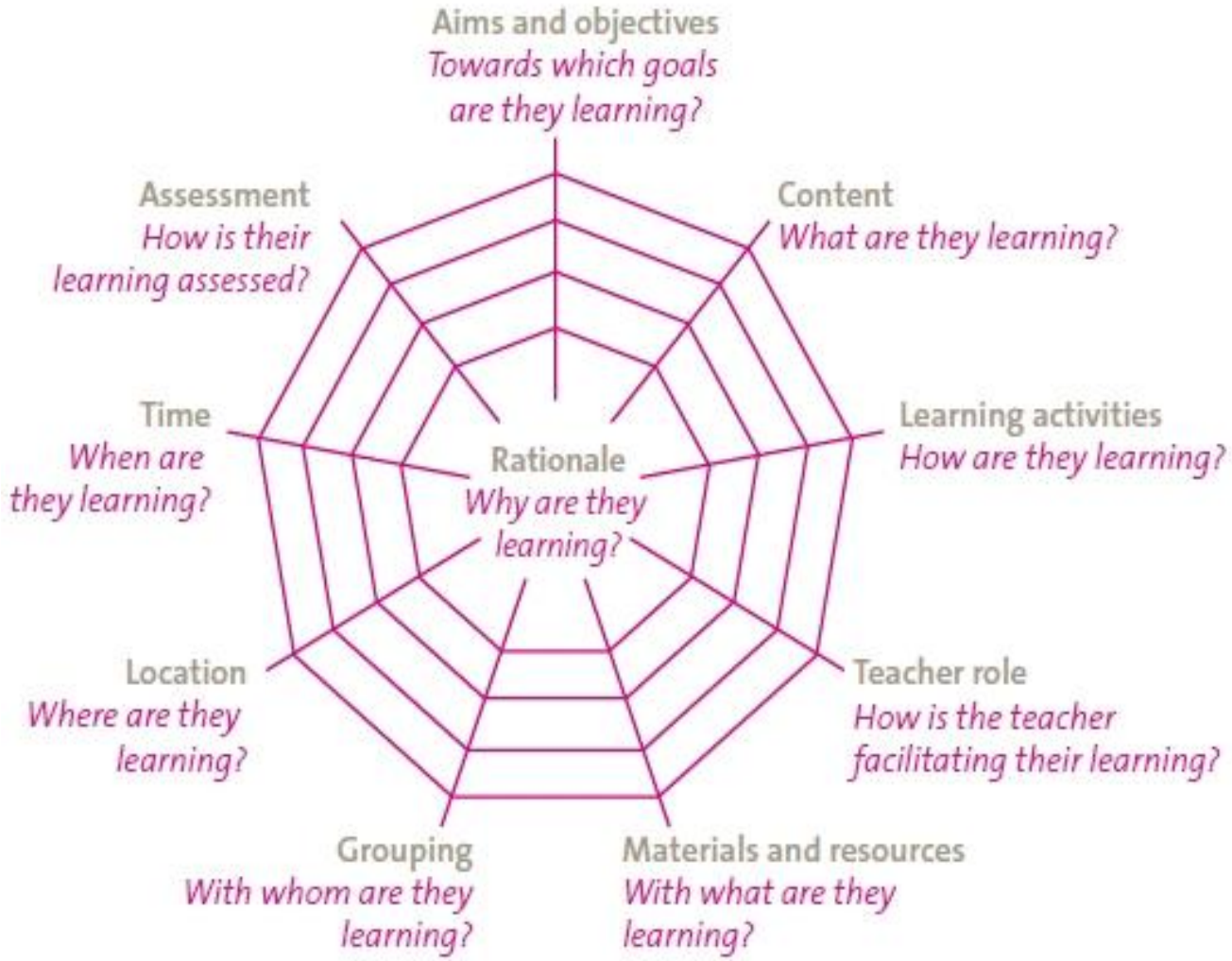
Curricular spider web (van den Akker, 2007)



Addendum to Report O1-A1 CEYS Training Needs Analysis

The Greek national agency inquired about the specific data collection methodology used for the focus group conducted in Romania. The paragraph below offers more background information on why the online methodology was chosen instead of face-to-face focus groups.

In the case of Romania the project consortium changed the data collection procedures for the "Training analysis needs through focus groups" from face to face discussion to an electronic survey after considering the specific benefits that the partner NILPRP – CSET provided to the project, especially the centre's access to a large pool of teachers, teacher trainers and teacher trainer organizations. Gathering data from a variety of stakeholders working in different environments and spread around the country is possible only through electronic means. The Romanian team capability to interact with large number of stakeholders proved to be a real added value to the preceding 'Creative Little Scientists' (CLS) project (see for example the number of teachers that participated in the CLS project survey). The electronic survey has made it possible to access more stakeholders and their opinions, and has strengthened the validity of the focus groups' results. The interaction with as many interested parties as possible throughout the entire CEYS project can be seen as an added value of NILPRP's participation in the project (see also the number of the Romanian Teachers involved in different CEYS activities). This adopted policy is considered by the project team as a valuable mean for the dissemination and thus increase of impact of the present project in Romania.

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