CREATIVE LITTLE SCIENTISTS:
Enabling Creativity through Science and Mathematics in Preschool and First Years of Primary Education

D3.3 Report on First Survey of School Practice

www.creative-little-scientists.eu

The project CREATIVE LITTLE SCIENTISTS has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 289081.

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D3.3 Report on First Survey of School Practice

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EXECUTIVE SUMMARY

Introduction

The *Report of First Survey of School Practice* aims at mapping and comparing existing practices to the teaching, learning, and assessment of science and mathematics in the early years and teacher education within and between the nine countries (and 13 educational systems) represented in the *Creative Little Scientists* consortium. The findings of this quantitative study are presented with the intent of revealing the potential for creativity and the role of inquiry in the classroom realities of pre-primary and first years of primary science and mathematics education, and are grounded on concepts and synergies identified in the *Conceptual Framework* (D2.2) and operationalized in the *List of Mapping and Comparison Factors* (D3.1) developed previously in the project.

The corresponding approaches as recorded in policy appear in the *Report on Mapping and Comparing Recorded Practices* (D3.2). Comparisons between policy and reported practice will take place subsequently as part of the *Comparative Report* (D3.4). In addition to informing the latter, this report provides implications for field work in the next stage of the project, as well as development of policy and teacher education by drawing attention to possible areas of focus.

The report addresses the wider research questions identified in the *Conceptual Framework* (D2.2), namely: *How are the teaching, learning and assessment of Science and Mathematics in early years in the partner countries conceptualized by teachers? What approaches are used? What role does creativity play in these?*

These questions were then adapted in this report to focus on comparing teacher practices across partner countries. The following overarching question and sub questions were identified:

- What are the main similarities and differences in how the teaching, learning and assessment of science and mathematics in early years are conceptualised by teachers in the partner countries? What role does creativity play in these?
- What are the main similarities and differences in the approaches used for the teaching, learning and assessment of science and mathematics in the partner countries? What are the opportunities and challenges for skills/attitudes associated with creativity?
- What are the main similarities and differences in early years teachers' knowledge, skills and confidence in the teaching, learning and assessment of science and mathematics in the partner countries? What constitute their relevant experiences in teacher education (ITE and CPD)?
- What are the main similarities and differences between the findings emerging from analysis in relation to questions 1-3 for preschool and early primary school phases respectively?

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These questions were examined by considering the following curriculum components based on those defined by van den Akker (2007) and focusing on key aspects of learning in schools; these have also structured previous work in the *Creative Little Scientists* project.

- Rationale or vision: *Why are children learning?*
- Aims and objectives: *Toward which goals are children learning?*
- Learning activities: *How are children learning?*
- Pedagogy: *How is the teacher facilitating learning?*
- Assessment: *How to measure how far children's learning has progressed, and how is s/he using this information to inform planning and develop practice?*
- Content: *What are children learning?*
- Location: *Where are children learning?*
- Materials and resources: *With what are children learning?*
- Grouping: *With whom are children learning?*
- Time: *When are children learning?*

To these the following dimensions were added, focusing on key aspects of teachers' education and professional qualifications:

- Teacher Personal Characteristics
- Teacher General Education and Training
- Teacher Work Experience
- Teacher Science and Mathematics Knowledge, Skills and Confidence
- Initial Teacher Education
- Continuing Professional Development

Methodology

In order to address the research questions stated above a questionnaire survey was devised and administered online to teachers of preschool and early primary education in the partner countries.

The questionnaire included a short introduction and 44 questions divided into 7 sections. These sections are:

- Background Information – About your School
- Background Information – About You
- Your Knowledge, and Skills and Confidence in Teaching Science and Mathematics
- Your Views about and Approaches in Teaching Science
- Your Views about and Approaches in Assessing Science Learning
- School Science and Mathematics Resources and Your Use of Them
- Thanking You and Further Communication

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The average duration required to complete the questionnaire was 40 minutes. The majority of the questionnaire items – except for the sections requesting factual background information – were four-point Likert-type questions. All items included were chosen to specifically address all curriculum components mentioned above and important themes of the conceptual framework.

Data collection started in mid May 2012 and was planned to last until the end of the school year (summer 2012). The recruitment of respondents proved however more difficult than anticipated. As a result data collection was extended to the first half of November 2012.

The analysis was carried out in two stages. First, partners carried out an analysis of their country's data to produce a National Report discussing the findings and situating them within their country's educational context. The results of this first layer of analysis can be found as addenda to this report (*Addenda to D3.3*). In the second stage, the data gathered from all the partner countries were amalgamated and analysed as a whole. Statistical comparisons were performed to identify similarities and differences between perceived practices in partner countries; information provided in the National Reports was used to interpret these similarities and differences. The findings of this second layer of analysis are presented in this report.

The analysis was conducted using SPSS and Microsoft Excel software, and was based entirely on the total valid sample of respondents from all partner countries, that is all preschool and primary school staff who taught the children age group studied by the *Creative Little Scientists* project (children from the age of 3 and up to the age of 8) during the 2011-12 school year. Additionally, respondents were divided into two sub-samples based on the level of education they teach, i.e. preschool or early primary school. The report is structured to present the findings of the study for the total sample, as well as for both sets of preschool and primary teachers. Moreover, as previously mentioned, the mapping and comparisons factors (D3.1) are used throughout the report to group and present these findings, in a way similar to the policy review report (D3.2), so as to allow for comparisons between policy and reported practice to take place subsequently as part of the *Comparative Report* (D3.4).

Similarities and differences amongst partner countries in relation to their sampled responses to specific questionnaire items and/or factors have been identified as significant (at the 0.05 level) by comparing their means using one-way ANOVA tests. In a similar line, comparisons of the means of responses given by the preschool and early primary school staff both to particular questionnaire items and selected factors were conducted with independent t-tests, revealing interesting and significant (at the 0.01 level) similarities and differences amongst the two sub-samples. Finally, any significant differences between the preschool and primary school teachers' responses to ordinal or nominal variables (e.g. teaching experience, level of education completed, etc.) were identified out using Pearson's chi square tests.

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Final Sample and Limitations

A total of 815 teachers from 605 schools (238 preschools and 367 primary schools) across the consortium countries completed the online questionnaire.

Despite exceeding the minimum number of sampled schools, specified as 500 in the project's Description of Work (DoW), it is important to recognise a series of biases in the sample. First of all, although it was recognised from the outset (i.e. in the DoW) that the national samples are not going to be 'representative' in a formal statistical sense of either the number of schools or teacher population in the partner countries, some countries' or regions' samples were clearly under-represented in relation to the teacher population they correspond to, in particular Germany's, France's, Wallonia's, Wales' and Scotland's, whereas other countries' samples are overrepresented in the total sample, namely Finland's, Greece's and Romania's. Furthermore, the small number of sampled teachers in some partner countries or regions meant that it was not statistically realistic to compare their responses with others' in the rest of the partner countries. Finally, the non-representative character of the samples also means that there should be caution in the interpretation of the similarities and differences amongst countries, which can be only understood in depth in view of the unique characteristics of the different educational systems they refer to. The value of the *National Reports* for this purpose is paramount and this is why these are appended to this report.

Key findings

Key themes are summarised and presented below under the three broad strands running across the project's research questions.

Aims, purpose, priorities

- Children developing important attitudes and dispositions as a foundation for future learning, and becoming socially and environmentally aware and responsible citizens are the most important purposes for teaching science in compulsory education. The purpose which is seen as least important is to provide a foundational education for future scientists and engineers.
- Teachers very often plan their teaching of science in preschool and early primary education to pursue affective outcomes about science, science learning and learning in general. Social outcomes are also commonly pursued, whereas science cognitive outcomes are less so and more frequently by primary teachers.
- Out of the inquiry-related science learning outcomes teachers foster quite or very frequently the development of children's capabilities to carry out scientific inquiry, such as questioning, gathering and communicating findings, though to a lesser degree planning and conducting simple investigations.
- Learning outcomes related to the nature of science and thus understandings about scientific inquiry, that is about how scientists develop knowledge and understanding of

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the surrounding world, are the least frequently pursued by teachers overall, but more in early primary than in preschool education.

- The priorities set by teachers for the assessment of science are in agreement with the learning outcomes they pursue most frequently: affective priorities are considered comparatively as the most important, and cognitive outcomes as the least. Out of the latter the ones focusing on science processes and inquiry competences are thought of overall higher than the ones focusing on science ideas (facts, concepts, laws and theories) and on how science and scientists work.
- There is significant variation amongst partner countries in the importance their sampled teachers attribute to the assessment of science ideas and processes on the one hand, and the assessment of inquiry competences and understandings about the nature of science on the other.

Teaching, learning and assessment

- The inquiry-based science activities which are used most commonly by teachers - and even more by preschool teachers - are predominantly linked to observation, as well as to fostering children's questioning and eliciting their curiosity in natural phenomena. These activities are also strongly considered as enabling creativity development in children.
- Promoting understandings about scientific concepts and developing children's basic science procedural knowledge takes a less dominant place in the learning activities carried out in the classroom. In particular, learning activities that involve children planning and designing their investigations are the least common of all the learning activities tied to scientific inquiry. This is consistent with the findings about teachers' inquiry-related science learning priorities.
- Social activities such as communicating results and explanations based on evidence are also used quite frequently in the classroom. In these, teachers tend to allow children to choose freely and independently how to justify their explanations.
- Teachers however value a more 'guided' approach in respect of all other inquiry-related science activities (i.e. setting questions, identifying and analysing evidence, making connections to scientific knowledge and reflecting on the inquiry process). In these children decide from a pre-selected by the teacher number of choices.
- Teachers consistently and uniformly across the partner countries hold a great appreciation for all pedagogical contexts and approaches that promote dialogue and collaboration in science amongst children. They however fail to see the potential of these approaches for creativity development in children.
- Although also uniformly teachers endorse strongly affective learning outcomes in their teaching of science, the way they perceive the contexts and approaches identified in the research literature as enhancing motivation and affect in children varies significantly.
- There is a large consensus amongst teachers – reflected in their reported practice - that the teaching of science should be building on children's prior experiences and help relate

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science to everyday life. There is however less of a consensus as to whether these practices are enabling the development of creativity in children.

- Using drama and history to teach science are not practices very commonly used by teachers across the partner countries. Nor are they considered very 'creativity enabling' by them.
- Preschool teachers use more frequently than early primary school teachers open/unstructured and role/pretend play in their teaching of science. They also conceptualise them more as creative contexts.
- Similarly, preschool teachers plan more frequently outdoor learning activities for children than early primary school teachers, even though the latter consider them more as 'creativity enabling'.
- The large majority of all teachers promote frequently the physical exploration of materials by children and consider this as a creative practice.
- All problem solving science contexts and approaches are thought of as amongst the most 'creativity enabling' by a large number of teachers, who also report to use them quite or very frequently.
- Teachers tend not to foster children's autonomy in learning very frequently, nor to link this autonomy with creativity.
- There is correspondence between teachers' frequent use of practices that encourage children to ask questions and foster their imagination and teachers' strong view of these practices as 'creativity enabling'. On the other hand, the use of questioning as a teaching tool, although very common, is not similarly appreciated by teachers as promoting creativity.
- Teachers quite or very frequently encourage children to record and express their ideas in different ways, as well as evaluate alternative ideas, but they also fail to see the potential contribution of these practices to the development of children's creativity.
- A number of 'creative' dispositions identified in the research literature on creativity education are frequently praised and rewarded in the science classroom, according to teachers from the partner countries. The most frequently rewarded out of these are children's ability to work together - a finding consistent with previous findings - and children's sense of initiative.
- Interestingly, preschool teachers report to be assessing children's curiosity a little more frequently (but significantly in statistical terms) than early primary school teachers.
- Overall, teachers report to be assessing children frequently during classroom interaction, attending to the pictures and other visual materials they produce as well as to their gestures or physical activity, and using questions in-context, authentic problem-based tasks and portfolios (collection of evidence of children's work and progress). All these point to a formative emphasis of science assessment by teachers for the particular age range examined by *Creative Little Scientists*.

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- Out of all formative approaches, these of self- and peer-assessment where the locus of the assessment judgment is on children rather than on teachers are the least used.
- Early primary teachers use more frequently than preschool teachers summative ways for the assessment of science, such as homework and tests but also tend more to ask children to reflect on their own learning and progress.
- On the other hand preschool teachers are more used to evaluate children's visual representations of their scientific reasoning.
- The use of assessment by teachers is similarly predominantly for formative purposes, such as to identify ways to improve science learning and regularly monitor children's progress towards a set of desirable science learning outcomes. The latter however seem to be defined by teachers themselves who only infrequently involve children in the decision process.
- Improving the science curriculum and grouping children for instruction are the least frequently identified purposes of assessment for the 3-8 age group of children.
- Primary teachers appear to be using assessment significantly more frequently for most of the functions that are traditionally associated with child-centered formative objectives.

Contextual factors

Curriculum-related factors

- In the national curricula for preschool and early primary education in the partner countries science, unlike mathematics is rarely presented as a separate area of learning; it is generally included within broader areas of learning, and thus integrated cross-curricular approaches to learning and teaching are advocated. Mathematics however is more commonly set out as a distinct area of learning.
- Group work is the preferred way of work for teachers in the early years science classroom, which on average has between 21 and 30 children.
- Teachers report spending 2 hours or less per week teaching science, whereas they spend more than 3 hours weekly on mathematics. As it could be expected more time is spent in primary than in preschool education on both subjects, but even more in mathematics compared to science.
- According to their teachers preschools and early primary schools are well resourced in computers and relevant library materials for science teaching, and in instructional materials, computers and equipment and materials for hands-on exploration in the classroom for mathematics teaching. Support personnel for teaching or for technical issues in both science and mathematics is overall the least available resource in schools.
- In their teaching of science and mathematics, overwhelmingly teachers use materials prepared by themselves or downloaded from the internet. On the other hand, materials prepared collaboratively by teachers in the school are the least commonly used resource by teachers after digital technologies.

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- Teachers also frequently use equipment and materials for hands-on exploration *in* the classroom, but less frequently equipment and materials for hands-on exploration *outside* the classroom.
- The availability of computers and other digital technologies (such as interactive whiteboards) appears to match and exceed respectively their use in schools
- Schools seem to be better resourced in mathematics than in science, at least in terms of instructional materials, equipment for hands-on exploration in the classroom and ICT resources.
- Primary schools are overall better resourced than preschools in computers and technical support personnel. Accordingly, primary teachers overall use more frequently than preschool teachers the corresponding resources.
- Preschool teachers on the other hand overall use more frequently than early primary teachers relevant library materials and resources for hands-on exploration in the classroom.

Teacher-related factors

- Preschool and primary school teachers have a Bachelor's (or equivalent) level degree and are certified to teach.
- At least half of the teachers have not studied science and mathematics at a tertiary education level.
- More primary than preschool teachers have education higher than Bachelor's (or equivalent) and have studied science and mathematics at a higher level of formal education.
- The majority of all teachers appear to have had only an overview of, or introduction to Mathematics, Science, Environmental or Earth Sciences and ICT as part of their post-compulsory and initial teacher education, whereas areas of emphasis in their studies were the ones of Pedagogy, Developmental Psychology, Children's Development of Creativity, and Creative Teaching Approaches.
- Mathematics and Science have been studied at a deeper level at post-compulsory and initial teacher education level by more primary school than preschool teachers, whereas Developmental Psychology and Children's Development of Creativity have been study areas of emphasis by more preschool than primary school teachers.
- Engaging in informal dialogue with colleagues on how to improve their science and mathematics teaching is predominantly the professional development activity in which the large majority of teachers across all partner countries participates. This activity is also considered by teachers as having the maximum impact on their practice.
- Fewer than half of the teachers of the partner countries have recently participated in formal school-based CPD opportunities involving peer teaching observations and mentoring or coaching of science and/or mathematics teaching, or in science education

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research conferences or seminars, even though the large majority of teachers consider them as moderate and very effective.

- Participation in teacher networks formed specifically to promote the professional development of teachers in science and mathematics is low amongst teachers, who also appear to perceive it as having a low impact on their practice.
- Participation in CPD activities is overall higher for primary than for preschool teachers. In particular, the difference is greatest for participation in courses/workshops as well as mentoring and/or peer observation and coaching of mathematics teaching.
- Finally, teachers overall feel most confident in their general pedagogic knowledge and least confident in both their knowledge/understanding of science (ideas, processes and nature) and their competencies to carry out scientific inquiry.
- More teachers feel confident in their mathematics teaching, assessment and pedagogic knowledge, than in their science teaching, assessment and pedagogic knowledge.
- More primary teachers are more confident than preschool teachers in both their science and mathematics teaching practice and their science and mathematics knowledge and competences.

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1. Introduction

1.1 Aims of this report

The *Report of First Survey of School Practice* aims at mapping and comparing existing practices to the teaching, learning, and assessment of science and mathematics in the early years and teacher education within and between the nine countries (and 13 educational systems) represented in the *Creative Little Scientists* consortium. The findings of this quantitative study are presented with the intent of revealing the potential for creativity and the role of inquiry in the classroom realities of pre-primary and first years of primary science and mathematics education, and are grounded on concepts and synergies identified in the *Conceptual Framework* (D2.2) developed previously in the project.

In particular, this report has been prepared as part of Work Package 3 (Task 3.3) of the *Creative Little Scientists* project and provides an initial account of classroom reality as this is reflected in working practitioners' answers to the survey. It furthermore examines overarching similarities and differences in this reality between the partner countries.

Existing approaches are mapped and compared based on the dimensions of the list of factors developed in Task 3.1 - *List of Mapping and Comparison Factors* (D3.1) on the grounds of the conceptual framework put forward in Work Package 2. These factors also provide the scope and parameters for comparisons between existing approaches in practice (D3.3) and approaches as recorded in policy (D3.2). The results of these comparisons are reported in the *Comparative Report* (D3.4), which is the final outcome of Work Package 3.

The positioning of this report within the project can be seen in the figure below (Figure 1.1).

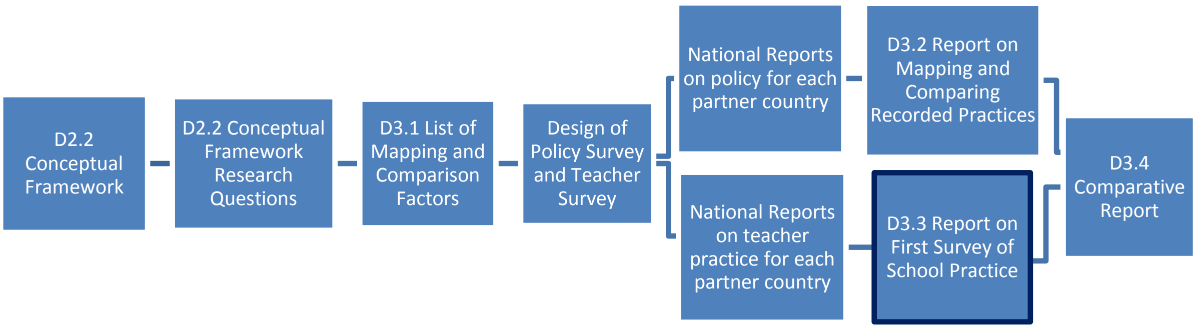

Figure 1.1. Positioning of D3.3 report within the project

Apart from providing a first look into school reality in all relevant areas of interest for the project, this report intends to contribute to the project aims by informing subsequent empirical research in schools carried out in Work Package 4, as well as the development of teacher education curriculum design principles in Work Package 5. Towards the latter, the report provides empirical

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data on early years teachers' knowledge, skills and confidence, and on initial teacher education (ITE) and continuing professional development (CPD) opportunities in the partner countries.

1.2 Recorded approaches: teacher practice

The *Conceptual Framework* (D2.2) highlighted that teachers' conceptualisations of, and their values and stances towards, science and mathematics education and creativity frame and shape classroom practice. Teachers' perceptions of themselves, their values, as well as their understandings and views of learning and inquiry based approaches are all influential in guiding pedagogical views and practice. Quoting from the *Conceptual Framework* itself (pp38-39):

"Teachers' values are made manifest in learning contexts and tasks, and need to be translated meaningfully for each learner. Teachers' perceptions of themselves as 'creative practitioners' or as 'scientists' and their understanding of and commitment to child development also shape their pedagogy (Fleer, 2009). In investigating preschool teachers' educational practice Einarsdottir (2003) shows that their educational beliefs and knowledge of child development have a fundamental impact on their teaching. Thiel (2010) identified differences in teachers' beliefs about the importance of mathematical thinking and application of mathematics in the nursery curriculum, while Iannone and Cockburn (2008) documented the impact on classroom practice of belief in the importance of mathematical thinking and conceptualising mathematics as being about structure, pattern and connections.

In a study examining the stance of teachers teaching written and musical composition to 4-14 year olds, Craft et al. (2007) also reveal that teachers' own values are highly influential in guiding how pedagogy is conceived, how classrooms are resourced, how ethos is developed, and how tasks are formulated. This is also confirmed by Forrester and Hui (2007) in relation to nurturing creativity. Woods and Jeffrey (1996) highlight the humanist approach, openness to emotions and strong moral and political investment of creative teachers and Cremin et al. (2009) drawing on their research, suggest that creative educators are aware of, and value, the human attribute of creativity in themselves and seek to promote this in children. Such teachers, they posit, have a 'creative state of mind'. Additionally, in the early years possibility thinking work, it is noted that teachers, influenced by particularly constructivist views of learning, viewed the children as active constructors of meaning and positioned themselves as facilitators (Cremin et al., 2006)."

Van den Akker (2007) provides a theoretical rationale for considering policy as well as classroom practice in the *Creative Little Scientists* project. According to Van den Akker, it is possible to distinguish between three broad forms of curriculum representation as illustrated in Table 1.1.

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Intended	Ideal	Vision (rational or basic philosophy underlying a curriculum)
	Formal/Written	Intentions as specified in curriculum documents and/or materials
Implemented	Perceived	Curriculum as interpreted by its users (especially teachers)
	Operational	Actual process of teaching and learning (also curriculum in action)
Attained	Experimental	Learning experiences as perceived by learners
	Learned	Resulting learning outcomes of learners

Table 1.1. Typology of curriculum representations (van den Akker, 2007, p.38).

In trying to understand and shape the role of creativity in early science and mathematics learning, it is necessary to consider each of these different interconnected aspects. The project's *Report on Mapping and Comparing Recorded Practices* (D3.2) with its analysis of policy is highly relevant to the first of the three levels: the *Intended Curriculum.* This report, focusing on teachers' conceptualisations of classroom practice, is relevant to the *Implemented Curriculum*, and describes *'perceived'* aspects of it. Both reports, synthesized in the *Comparative Report* (D3.4), will provide a window into what is intended and considered as implemented. Further work in Work Package 4 will focus on what is in practice implemented and attained, by addressing both the 'operational' aspects of the *Implemented Curriculum* and the 'experimental' and 'learned' aspects at the level of the *Attained Curriculum.*

1.3 Research questions

The research questions for this report originate from the project's overall research questions as they are identified in the *Conceptual Framework* (D2.2). The overall research questions are:

1. How are the teaching, learning and assessment of science and mathematics in early years in the partner countries conceptualised by teachers and what role if any does creativity play in these? This would include how teachers conceptualise objectives and outcomes as well as how policy frames these.
2. (Probing practice): What approaches are used in the teaching, learning and assessment of science and mathematics in early years in the partner countries and what role if any does creativity play in these? This would include the exploration of opportunities and challenges for development of skills and attitudes associated with creativity.
3. (Probing practice): In what ways do these approaches seek to foster young children's learning, interest and motivation in science and mathematics, and how do teachers perceive their role in doing so?

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4. (Drawing on mapping and probing questions): How can findings emerging from analysis in relation to questions 1-3 inform the development of practice in the classroom and in teacher education (ITE and CPD)?

As mentioned above, this particular part of the project's work is dedicated to revealing current practice in the intersection between science, mathematics and creativity in both pre-school and first years of primary education in the partner countries, identifying overarching similarities and differences between them. As such, the *Report on First Survey of School Practice* (D3.3) has to focus on the following research questions:

1. What are the main similarities and differences in how the teaching, learning and assessment of science and mathematics in early years are conceptualised by teachers in the partner countries? What role does creativity play in these?
2. What are the main similarities and differences in the approaches used for the teaching, learning and assessment of science and mathematics in the partner countries? What are the opportunities and challenges for skills/attitudes associated with creativity?
3. What are the main similarities and differences in early years teachers' knowledge, skills and confidence in the teaching, learning and assessment of science and mathematics in the partner countries? What constitutes their relevant experiences in teacher education (ITE and CPD)?
4. What are the main similarities and differences between the findings emerging from analysis in relation to questions 1-3 for preschool and early primary school phases respectively?

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2. Methodology

There are three broad strands running across the research questions (as first identified in the *Conceptual Framework* (D2.2), and further elaborated in the *List of Mapping and Comparison Factors* (D3.1):

- Aims/purpose/priorities, including teachers' and national policies' conceptualisations of the aims and purposes of science and mathematics education and the role of creativity in them;
- Teaching, learning and assessment, including use of inquiry activities, dynamics between teachers and children, also how teachers assess creativity in early science and mathematics education;
- Contextual factors, including resources used or prescribed, teacher characteristics and competencies, curriculum, institutional factors.

The *List of Mapping and Comparison Factors* (D3.1), drawing on the framework of curriculum components 'the vulnerable spider web' (van den Akker, 2007, p.39) breaks down further these three broad strands into the following ten more narrowly-defined dimensions, which focus on key aspects of learning in schools and address the relevant key questions:

- Aims/purpose/priorities
    - Rationale or vision: Why are children learning?
    - Aims and objectives: Toward which goals are children learning?
- Teaching, learning and assessment
    - Learning activities: How are children learning?
    - Pedagogy: How is the teacher facilitating learning?
    - Assessment: How is the teacher assessing how far children's learning has progressed, and how is s/he using this information to inform planning and develop practice?
- Contextual factors
    - Content: What are children learning?
    - Location: Where are children learning?
    - Materials and resources: With what are children learning?
    - Grouping: With whom are children learning?
    - Time: When are children learning?

To the 10 'spider-web' dimensions and under the 'Contextual Factors' strand D3.1 has added the following dimensions which focus on key aspects of teachers' education and professional qualifications:

- Teacher Personal Characteristics
- Teacher General Education and Training

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- Teacher Work Experience
- Teacher Science and Mathematics Knowledge, Skills and Confidence
- Initial Teacher Education
- Continuing Professional Development

For each of these dimensions the *List of Mapping and Comparison Factors* (D3.1) proposed a number of 'creativity enabling' indicators to be used to identify approaches to and practices of early years science and mathematics education which have a strong potential to foster the development of creative skills in children. These factors focus both on learning and teaching aspects, characterising the approaches and educational contexts involved in the teaching, learning and assessment of science and mathematics as these are realised in the school context but also conceptualised by teachers and in the relevant policy documents.

2.1 Research instrument

In order to address the research questions stated above a questionnaire survey was devised and administered online to teachers of preschool and early primary education in the partner countries.

Development of the questionnaire

The questionnaire was developed in English by Task leader Ellinogermaniki Agogi (EA). Its purpose was to reveal whether and how often teachers use approaches to early years science and mathematics education which have a strong potential to foster the development of creative skills in children. The development of the questionnaire was directly informed by the need to collect data which would be validly and reliably interpreted and analysed using the 'creativity enabling' indicators developed in D3.1 based on the project's *Conceptual Framework*. To fulfil this requirement, the questionnaire items were constructed following a combination of two processes: by studying the project's conceptual framework closely and transforming the relevant D3.1 indicators into question items, as well as by modifying validated question items taken from previous relevant large-scale research projects (Cachia et al., 2009; Diakidoy and Kanari, 1999; Murphy and Beggs, 2005) and international surveys (OECD, 2010). On the whole, the former process gave rise to the questionnaire items which address the factors about 'Aims/purpose/priorities' and 'Teaching, learning and assessment', and the latter to the items which address the context-related factors, such as school and setting characteristics, teachers' background knowledge and skills, CPD experiences, teachers' confidence, materials and resources, etc.

Exceptions to this generalization are research reports by Cachia et al. (2009) and Diakidoy and Kanari (1999) which informed question items linked to teachers' use of creative learning contexts and approaches in the science classroom. Both studies examined how teachers in Europe perceive and understand creativity as well as foster creativity through their teaching. The Cachia et al. study also touched on other issues such as the use of ICT to encourage creativity; and the kind of context and support necessary for teachers to cultivate creativity in their students. Murphy and

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Beggs (2005) conducted a qualitative study across the UK on teaching practice in primary science and provided material to construct questions concerning creative learning activities appropriate for early years settings. Finally, the National Research Council (2000) standards document and Levy et al. (2011) provided very useful information on the use of inquiry-based science education (IBSE) in practice such as essential features of inquiry learning in science, as well as learning approaches and assessment of IBSE methodology.

An initial draft of the questionnaire was sent to all partners for feedback. Comments provided by partners included:

- Reducing the length to avoid respondent fatigue and high participant dropout numbers
- Rephrasing some of the questions to make them more appropriate for early years practitioners
- Removing questions with identical items to avoid confusion about the repetition of certain questionnaire items and lists for different purposes
- Reducing questions linked to complicated concepts to avoid teachers getting lost in detail and causing increased respondent dropout

Partners' comments led to an updated version of the questionnaire which focused on providing a more teacher orientated and explicit structure, signalling purpose and sense of direction across the questionnaire. The amended version of the questionnaire encompassing all partners' comments was sent to partners for final approval one more time.

Piloting the questionnaire

After reaching a consensus on the final version of the questionnaire among the consortium, the questionnaire was translated from English to all partner countries' languages and practicing teachers and academics in all countries were asked to complete the survey and provide detailed comments. Due to time constraints the piloting phase was short and involved small numbers of participants; it was however of a discursive nature, that is "this works, I think it would work better if you change this" type -deeming this as the most useful at that stage- and revealed a number of significant issues that led to additional changes in the questionnaire. Appendix 1 contains the comments made in each country and the responses made to them by EA. Common comments included:

- The duration required to complete the questionnaire was too long and concerns for participant drop out were raised.
- An additional question should be provided at the end that would allow teachers to comment either about the issues or in response to the questionnaire. This particular question would provide information on whether the questionnaire prompted thought about other issues or if there were particular questions they felt they could not answer and why.

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- Certain terminology used in the questionnaire did not translate well to early years practitioners – more appropriate for secondary teachers.

A number of comments made during the piloting phase which were dependent on specific country settings did not lead to changes in the questionnaire as the priority was to construct a common research instrument which would cover a multitude of different EU settings. However, partners were encouraged to make adaptations in the translated versions of the questionnaire, so that the questions were meaningful, though not necessarily applicable, to all respondents.

Online final version of questionnaire

The final version of the questionnaire, which resulted after including the feedback from piloting, and its translated versions (Greek, Dutch, Romanian, German, French, Finnish, Portuguese and Welsh) were made into online surveys using SurveyMonkey (www.surveymonkey.com), an online survey software and questionnaire tool. A total of 13 separate questionnaires were uploaded to SurveyMonkey and separate web links were sent to all partners to start disseminating the survey and gather participants.

The questionnaire that resulted from this development process can be found in Appendix 2 and includes a short introduction and 44 questions divided into 7 sections. These sections are:

- Background Information – About your School
- Background Information – About You
- Your Knowledge, and Skills and Confidence in Teaching Science and Mathematics
- Your Views about and Approaches in Teaching Science
- Your Views about and Approaches in Assessing Science Learning
- School Science and Mathematics Resources and Your Use of Them
- Thanking You and Further Communication

The average duration required to complete the questionnaire was 40 minutes. The majority of the questionnaire items – except for the sections requesting factual background information – were four-point Likert-type questions. As previously mentioned, all items included were chosen to specifically address all curriculum components associated with the 'vulnerable spider web' and important themes of the conceptual framework. These questions were then pre-coded according to the list of factors (D3.1) linking questionnaire items to specific factors. The relationships between strands in the Conceptual Framework (D2.2), the curriculum components, the questionnaire items and the *List of Mapping and Comparison Factors* (D3.1) are shown in Appendix 3.

Finally, this questionnaire informed the development of the questionnaire used by partners to rate the extent to which a number of 'creativity-enabling' approaches in early years science and mathematics education were emphasized across policy documents (if at all) (as part of the country policy review in Task 3.2). By aligning the two research instruments, the aim was to

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facilitate subsequent comparisons in the *Comparative Report* (D3.4), between approaches promoted in policy and those conceptualised by teachers, for whom policy is largely intended.

2.2 Collection of data

The *Description of Work* (DoW) of *Creative Little Scientists* specify that the survey will be addressed to teachers in at least 500 selected schools, reflecting a range of contexts in the nine sample countries. During the 2nd Project Meeting, which was held in Paris on 22-23 March 2012, i.e. shortly before the start of this Task, it was agreed to target equally teachers in preschool and those practicing in early primary school and all partners agreed to a minimum number of schools for each country (see Appendix 4).

A broadly common data gathering approach was followed among the project partners. A participation invitation letter was drafted in English by EA and sent to partners to translate and customise so that it would be usable in their context. The participation invitation letters were sent electronically to large numbers of pre-primary and primary schools through both existing and new communication channels, using personal, institutional and national contact lists, and following more of an "open ended" approach in order to ensure that the numbers required would be reached. The letters provided a brief description of the project's aims and outcomes, an overview of the two research phases (teacher survey and in-depth field study), contact information for queries, and instructions on how to register as participants (see Appendix 5). All this information was also included on the project's website, in a page specially created for this purpose (http://www.creative-little-scientists.eu/content/teachers); partners could choose to direct their survey participants to register through that webpage if they wished to. Personal information (Name, Surname, School, E-mail and Years of Teaching Experience) was required from teachers in an effort to monitor the characteristics of the sample and ensure coverage of a wide spectrum of contexts and provisions, and thus practices regarding early years science and mathematics education. Furthermore, teachers were asked in the same form to indicate their interest in participating in the second phase of the research, the school-based in-depth field work; their personal information was necessary so that researchers would be able to contact them if they got selected. Teachers were informed that this information would be used solely for research purposes and were given the opportunity to withdraw their interest at any time. Personal data were retained in password protected servers in the partner institutions where only authorised staff had access to them.

Ethics

The necessity for ethics approval for this stage of the research varied a lot amongst the partner countries. The table in Appendix 6 shows which partners required (or not) ethics approval from their institutions and/or corresponding national agencies in order to carry out this research with teachers. Wherever an ethics approval was necessary, it was formally requested; any comments/suggestions received were taken into consideration, and changes requested were made both to the teacher questionnaire and accompanying documentation, which were used by

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the whole of the consortium. Ethics clearance was obtained in all relevant cases. As minimum standard of practice across the project it was agreed that any personal data provided by participants would be protected according to the EC directive 95/46/EC and used only for research purposes. Moreover, all data gathered from the survey were stored in a secure location accessible only to the researchers.

Sampling

Data collection started in mid May 2012 and was planned to last until the end of the school year (summer 2012). The recruitment of respondents for the *Creative Little Scientists* (CLS) teacher survey proved however more difficult than anticipated. Teachers' increased workload at the end of the school year, their overexposure or underexposure (depending on the national context) to this method of data collection, together with the demanding nature of the CLS questionnaire in terms of both scope and scale, were the reasons given by partners for the difficulty they faced in engaging respondents (see also partners' national reports in *Addenda to D3.3*). As a consequence in Wales, Scotland and Germany the data collection was extended to the end of September. UoM faced the extra complication of not being given the ethics clearance by its national agency until the end of September and thus conducted the survey during the months of October and first half of November 2012.

These difficulties faced in data collection practically meant that most project partners ended up using convenience (or opportunity) sampling, whereas cluster sampling was the method used only in Finland. Despite the difficulties the overall sample provided coverage of a range of school contexts and settings for the required age range of children (3 to 8 years old) in the nine partner countries.

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3. Analysis of data

3.1 Approach to analysis

Deciding on the appropriate methods for analysing and comparing national approaches to teaching, learning and assessment depends upon the theoretical and hence methodological paradigm adopted. Lor presents an illustration of key methodological approaches in Figure 3.1 (Lor, 2012).

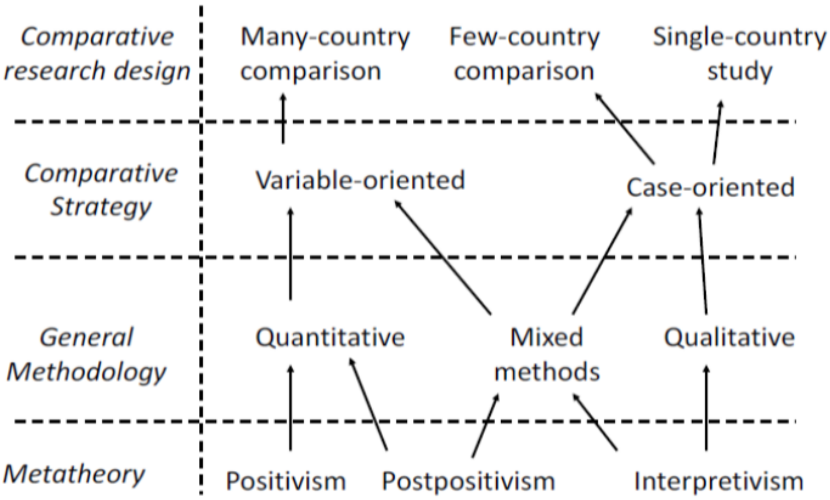

Figure 3.1. Relationship of comparative methodological choices to metatheory (Lor, 2012, p.5).

With data from nine countries and 13 national education systems to compare, this comparison might be described as falling between 'Many country comparison' and 'Few-country comparison' using Lor's descriptors. This presents the option of adopting either a variable-oriented or case-oriented comparative strategy.

The *Conceptual Framework* (D2.2) advocated the use of an overall interpretive paradigm for this project in order to understand how creativity is conceptualised in early science and mathematics education. However, in this first phase of the project, the research instrument used is a survey questionnaire and thus a quantitative variable-oriented approach was adopted to help identify and reflect on similarities and differences between the perceived approaches in the partner countries. A more qualitative, case-oriented methodology will be adopted in the next research phase (in Work Package 4) where a deeper analysis of practice in relation to science and mathematics explored with the lens of creativity is to be carried out through classroom based research in each partner country.

The analysis was carried out in two stages. First, partners carried out an analysis of their country's data to produce a National Report discussing the findings and situating them within their country's educational context. The results of this first layer of analysis can be found as addenda to this report (*Addenda to D3.3*). In the second stage, the data gathered from all the partner

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countries were amalgamated and analysed as a whole. Statistical comparisons were performed to identify similarities and differences between perceived practices in partner countries; information provided in the National Reports was used to interpret these similarities and differences. The findings of this second layer of analysis are presented in this report.

To ensure consistency, but more importantly to follow a shared approach to analysis and facilitate comparisons in this report, as well as in the final *Comparative Report* (D3.4) between the analysis of policy (D3.2) and the analysis of practice (D3.3), a common structure was provided to partners for each National Report. This was in the form of a Table of Contents (ToC) document accompanied by brief instructions on the important themes that had to be addressed under each section/heading of the ToC.

3.2 The analysis process

All data were gathered using the online surveys hosted by SurveyMonkey. The data, as extracted from SurveyMonkey, included incomplete and multiple entries by the same respondent. Entries which were defined as incomplete and had to be removed from the sample included those that had no answer in any of the questions after the third section of the survey on 'Your Knowledge, Skills and Confidence in Teaching Science and Mathematics' (Q19). Both incomplete and multiple entries were removed by partners before the data analysis took place.

Guidelines for this data cleaning and then analysis were issued by EA to ensure consistency among the national reports and facilitate the merging of the national data and synthesis of analyses for the purposes of this report. Partners had to send EA the following material:

- Data either in SPSS or Microsoft Excel files for total/preschool/primary samples
- Frequency tables for all questionnaire items grouped according to the factors of D3.1
- National reports containing the analysis and commentary on the findings of the survey

The SPSS/Excel data files were used to merge all the responses gathered to produce the total sample from all countries. Although such an approach might seem as inappropriate when taking into account the differences between the consortium countries, as evident in the policy report (D3.2), merging the data provides the opportunity to produce an overview of the current situation across the nine partner countries. Frequency tables prepared by partners presented teachers' responses to questionnaire items as percentages, means and standard deviations (only for Likert scale questions). The tables, apart from providing a visual representation of the data gathered, grouped questionnaire items accordingly to the factors pre-identified in deliverable D3.1 *List of Mapping and Comparison Factors*. This further enabled the authors of this report to conduct comparisons between countries for all the groups of factors, reveal similarities and differences and group countries according to certain characteristics. Finally, national reports sent by partners played an important part in this final report as they provided information and context-based data interpretations for all countries, which gave the authors a much needed insight to make informed comparisons between countries represented in the consortium. The national reports were also

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key in highlighting tensions between policy, as captured in the report on policy (D3.2) and teaching practice, illustrated by teachers' questionnaire responses.

The second stage of analysis was conducted by the task leader (EA) using SPSS and Microsoft Excel software, and was based entirely on the total valid sample of respondents from all partner countries, that is all preschool and primary school staff who taught the children age group studied by the *Creative Little Scientists* project (children from the age of 3 and up to the age of 8) during the 2011-12 school year. Additionally, respondents were divided into two sub-samples based on the level of education they teach, i.e. preschool or early primary school. The report is structured to present the findings of the study for the total sample, as well as for both sets of preschool and primary teachers. Moreover, as previously mentioned, the mapping and comparisons factors (D3.1) are used throughout the report to group and present these findings, in a way similar to the policy review report (D3.2), so as to allow for comparisons between policy and reported practice to take place subsequently as part of the *Comparative Report* (D3.4). It should be noted that with the total sample of responses most factors or groups of factors were tested for inter-item reliability using Cronbach's alpha. In this way we checked whether our theoretically derived questionnaire items could also form reliable constructs corresponding to the intended factors. The factors that scored over the 0,7 threshold were deemed as reliable constructs.

Similarities and differences amongst partner countries in relation to their sampled responses to specific questionnaire items and/or factors have been identified as significant (at the 0.05 level) by comparing their means using one-way ANOVA tests. In a similar line, comparisons of the means of responses given by the preschool and early primary school staff both to particular questionnaire items and selected factors were conducted with independent t-tests, revealing interesting and significant (at the 0.01 level) similarities and differences amongst the two sub-samples. Finally, any significant differences between the preschool and primary school teachers' responses to ordinal or nominal variables (e.g. teaching experience, level of education completed, etc.) were identified out using Pearson's chi square tests.

Final Sample and Limitations

A total of 815 teachers from 605 schools (238 preschools and 367 primary schools) across the consortium countries completed the online questionnaire. The distribution of schools and teachers per setting and country can be seen in Table 3.1. Further characteristics of the sampled schools and teachers are presented in the following section together with the other findings of the survey.

Despite exceeding the minimum number of sampled schools, specified as 500 in the project's Description of Work (DoW), it is important to recognise a series of biases in the sample. First of all, although it was recognised from the outset (i.e. in the DoW) that the national samples are not going to be 'representative' in a formal statistical sense of either the number of schools or teacher population in the partner countries, some countries' or regions' samples are clearly under-

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represented in the total sample, in particular Germany's, France's, Wallonia's, Wales' and Scotland's, whereas other countries' samples are overrepresented, namely Finland's, Greece's and Romania's. In the case of Romania in particular, surveyed schools and teachers make up 27% and 30% of the total school and teacher samples respectively, outweighing the country's anticipated contribution to the sample. Difficulties with sampling and potential reasons for these have been mentioned in section 2.3. In all relevant cases extra effort was made to increase the number of responses, by intensifying the dissemination of the survey through existing and new communication channels, using personal, institutional and national contact lists, and extending the period of data collection. However, figures still remained sub-optimal in some cases. Having said this, since the national samples were not deemed as 'representative', we decided against weighting their data in the total sample and rather use it in the analysis as it was.

	Preschool		Primary school		Total	
	No.	Teachers	No.	Teachers	Schools	Teachers
BE(Fl)	44	51	3	3	**47**	**54**
BE(Wa)	2	2	2	3	**4**	**5**
FI	13	13	57	57	**70**	**70**
FR	23	23	23	23	**46**	**46**
GE	16	19	25	30	**41**	**49**
GR	41	56	23	40	**64**	**96**
MA	8	35	9	44	**17**	**79**
PT	21	33	33	40	**54**	**73**
RO	56	101	105	140	**161**	**241**
UK(EN)	8	8	68	68	**76**	**76**
UK(NI)	2	2	10	10	**12**	**12**
UK(Sco)	2	2	6	6	**8**	**8**
UK(WA)	2	3	3	3	**5**	**6**
	238	348	367	467	**605**	**815**

Table 3.1. Survey schools and respondents per setting and country.

In addition, the facts that the survey was promoted through social and e-communication media and moreover was conducted online may have created a bias attracting respondents who are more familiar with this kind of media and prone to using ICT. In the case of Malta, the partner in order to counteract this bias handed paper copies of the questionnaire and then manually entered the data in the SurveyMonkey survey environment.

Finally, given that the survey was answered on a voluntary basis, it is likely that the sample of respondents have a positive attitude towards the issues being explored in the survey, and thus their responses a positive bias. Having said this, since the questionnaire items in their large majority refer to the frequency of use of a number of 'creativity-enabling' micro-practices and do not attempt to identify all the practices used more generally, the effect of this positive bias on the findings is stipulated as equally shared and thus small for comparisons. In order to counteract this

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bias as well as the rest of the limitations of sample size and ICT familiarity, some partners discussed their national survey findings (e.g. for Germany and Scotland), their interpretation and validity with other national experts in the field and included relevant commentary about these issues in their national reports (see Addenda to this deliverable).

Overall, conclusions and findings of this study should be considered in the light of these limitations. The population of the survey is not statistically representative of the schools and teachers in the nine European countries and 13 educational systems represented in the consortium, but embodies teachers in those countries who were willing to account for their 'creativity-enabling' practices through our online survey. The mapping of reported practices in the following sections will have to be regarded with this in mind. On the other hand, the comparison of reported practices amongst the partner countries and between the two sub-samples of preschool and early primary school teachers is affected mainly by the sample size limitations, as the rest of the limitations can be thought of as affecting all country samples in similar ways. In order to avoid the distortion of the findings from these comparisons, the comparison analysis took place amongst samples of more than 40 teachers.

Despite all the biases discussed above, this study is still unique, since it addresses issues not being tackled previously, via a thorough extensive questionnaire, answered by teachers in 13 different educational systems across Europe.

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4. Findings

This section provides a synthesis of findings, drawing from the *National Reports* (results and commentary) and the subsequent analysis of questionnaire data for the whole sample and sub-samples of preschool and early primary school staff. The findings are presented under the dimensions identified in the *List of Mapping and Comparison Factors* (D3.1) and are linked to their specific factors, built on the concepts and synergies highlighted in the *Conceptual Framework* (D2.2) (see section 2 above). Similarities and differences among the partner countries are identified alongside issues and tensions relating to the potential for creativity and the use of inquiry based approaches in early years science and mathematics education practices around Europe.

As discussed in the previous sections, it is important when interpreting these findings to acknowledge the unique characteristics of different educational systems across the consortium as well as the characteristics of the sample, and to review findings in this context. The former is accomplished by consulting the *National Reports* and their interpretations of results in context, and the latter by prefacing the findings with a summary of key characteristics of the sampled schools and teachers.

4.1 Overview of key characteristics of the sampled schools and teachers (Contextual Factors)

The figures that follow present characteristics of the schools in which the total sub-samples of preschool and early primary school teachers were situated, as well as the teachers' own characteristics: e.g. gender, age and years of experience distribution.

4.1.1 Size, location and status of sampled schools

In Figure 4.1 below one can see that about 40% of the preschool teachers but only 16% of the primary teachers surveyed were situated in small size settings (i.e. with fewer than 100 children). On the other hand, the sampled primary teachers in their great majority (60%) were situated in schools with more than 200 children on average. This is rather expected, since on the whole pre-primary settings are more often of smaller size than primary schools. Additionally, there is great variation amongst partner countries samples in this respect. More than half of the respondents in France, Greece, Portugal and UK(Wales) respectively are teaching in small size settings (i.e. with fewer than 100 children), whereas in Belgium (Flanders and Wallonia), Malta, Romania and UK(England) more than half of the respondents are teaching in schools of at least twice this size (i.e. more than 200 children). Finally, more than a third (38.6%) of all respondents teaching in very small schools (i.e. with fewer than 50 children) are in Greece, and almost half (48%) of all respondents teaching in very big schools (i.e. with more than 750 children) are in Romania.

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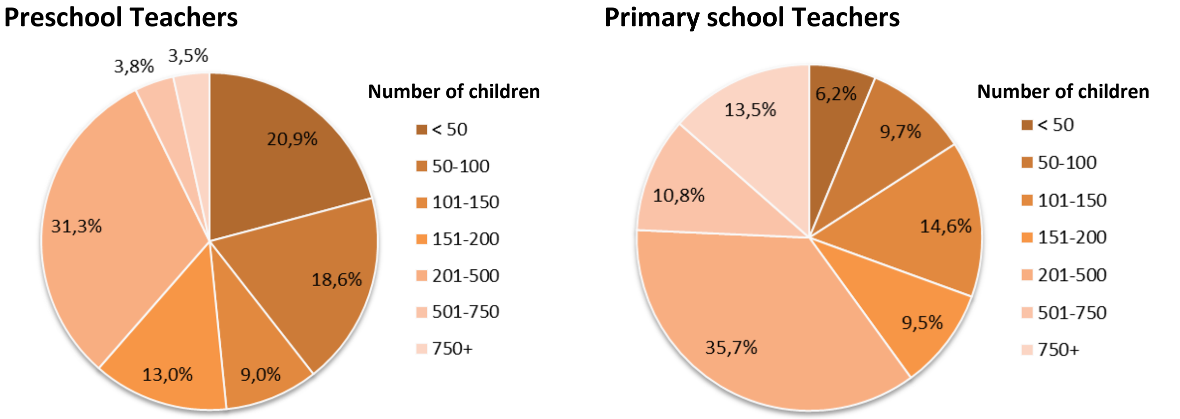

Figure 4.1. Size of schools, in which the sampled teachers are situated.

Figure 4.2 shows the size of the communities in which the sampled teachers' schools were located. Interestingly, preschool teachers were located on the whole in smaller settings but in bigger communities than primary school teachers: 29.6% of sampled preschool teachers are located in communities of more than 100.000 people, compared to 22.9% of sampled primary teachers. Similarly, 20.7% of preschool teachers but 28.9% of primary teachers are in schools in rural areas of fewer than 3.000 people. This disparity between size of school and size of community served by the school across the two age phases probably reflects the fact that preschool education does not have the same compulsory status across all partner countries.

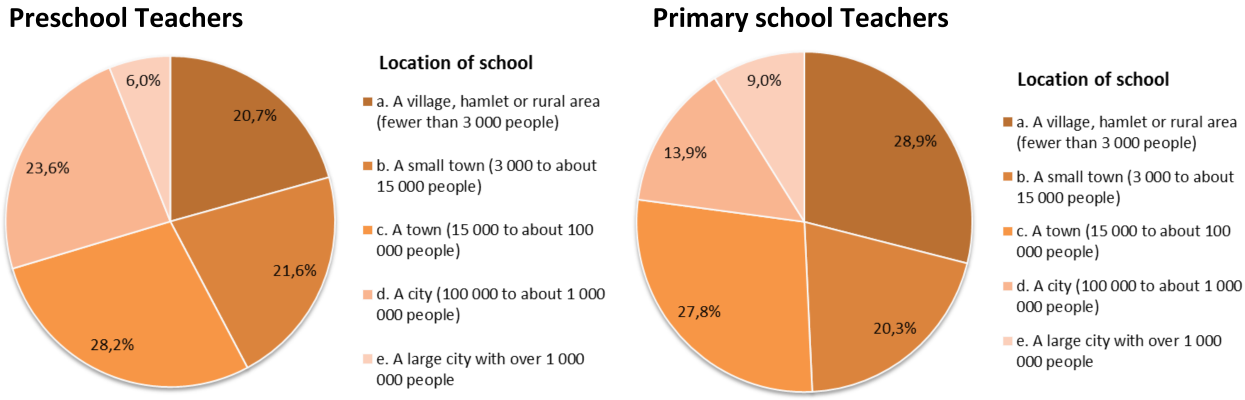

Figure 4.2. Location of schools, in which the sampled teachers are situated.

Concerning the governance status of sampled schools, 15% of all the teachers who completed the questionnaire worked in private schools (Figure 4.3). The largest proportion of private school teachers (91.2%) was in the Finnish sample, accounting for 57.9% of the total sample (34.2% of the private preschool staff and 71% of the private primary school staff samples). Greece's and Germany's contributions to this total follow with 23.4% and 7.5% respectively, Greece equally contributing to both private preschool and private primary school staff samples and Germany only to the private preschool staff sample by 21.1%.

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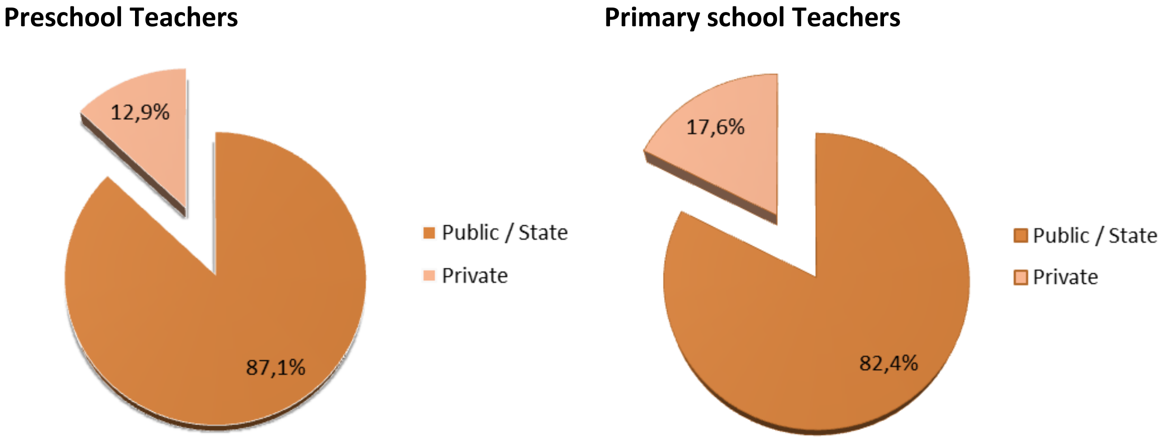

Figure 4.3. Type of provision of schools, in which the sampled teachers are situated.

4.1.2 Teacher personal characteristics

4.1.2.1 Gender of respondents

Reflecting the gender balance of the sampled teachers (Figure 4.4), female respondents were largely predominant in both samples, overwhelmingly of preschool, but also of primary school staff (difference is significant at $p<0.01$), accounting for nearly 92% of the total sample. This gender imbalance in both preschool and primary school practitioners was expected and has been extensively reported in the research literature, and thus the survey reflects this situation. Moreover, it is common amongst all partner countries; excluding the very small samples of under 46 respondents, the female dominance varies from 82.06% in the French teacher sample to 96.1% in the Maltese teacher sample.

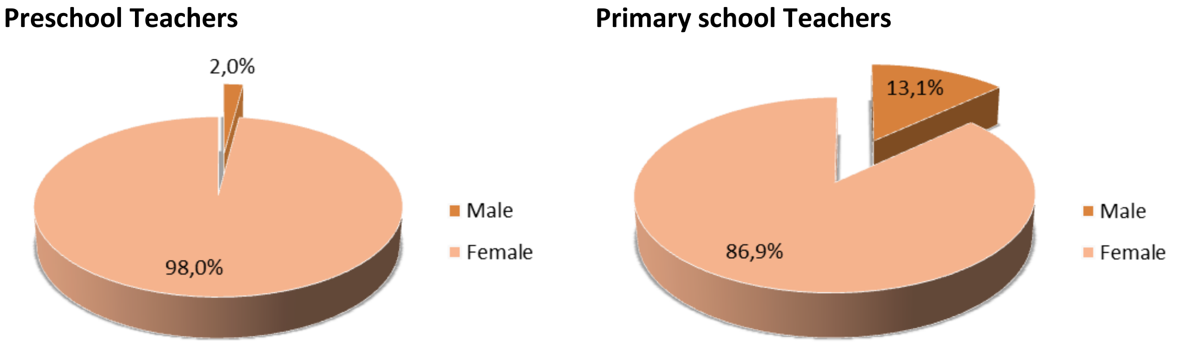

Figure 4.4. Gender distribution of surveyed teachers.

4.1.2.2 Age of respondents

The age distribution of respondents (Figure 4.5) is similar in the preschool and primary teacher samples (difference not significant at $p<0.01$). Overall, the largest majority of respondents (63%) are aged between 30 and 49 years old. The Flemish and Maltese samples have proportionally the largest number of younger teachers: almost half to a third of their respective sample are under 29

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years old. Equally, the Portuguese and German teachers are proportionally older: almost half to a third of their respective sample are over 50 years old.

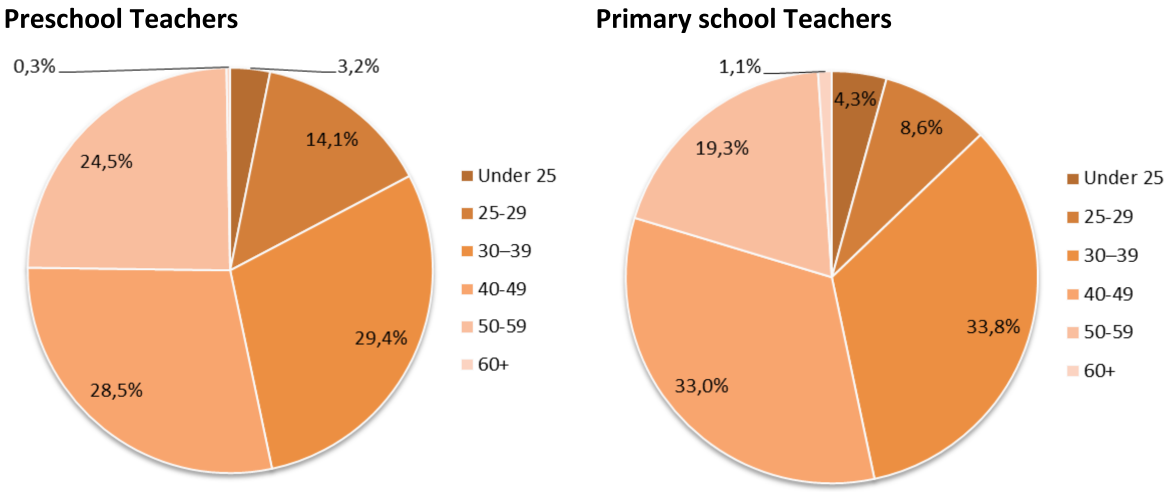

Figure 4.5. Age distribution of surveyed teachers.

4.1.2.3 Teaching experience

As illustrated in the figure below (Figure 4.6), teachers who took part in this survey are **quite experienced**, as more than two thirds of respondents in both samples of preschool and primary school teachers have taught for more than 10 years and more than a third for more than 20 years. This distribution of teachers' work experience in the two sub-samples is consistent with the overall sample and there is no significant difference between them.

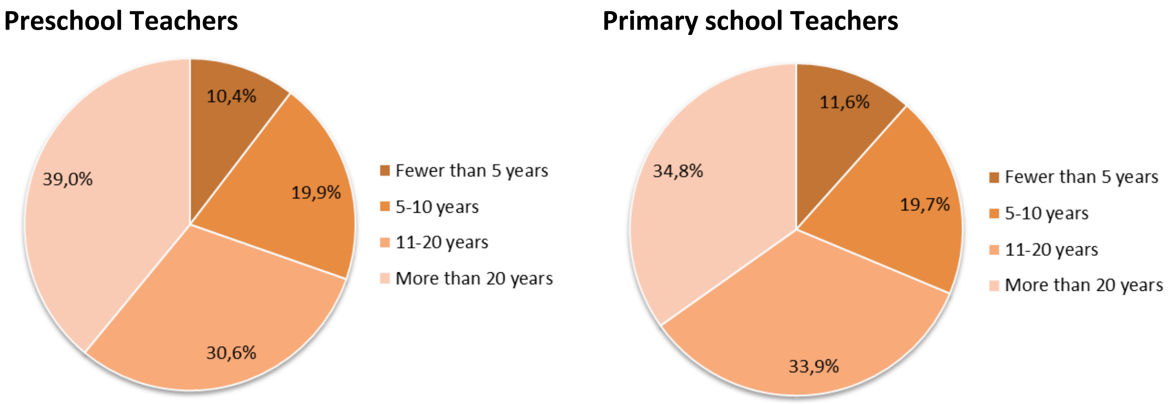

Figure 4.6. Age distribution of surveyed teachers.

There is however a significant variation in this distribution among the partner countries. At one end, there are the Flemish sampled teachers of whom 40.7% have over 10 years of experience and at the other, the Portuguese sampled teachers of whom 95.8% have over 10 years of teaching experience. Excluding the very small samples of under 46 respondents, the Flemish, Greek, English and Maltese samples have the most low experienced teachers (with less than 5 years of teaching), varying from a third to about a sixth of their sample, and the Portuguese and Romanian

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samples the most highly experienced teachers (59.7% and 45.1% respectively with over 20 years of teaching).

4.1.2.4 Teachers' general education, training and certification

Respondents were also asked to provide information on the **level of formal education** they have **completed**. As to be expected based on the policy review carried out in D3.2, the vast majority of teachers who responded in the survey has obtained at least a Bachelor's (or equivalent) degree (88%) and 27% have obtained a higher than Bachelor's (or equivalent) degree. However, preschool and primary teachers differ significantly ($p<0.01$) in their educational background. Whereas the proportion (about 61%) of teachers with Bachelor's (or equivalent) level of education is similar in the preschool and primary school samples, the proportion of teachers with education higher than Bachelor's (or equivalent) is much larger in the primary school teachers sample (32.0%) than in the preschool teachers sample (20.2%) (Figure 4.7).

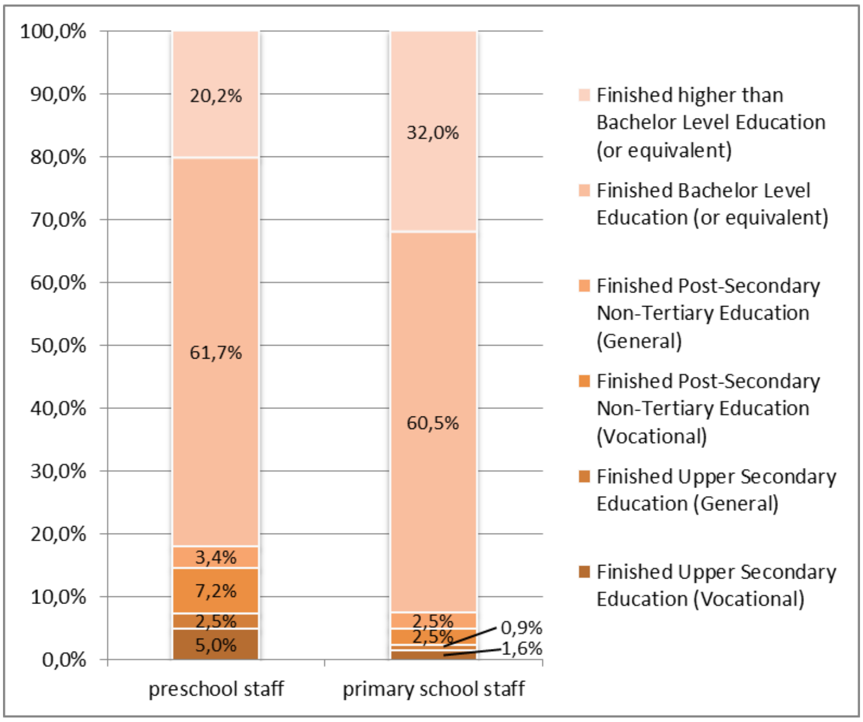

Figure 4.7. General education and training of surveyed teachers.

Regarding the national samples, distinctive cases seem to be the ones of Malta and Germany where 45.8% and 44.9% of the sampled teachers respectively do not have a Bachelor's (or equivalent) degree. Moreover, the German sample appears the most unevenly divided, since it has both the second largest proportion of teachers with lower than a Bachelor's level of education (44.9%) *and* the second largest proportion of teachers with higher than a Bachelor's level of education (53.1%). Finally, the Finnish sample has overall the largest percentage (57.1%) of 'highly educated' teachers, but also a non-trivial percentage (22.9%) of teachers who do not possess a Bachelor's (or equivalent) degree.

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With regard to **teacher certification**, 97% of the total sample declared themselves as certified, with no significant differences between the preschool and primary school staff (Figure 4.8). In consistence with the findings above, Finland had the lowest proportion of certified sampled teachers, but still at 90%.

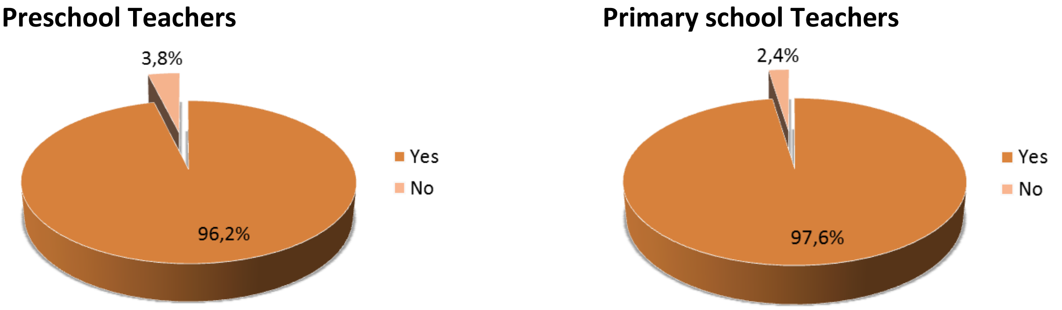

Figure 4.8. Teacher certification of surveyed teachers.

4.1.2.5 Teachers' background in science, mathematics and creativity

Concerning the **highest level of formal education** in which teachers last studied **science and mathematics**, teachers' responses show that at least half of the total teacher sample, but also of the two sub-samples did not study science and mathematics at a tertiary (i.e. Bachelor or above) education level. The situation is worse in the case of mathematics, which was studied at below tertiary level by 56.1% of all surveyed teachers, and by 63.5% of the preschool surveyed teachers. Overall the two sub-samples differ significantly ($p<0.01$) in their science and mathematics knowledge and skills (as measured by highest qualification), with the primary school staff having overall studied the disciplines at a higher level of formal education than the preschool staff (Figure 4.9).

The national samples[1] show a great variation in this aspect as well: from 92.3% of the sampled teachers in Malta to 24.7% in Portugal have studied science at below tertiary level, and from 88.6% of the sampled teachers in France to 12.3% in Portugal have studied mathematics at below tertiary level. Similarly to what we have noted previously Finland has overwhelmingly the highest proportion of teachers who have studied science (38.2%) and mathematics (36.8%) as part of their Master's degree studies.

[1] Excluding small samples of fewer than 44 teachers.

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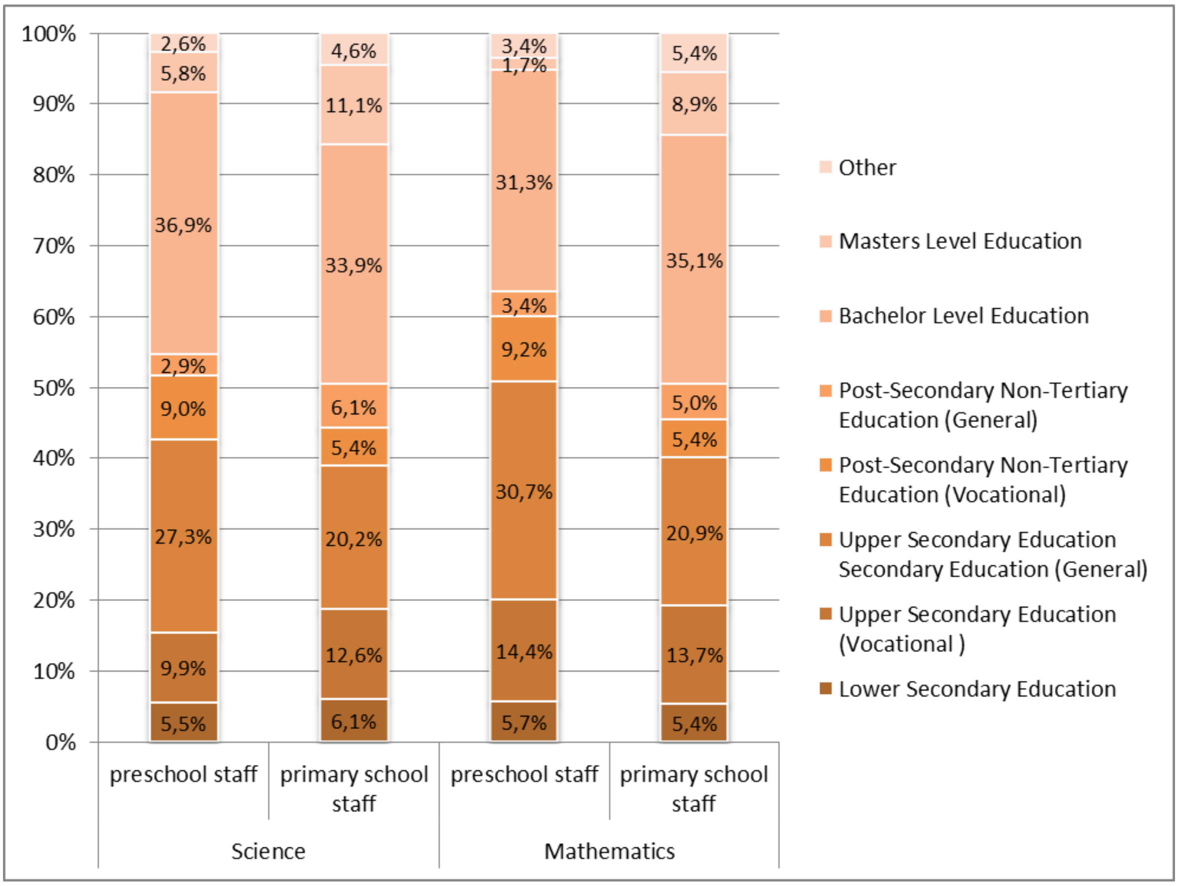

Figure 4.9. Teacher background in science and mathematics.

A follow up question inquired about the extent to which **a number of** relevant to the CLS research **disciplines and knowledge areas** were studied **as part of teachers' post-compulsory education and/or initial teacher training**. The majority of all teachers appear to have had an overview of, or introduction to Mathematics (51.6%), Science (57%), Environmental or Earth Sciences (58.7%) and ICT (53.2%) as part of their post-compulsory education, whereas areas of emphasis in their studies were the ones of Pedagogy (77.9%), Developmental Psychology (61.1%), Children's Development of Creativity (50.8%), and Creative Teaching Approaches (48.4%).

Significant differences ($p<0.01$) between the preschool and primary school teachers' preparation are detected in relation to the disciplines/areas of Mathematics, Science, Developmental Psychology and Children's Development of Creativity (Figure 4.10). The former two have been studied at a deeper level by more primary school than preschool teachers, whereas the latter two have been study areas of emphasis by more preschool than primary school teachers. Interestingly Creative Teaching Approaches are also more emphasised (significance at $p<0.05$) in preschool teachers' than in primary teachers' initial teacher training. .

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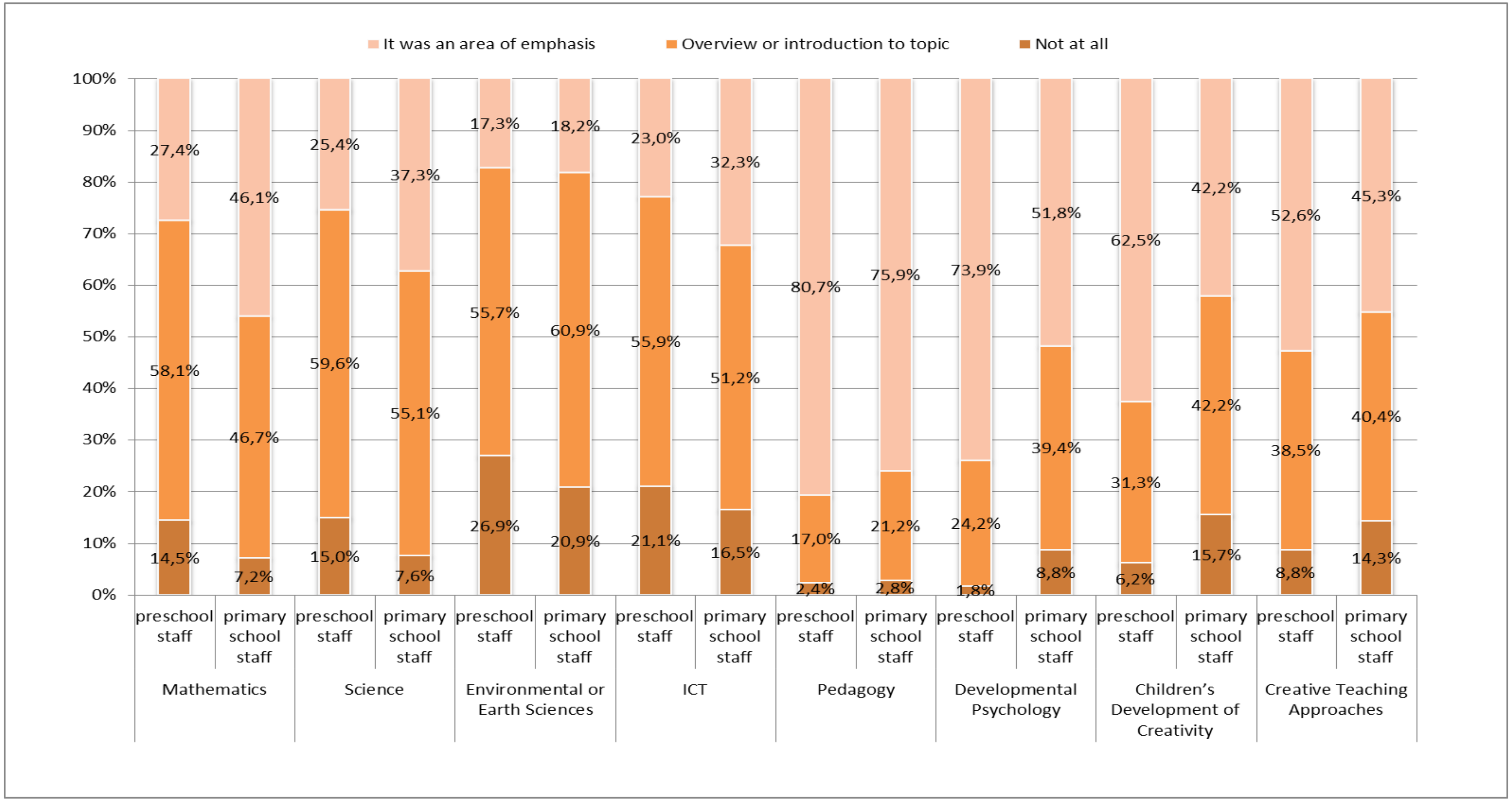

Figure 4.10. Study emphasis of relevant knowledge areas in teachers' initial training.

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The national samples differ significantly in the extent to which their teachers have been engaged with the knowledge areas in question as part of their post-compulsory education and/or initial teacher training. Mathematics and Science have been areas of emphasis in the initial training of 55.4% and 51.3% of English teachers respectively, but of only 11.9% and 4.5% of Finnish teachers. If one judges by their studies, one may presume that: the Finnish sample has the smallest percentage of teachers with deeper knowledge of Environmental or Earth Sciences (1.5%), Pedagogy (58.8%), Developmental Psychology (20.6%) and Children's Development of Creativity (9.0%); the Belgium Flemish sample has the highest percentage of teachers with more profound knowledge of Pedagogy (96.2%) and Developmental Psychology (92.6%); and the Romanian sample has the highest percentage of teachers with better appreciation of Children's Development of Creativity (77.8%) and Creative Teaching Approaches (68.9%). The latter seems to fare relatively worse amongst teachers in France, only 7.0% report to have had studies that emphasised Creative Teaching Approaches.

4.1.2.6 Teacher confidence

Teacher confidence has been identified in the research literature as an important enabling factor (or barrier) of innovative practice. The CLS survey attempted to assess the **teachers' confidence** in a variety of aspects **related to the teaching of science and mathematics**. Figure 4.11 shows that the majority of the surveyed teachers feels overall confident about all these aspects. As can be expected, the aspect most teachers (40.8%) feel very confident about is their general pedagogic knowledge. Over a fifth of them also feels very confident in their mathematics and science teaching and assessment, and their knowledge of mathematics and science pedagogy. It should however be noted that more teachers feel confident in their mathematics teaching, assessment and pedagogic knowledge, than in their science teaching, assessment and pedagogic knowledge. This is consistent with the finding that teachers are least confident in both their knowledge/understanding of science (ideas, processes and nature) and their competencies to carry out scientific inquiry.

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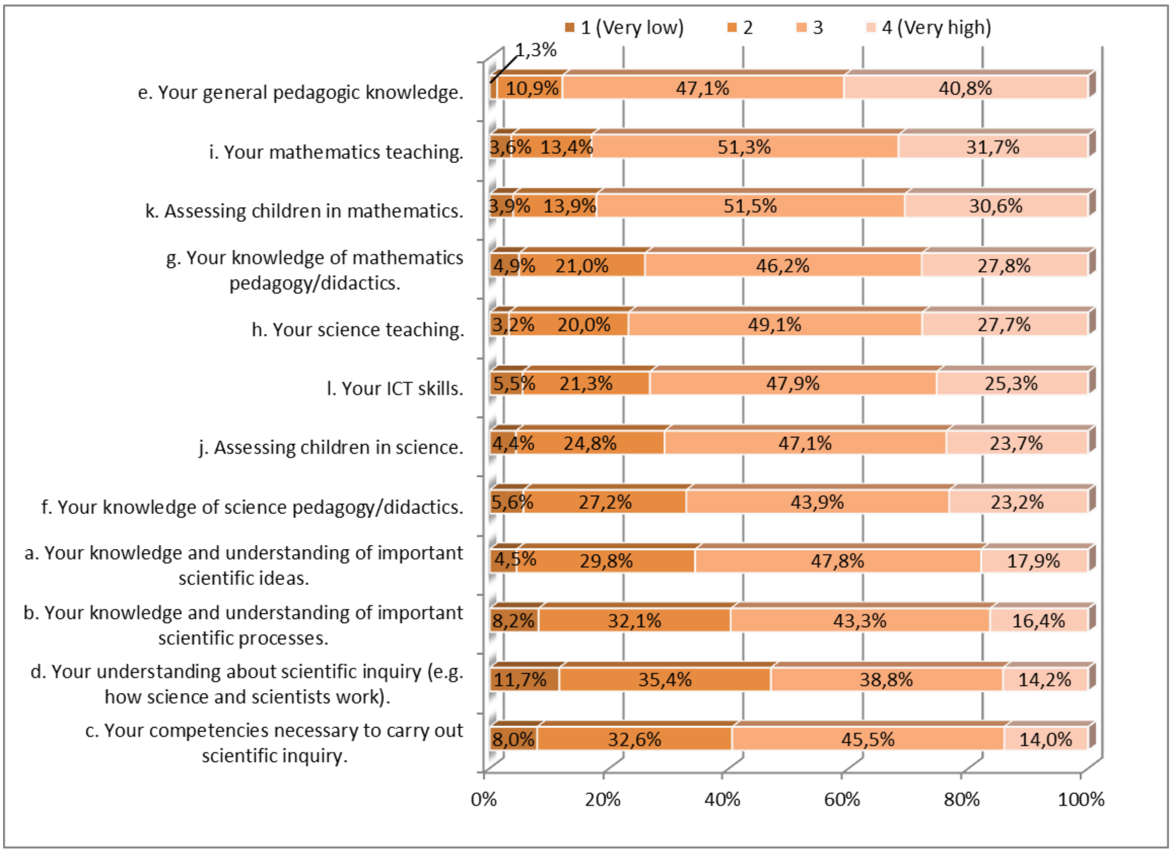

Figure 4.11. Teacher confidence.

Differences between preschool and early primary teachers

Preschool and primary teachers vary significantly (t-test, $p<0.01$) in their confidence in both their science and mathematics teaching practice and their science and mathematics knowledge and competences, with primary teachers being more confident overall than preschool teachers (Figures 4.12 and 4.13). On the other hand, they do not vary in their confidence in their general pedagogic knowledge and ICT skills. It would be interesting to look for connections between these differences in confidence and the corresponding preschool and primary teachers' conceptualisations of science and mathematics education.

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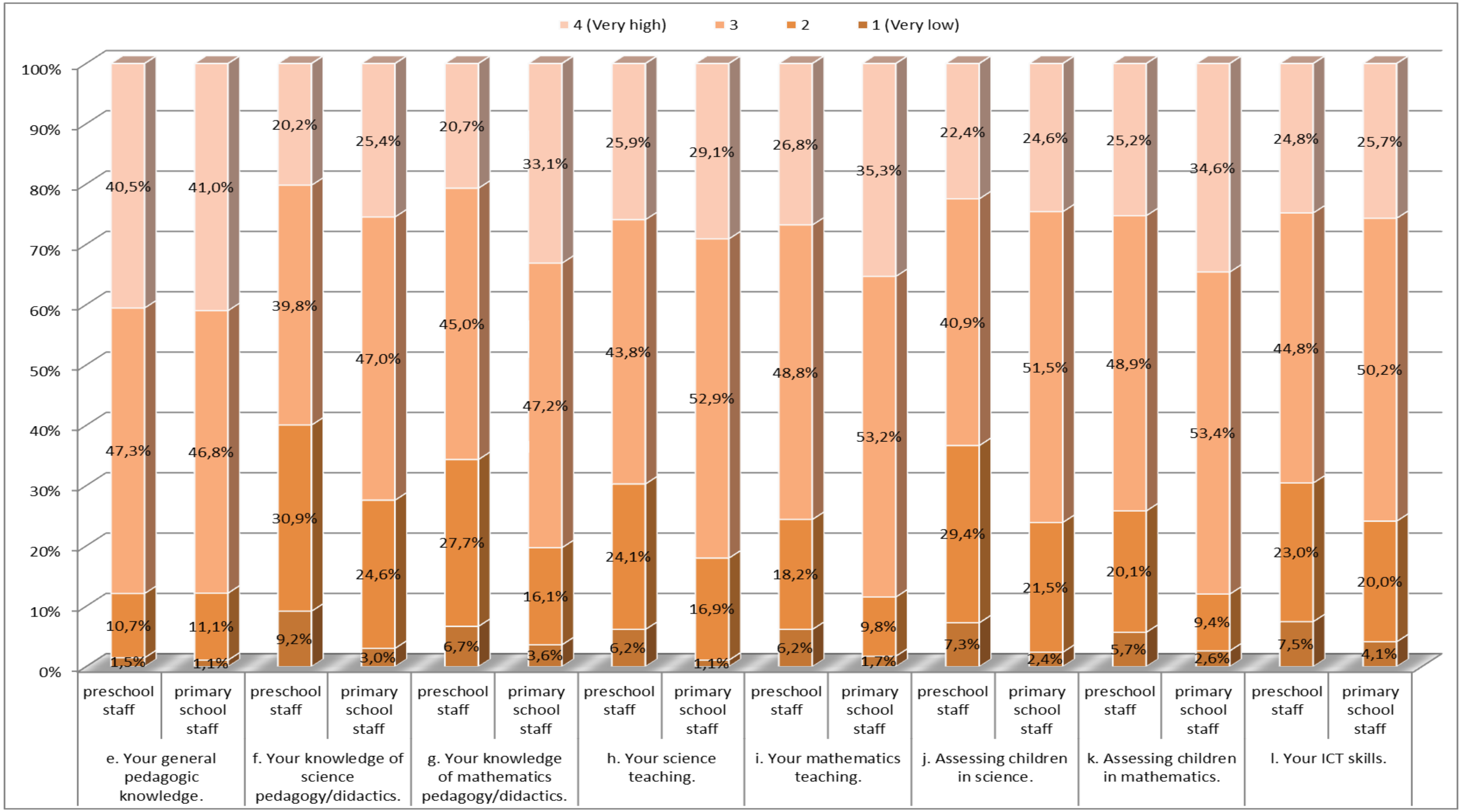

Figure 4.12. Preschool vs primary school teacher confidence in science and mathematics educational aspects.

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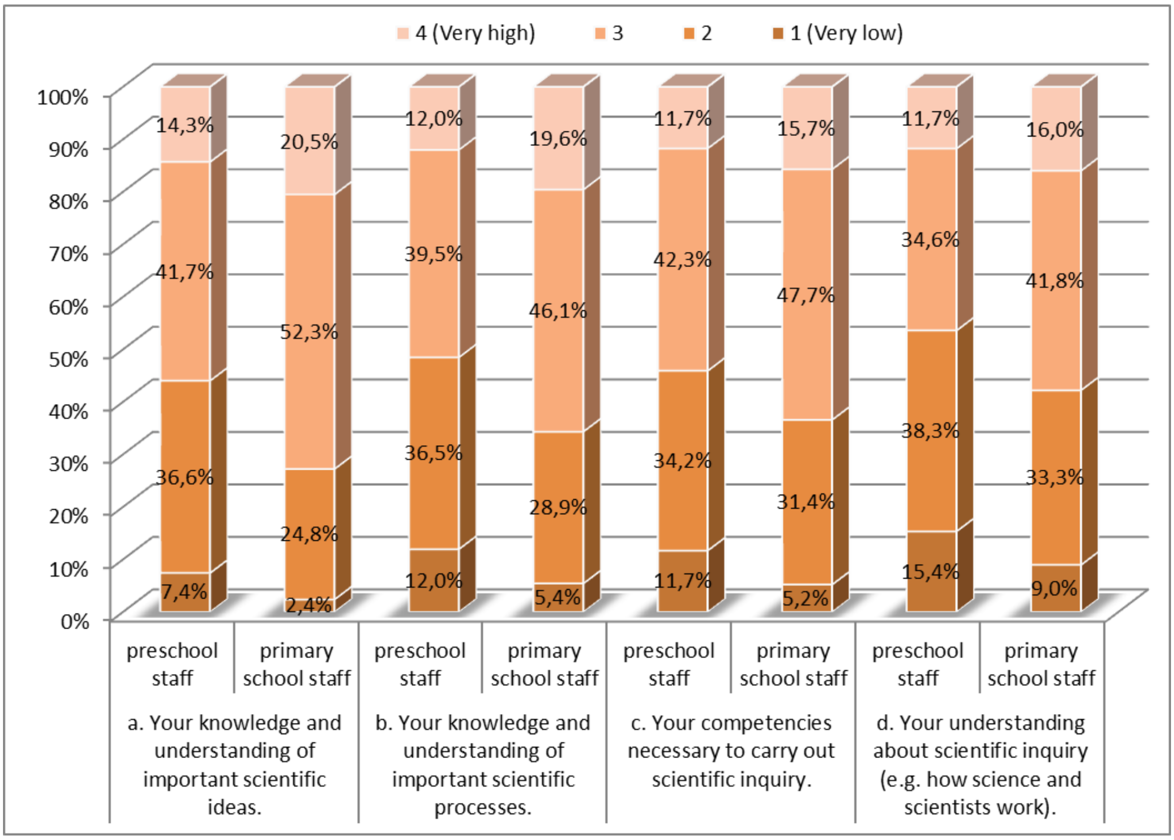

Figure 4.13. Preschool vs primary school teacher confidence in their knowledge and competencies of scientific inquiry.

Differences between partner countries

There is also significant variation amongst the national samples' teacher responses to this question as determined by one-way ANOVA ($p<0.05$). A Tukey post-hoc test revealed that if we exclude the samples of fewer than 45 teachers, the Romanian sample has significantly higher confidence than all other samples of teachers in all aspects related to science and mathematics teaching practice. More particularly, about the aspects that relate to the **teaching of science** the surveyed teachers in Romania are significantly more confident in:

- their knowledge of science pedagogy than all other teachers apart from the Portuguese;
- their science teaching compared to teachers in France, Belgium (Flanders), Greece, Germany and Portugal; and
- their science assessment compared to teachers in France, Belgium (Flanders), Finland, Malta, Greece, Germany and Portugal.

Additionally, the Romanian teachers have significantly higher confidence in their **knowledge and understanding of science ideas, processes and nature** than their Belgium (Flemish), Finnish (in the case of science processes and nature) and Maltese (in the case of science processes) counterparts. Concerning teachers' confidence in **their competencies to carry out scientific**

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inquiry both Romanian and English teachers are on the high confidence end and Maltese teachers are on the low end.

Concerning confidence in the aspects that relate to the **teaching of mathematics** the following national samples of teachers differ significantly and the most:

- French and Romanian teachers are at the different ends of the low-to-high spectrum regarding their knowledge of mathematics pedagogy;
- German and Romanian teachers are at the different ends of the low-to-high spectrum regarding their confidence in mathematics teaching; and
- both Belgium (Flemish) and German teachers have the lowest confidence in mathematics assessment, with the Romanian teachers having the highest confidence.

As regards teachers' confidence in their **general pedagogic knowledge**, there seem to be two distinct and homogeneous subsets of teachers: Malta, France, Portugal on the lower end of the spectrum and the UK (England), Belgium (Flanders), Greece, Germany and Romania on the higher end.

Finally, in terms of confidence in their **ICT skills** the French teachers score the lowest and the UK (English) and Romanian teachers the highest.

All 12 items used for teacher confidence were tested for reliability and inter-item correlation and were found internally consistent (Cronbach's alpha is 0.929).

4.2 Teacher conceptualizations of early years science and mathematics teaching, learning and assessment

This section presents an overview of teachers' conceptualisations of early years science and mathematics based on their responses to the *Creative Little Scientists* survey across partner countries. It draws together themes identified in qualitative data provided in partner commentary in their National Reports with summaries of quantitative data from the questionnaires.

Results are presented according to the framework of curriculum components (van den Akker, 2007) used to structure the National Policy Reports and National Teacher Survey Reports. Commentary is provided on similarities and differences in the ways in which each component is represented in teachers' responses. Emphases in relation to each component were judged in relation to a series of items based on the *List of Mapping and Comparison Factors* (Deliverable D3.1) that characterise the common ground that early years science and mathematics can share with creativity. These judgments are summarised in the tables included in Appendix 7.

4.2.1 Rationale or vision: Why are children learning?

The 'rationale' component is placed at the centre of the spider web and refers to the overall principles or central mission of science and mathematics education. This dimension serves as a major orientation point, and the nine other dimensions that follow are ideally, linked to that rationale and preferably also consistent with each other. The corresponding factors, reflecting

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also the drivers behind this project and the wider educational context in which it is being undertaken, are:

- science as economic imperative;
- creativity as economic imperative;
- scientific literacy and numeracy for society and individual (including the development of the child as a citizen through science);
- technological imperative;
- science and mathematics education as a context for the development of general skills and dispositions for learning.

The survey data and the commentary provided by partners in their National Reports indicate a varied vision or rationale for science in compulsory education across partner countries. The overall picture of the purpose of science education is presented in the bar chart below (Figure 4.14) and clearly shows that all purposes included in the survey are considered important for teachers across all partner countries, the most important being for children to develop important attitudes and dispositions as a foundation for future learning (97.7% of the total sample) and become socially and environmentally aware and responsible citizens (97.2%).

The purpose which is seen as least important for science education in compulsory education by teachers is to provide a foundational education for future scientists and engineers. This particular purpose, described in the conceptual framework as indicative of the economic imperative driving science education, was chosen by a combined 28.9% of teachers as 'not important' and 'a little important'. The difference in the way teachers responded to this question item compared with the rest was corroborated by the reliability analysis. This showed that whereas the internal consistency among all six items of the question is statistically 'acceptable' (Cronbach's $\alpha=0.786$), the reliability rises to $\alpha=0.810$ if this item is removed. Having said this, this item was still found to have acceptable (i.e. >0.3) 'Corrected Item-Total Correlation' value (0.448) and thus was not removed.

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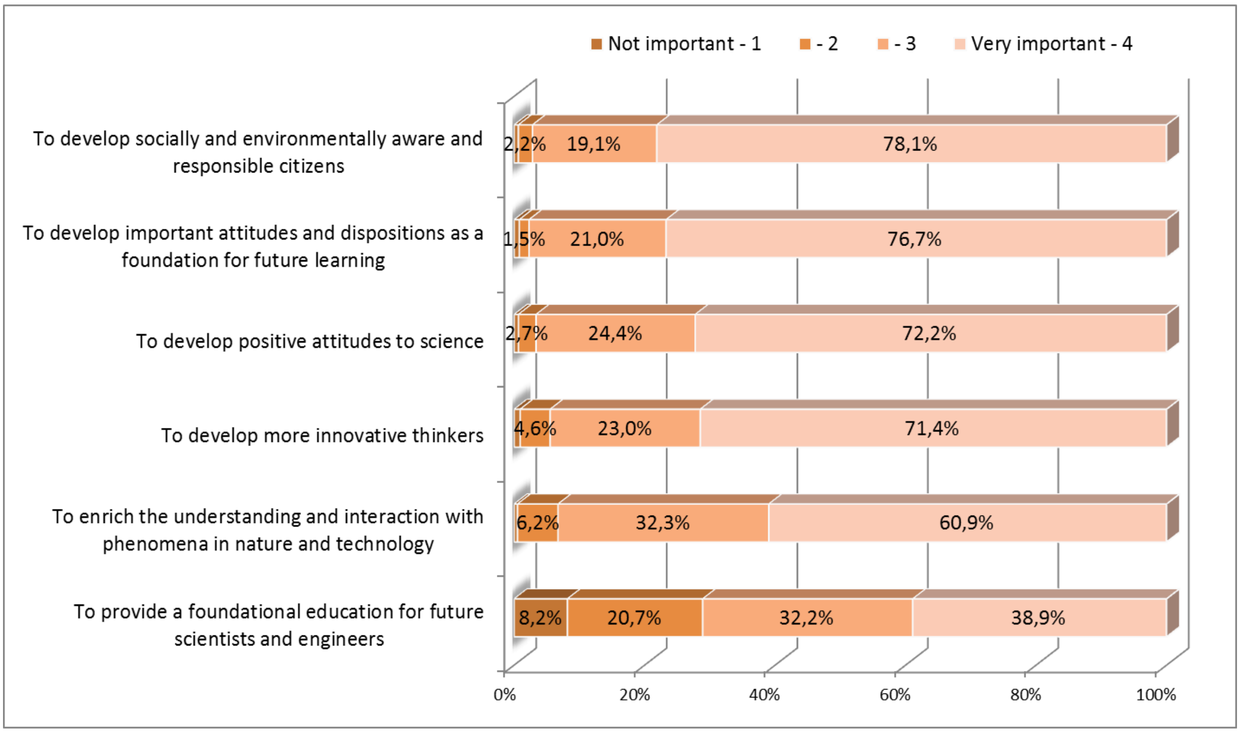

Figure 4.14. Teachers' views on the purposes of school science in compulsory education (5 to 16 years).

Differences between partner countries

These results prompted a deeper exploration into whether and how the various national samples' responses varied in the above mentioned respects (Figures 4.15-4.17). A one-way ANOVA comparison of means revealed no significant differences ($p<0.01$) between the national samples' responses to the two most favoured rationales for science learning: developing socially and environmentally aware and responsible citizens and developing important attitudes and dispositions as a foundation for future learning. On the other hand, the rationale of providing a foundational education for future scientists and engineers through science learning revealed significant difference ($p<0.05$) between the UK (England) sample, in which 94.2% of the teachers consider this economic driver as a 'very important' and 'important' purpose of science education, and the samples in Romania (75.4%), France (62.8%), Greece (61.4%), Germany (57.1%), Finland (56.9%) and Belgium (Flanders) (45.7%).

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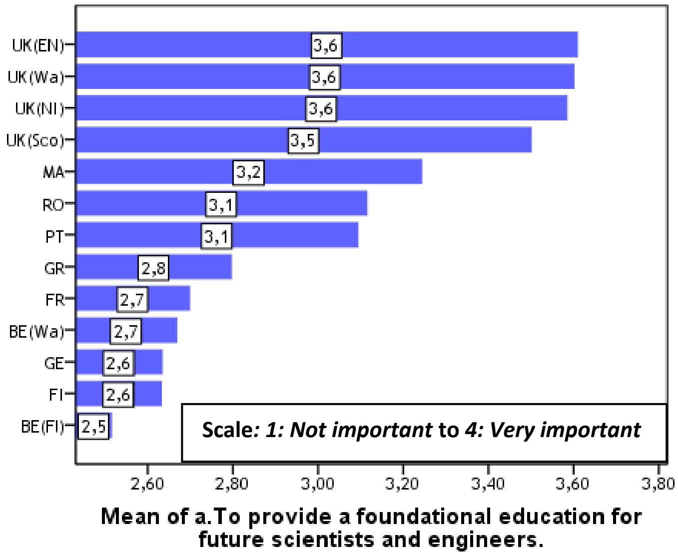

Figure 4.15. Importance of science education for economic growth: National samples' variations.

Interestingly, a similar variation amongst the countries was found in whether teachers perceive the development of more innovative thinkers as a purpose of science education. This purpose, as before, has been described in the project's conceptual framework as indicative of the economic imperative often driving the emphasis on creativity in education (including science education). Excluding samples of fewer than 46 teachers, Flemish teachers rated this purpose lower than all other teachers and significantly differently ($p<0.05$) than teachers in Greece, Portugal, Romania, Malta and the UK (England) (Figure 4.16).

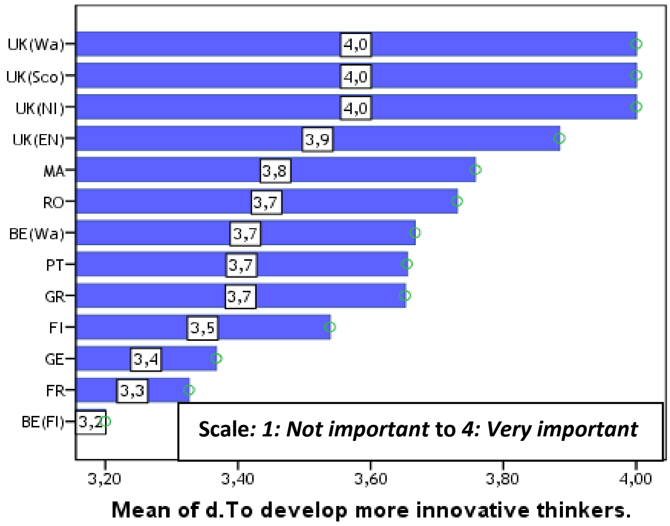

Figure 4.16. Importance of creativity for economic growth: National samples' variations.

Finally, the technological imperative ("To enrich the understanding and interaction with phenomena in nature and technology") is considered as a less important purpose of science education by French teachers than by teachers in Greece, Germany, Romania, Portugal and the UK (England) (Figure 4.17).

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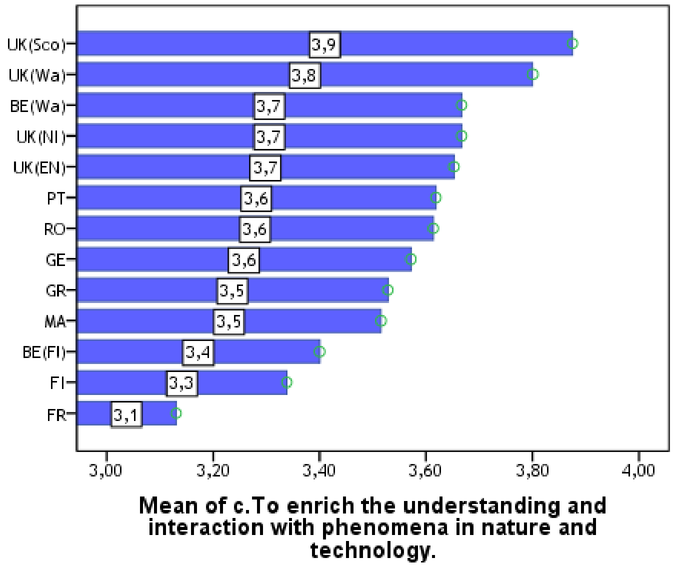

Figure 4.17. Importance of science education for the development of general skills and dispositions: National samples' variations.

Differences between preschool and early primary teachers

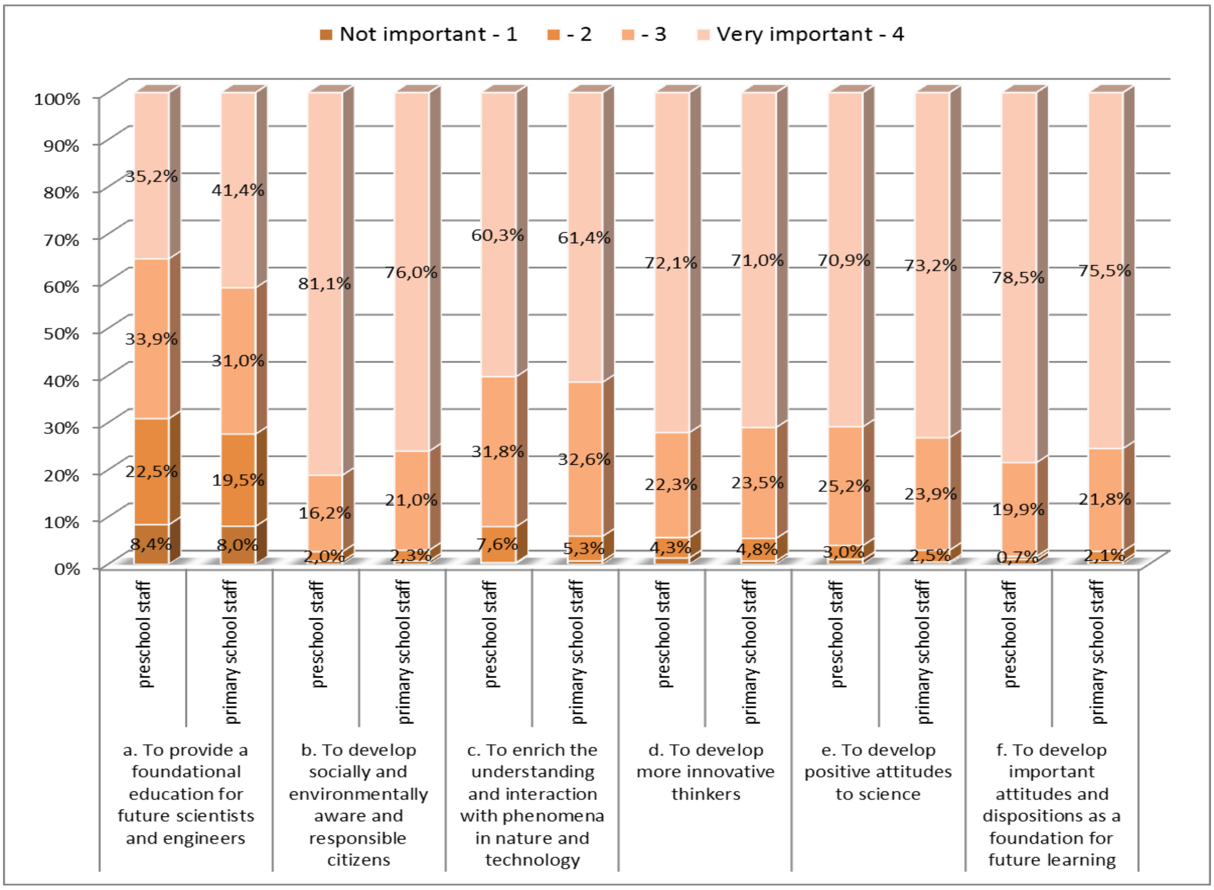

Figure 4.18. Preschool vs primary teachers: Importance of purposes of school science in compulsory education (5 to 16 years).

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Preschool and primary teachers' conceptualisations of the purposes of science learning in compulsory education do not vary significantly (t-test, $p<0.01$) (Figure 4.18).

4.2.2 Aims and objectives: Toward which goals are children learning?

Teachers' responses concerning their aims and teaching objectives for early years science, as evident in the chart below (Figure 4.19), reveal clear trends among cognitive, affective and social outcomes of science education. Teachers very often plan their teaching to pursue affective factors of science learning ("To have positive attitudes to learning"; "To be interested in science"; and "To have positive attitudes to science learning"). Social factors, such as fostering collaboration and communicating investigations and explanations, are also common early years science learning objectives among respondents across the participating countries, whereas cognitive factors, such as knowing and understanding important scientific ideas and processes are less so.

Interestingly from the project's point of view, more than three quarters of all teachers foster quite or very frequently the development of children's capabilities to carry out scientific inquiry or problem-based activities, such as questioning ("To be able to ask questions about objects, organisms and events in the environment"), gathering evidence ("To be able to employ simple equipment and tools, such as magnifiers, thermometers, and rulers, to gather data and extend to the senses") and communicating findings ("To be able to communicate investigations and explanations"). It should be noted that in this group of inquiry-related objectives, the ability to plan and conduct a simple investigation is promoted least frequently, and only by 29.80% of the teachers very frequently. Finally, learning outcomes related to the nature of science and thus understandings *about* scientific inquiry, that is about how scientists develop knowledge and understanding of the surrounding world, are the least frequently pursued by teachers of early years and early primary education.

It should be noted that the reliability analysis for all 13 items of this question showed that they have statistically good internal consistency (Cronbach's $\alpha=0.810$). However, interestingly one of the most favoured science learning objectives amongst teachers, "to be able to collaborate with other children", is only weakly correlated with the rest (corrected item-total correlation 0.080 is <0.3) and thus if this item were removed the reliability would increase to $\alpha=0.883$.

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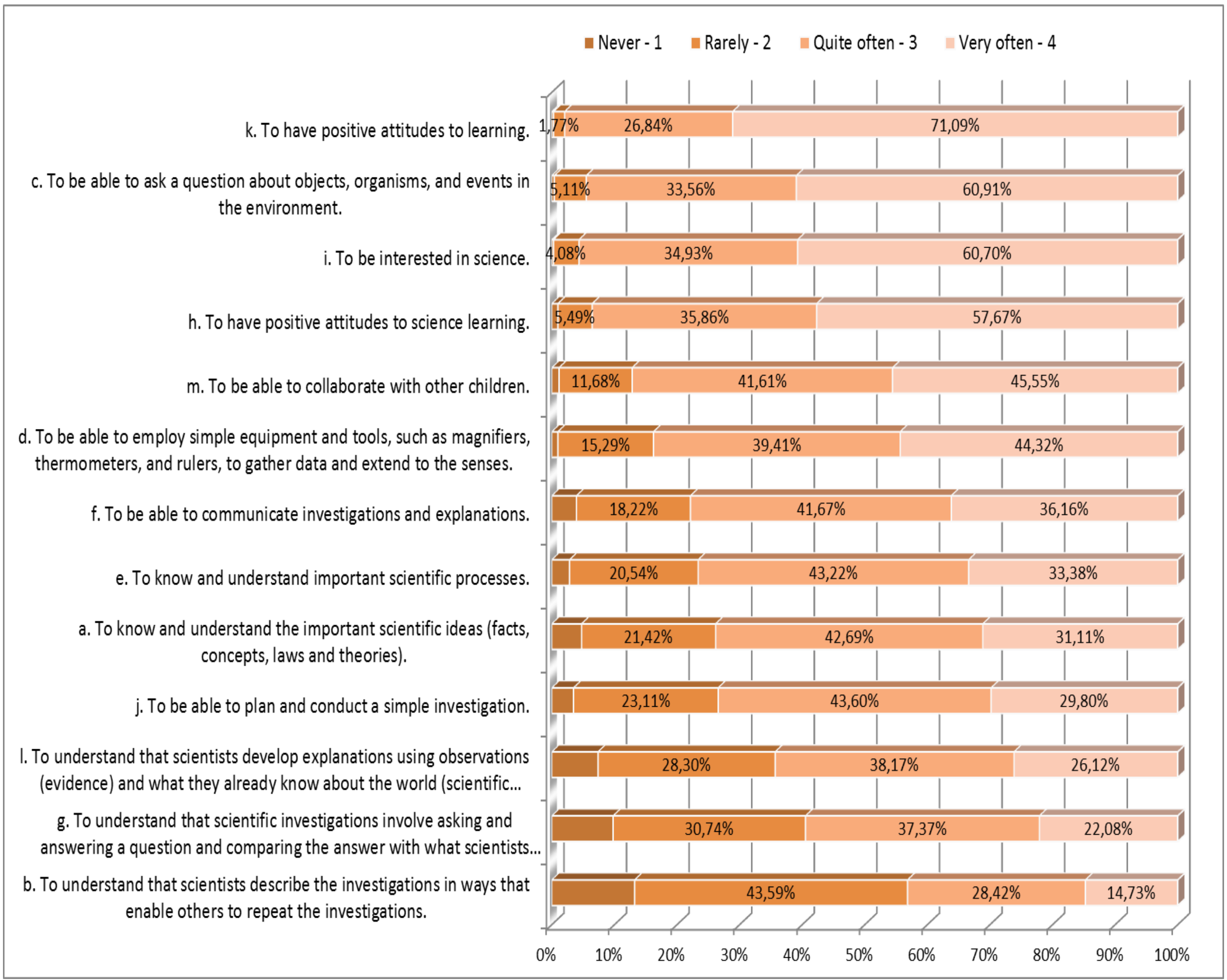

Figure 4.19. Frequency with which teachers foster science learning outcomes.

Differences between partner countries

The responses gathered in regard to the aims and objectives pursued in the teaching of science by the partner countries' samples of teachers are on the whole in agreement with the findings for the total sample presented and explained above. There are still however variations amongst the countries which are interesting and discussed here below.

Fostering collaboration amongst children in early years science classrooms is the only objective which does not show any significant variation amongst the respondents of all the partner countries. Moreover, there is also no significant variation in the pursuit of affective learning outcomes amongst the different samples, excluding the small samples of under 40 teachers. The biggest variation amongst the countries appears in relation to the pursuit of cognitive outcomes (Figures 4.20 and 4.21). In particular, French teachers appear to lie on the low end of the spectrum and are almost equally divided between those who frequently or very frequently set cognitive learning objectives and those who do not (or rarely do). The sampled Finnish teachers on the other hand seem overwhelmingly (97%) to pursue quite often and very often the

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development of children's knowledge and understanding of scientific ideas (but less so -65.3%- of scientific processes), and the German teachers the development of children's knowledge and understanding of scientific processes (95.7%) (but less so -77.6%- of scientific ideas).

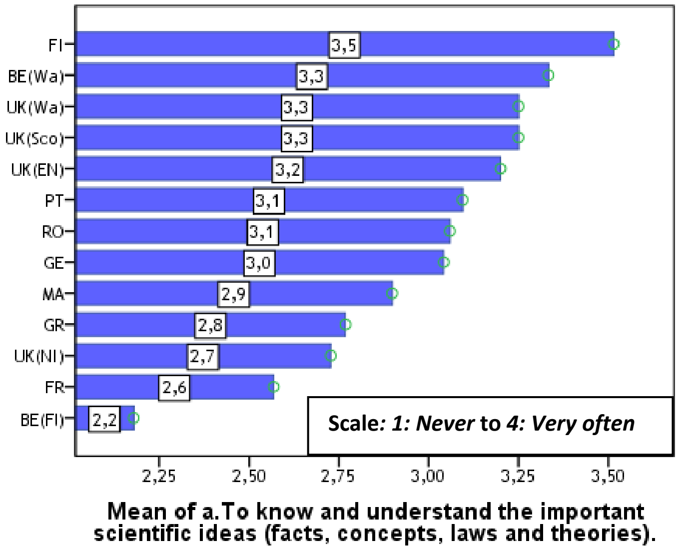

Figure 4.20. Frequency with which teachers foster cognitive learning outcomes about science ideas: National samples' variations.

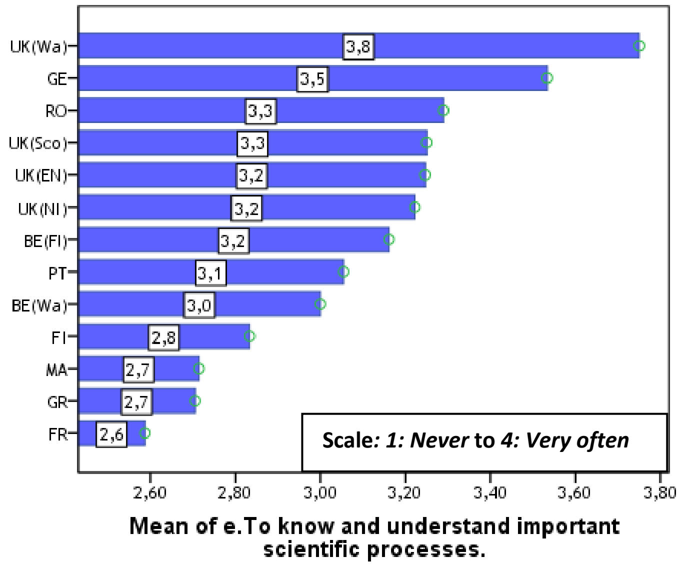

Figure 4.21. Frequency with which teachers foster cognitive learning outcomes about science processes: National samples' variations.

Concerning the objectives that relate to the development of children's capabilities to carry out scientific inquiry or problem-based activities (e.g. Figures 4.22 and 4.23), the English teachers seem to pursue them systematically more frequently than most other teachers, followed only by the German teachers who more frequently foster all but children's ability to ask questions (Figure

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4.22). On the other hand, the Maltese teachers appear to foster less often most of these inquiry-related objectives.

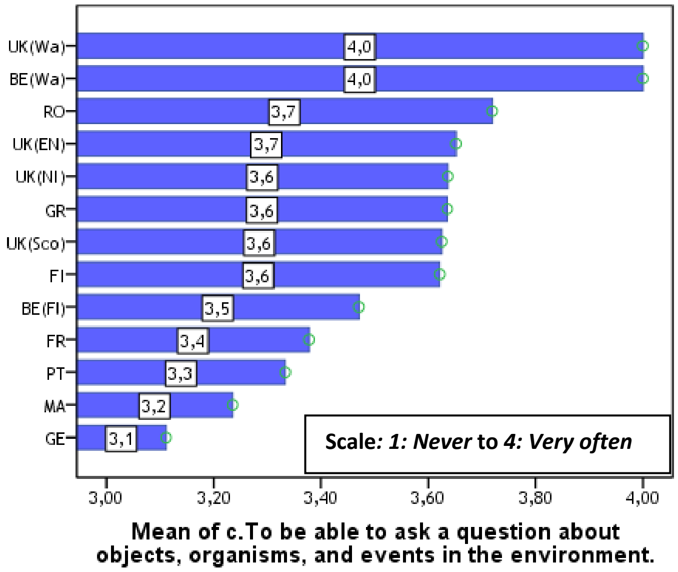

Figure 4.22. Frequency with which teachers foster children's questioning abilities: National samples' variations.

Promoting children's ability to plan and conduct a simple investigation, as also discussed above, is one of the objectives worth focusing on. A one-way ANOVA comparison of means, followed by a Tukey post-hoc test revealed that teachers in Greece, Finland, France, Portugal and Romania form a more homogeneous group who set this objective for their pupils less frequently than the rest (Figure 4.23).

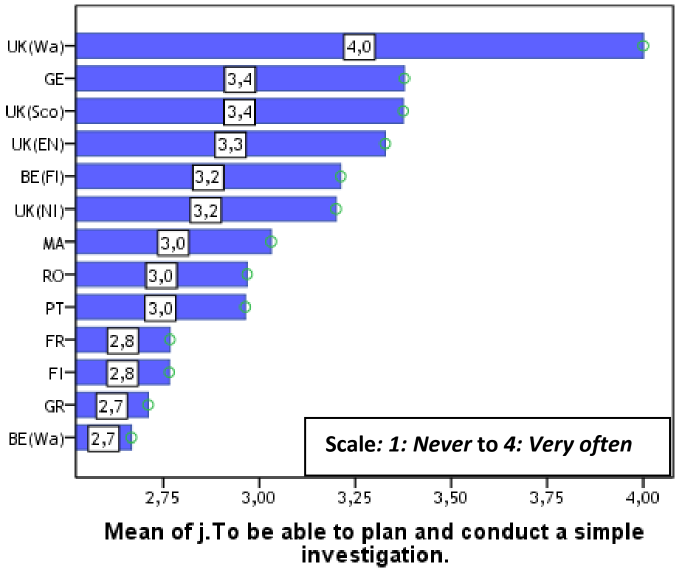

Figure 4.23. Frequency with which teachers foster children's ability to plan and conduct a simple investigation: National samples' variations

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Finally, all learning outcomes related to the nature of science are less frequently pursued by teachers in Finland and more frequently by teachers in Portugal than teachers in most other partner countries.

Overall, the limited deviations from the trends seen in the responses of the total teacher sample further signify the importance that teachers across Europe give to affective and social learning outcomes of science education, while highlighting the limited relative importance paid to objectives related to the nature of science, or understanding *about* science inquiry.

Differences between preschool and early primary teachers

An independent-samples t-test showed significant differences ($p<0.01$) between preschool and primary teachers in relation to 9 out of the 13 learning outcomes fostered by them (see Figures 4.24 and 4.25). Primary teachers set significantly more frequently than preschool teachers all these nine science learning objectives concerned mainly with cognitive and nature of science learning aspects and less with some inquiry-related and affective ones. There is no significant difference between the teachers of the two education levels in how frequently they promote children's collaboration, positive attitudes to learning and their abilities to ask questions about their environment and use simple equipment and tools.

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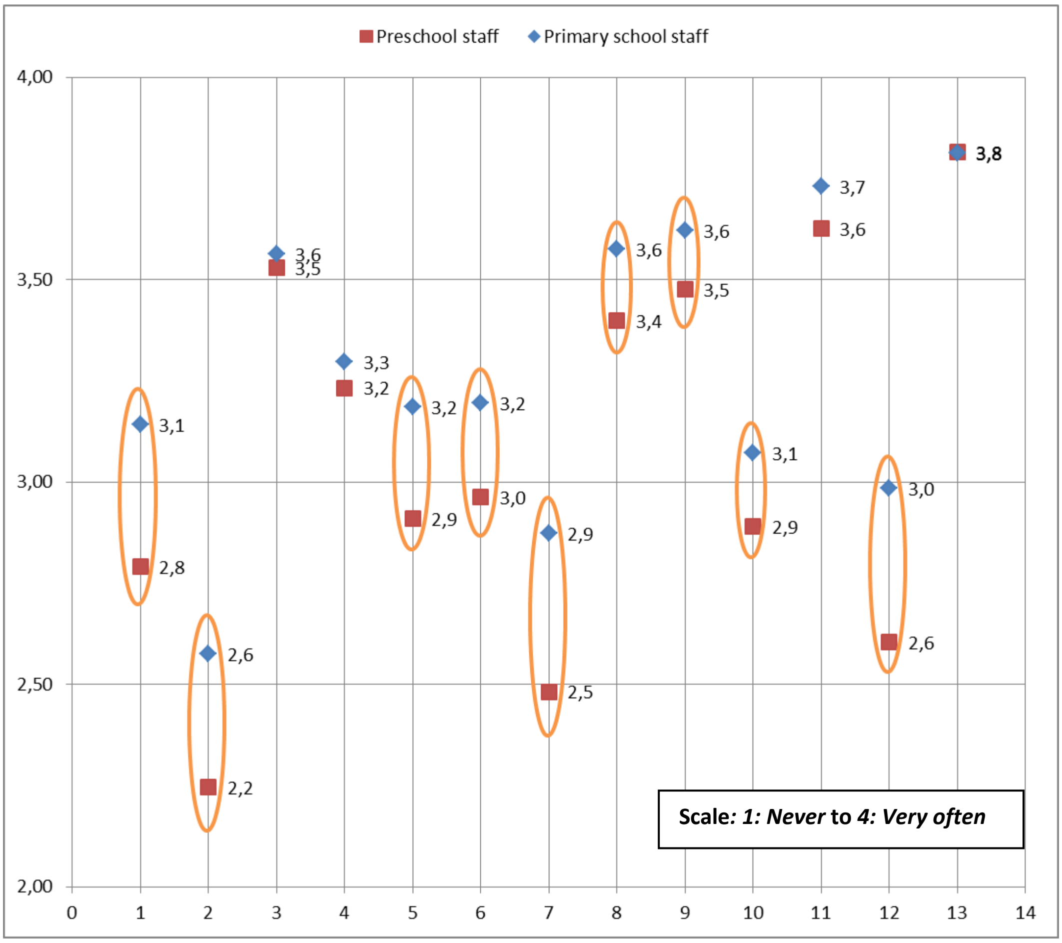

1: To know and understand the important scientific ideas (facts, concepts, laws and theories).
2: To understand that scientists describe the investigations in ways that enable others to repeat the investigations.
3: To be able to ask a question about objects, organisms, and events in the environment.
4: To be able to employ simple equipment and tools, such as magnifiers, thermometers, and rulers, to gather data and extend to the senses.
5: To know and understand important scientific processes.
6: To be able to communicate investigations and explanations.
7: To understand that scientific investigations involve asking and answering a question and comparing the answer with what scientists already know about the world.
8: To have positive attitudes to science learning.
9: To be interested in science.
10: To be able to plan and conduct a simple investigation.
11: To have positive attitudes to learning.
12: To understand that scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge).
13: To be able to collaborate with other children.

Figure 4.24. Differences between preschool and primary teachers' science teaching objectives.

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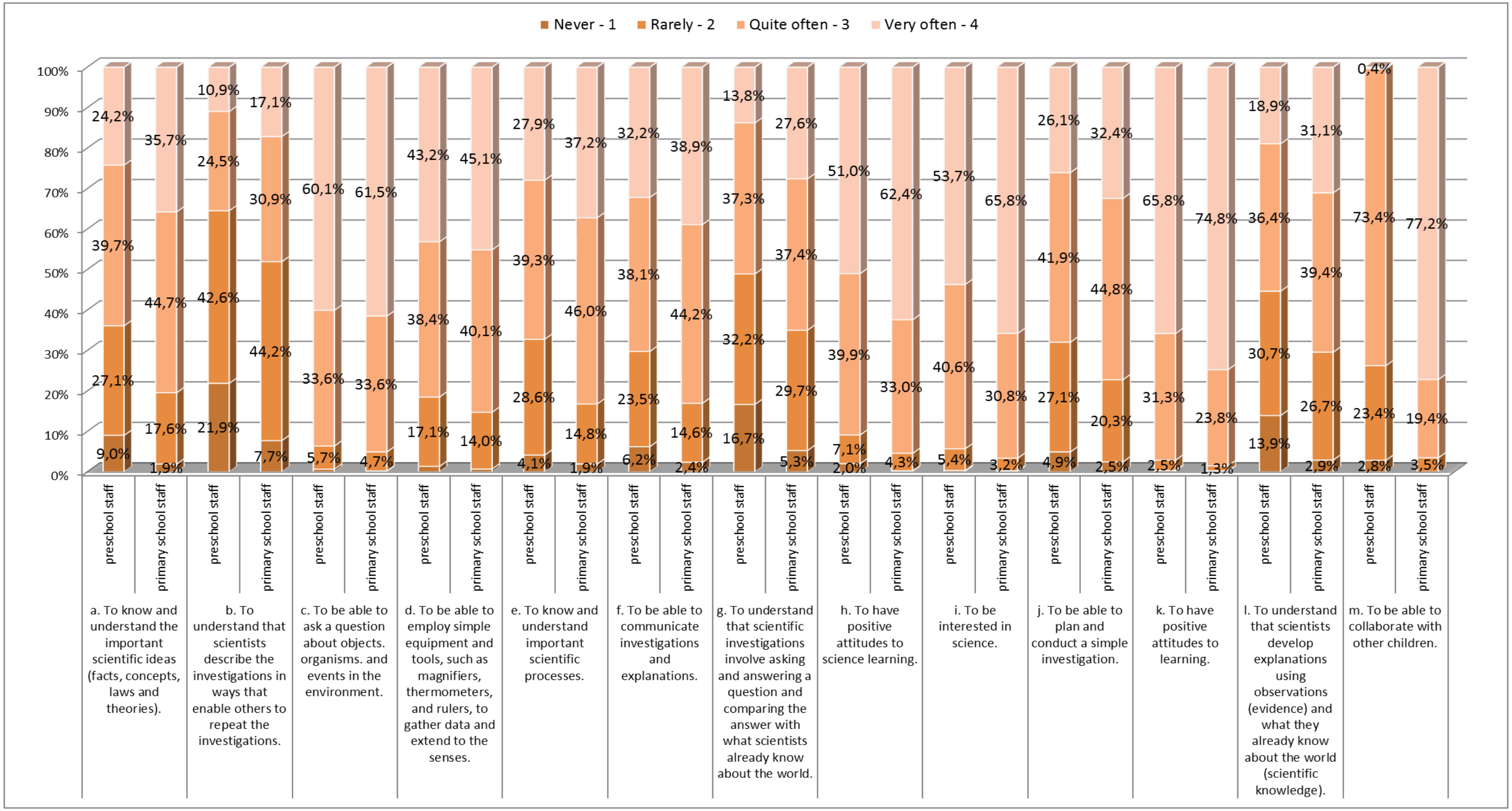

Figure 4.25. Preschool vs primary teachers: Frequency of fostering science learning outcomes.

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4.2.3 Learning activities: How are children learning?

All learning activities that were included in this section of the questionnaire and which teachers were asked to consider were defined in the *Conceptual Framework* (D2.2) as inquiry activities. The analysis of the responses on learning activities can be used to comment on whether teaching practice with potential for IBSE is evident in preschool and primary education.

4.2.3.1 Use of inquiry-based science activities

The National Reports indicate a common emphasis on hands on approaches and activities linked to children's everyday lives (Figure 4.26). The learning activities which are used most commonly by the respondents are predominantly linked to observation, as well as to fostering children's questioning and eliciting their curiosity in natural phenomena. Social activities such as communicating results and explanations are also used quite often, along with using simple equipment to gather data and extend to the senses. On the other end of the spectrum, learning activities that involve children planning and designing their investigations are the least common of all the learning activities tied to scientific inquiry; more than one third of all respondents either never or rarely use them as part of their science teaching. In general, consistently with what was noted in the analysis of teachers' inquiry-related learning objectives, a more experiential approach is preferred by teachers across the partner countries, while promoting understandings about scientific concepts and developing children's basic procedural knowledge takes a less dominant place in the learning activities carried out in the classroom.

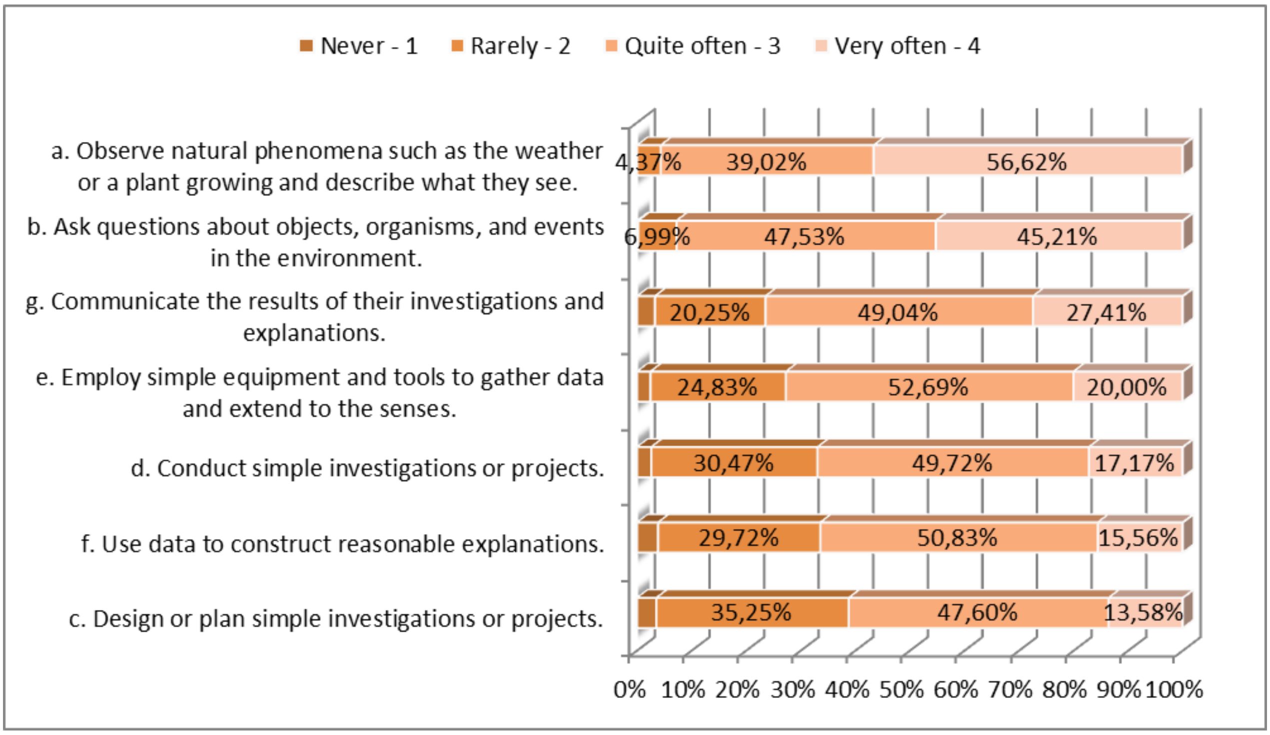

Figure 4.26. Frequency with which teachers encourage inquiry-based science activities.

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It should be noted that the reliability analysis for all 7 items of this question showed that they do not have statistically acceptable internal consistency (Cronbach's α=0.589). However, interestingly one of the least favoured science learning activities amongst teachers, "to use data to construct reasonable explanations", is only weakly correlated with the rest (corrected item-total correlation 0.209 is <0.3) and thus if this item were removed the inter-item reliability would increase to α=0.707, which is statistically acceptable.

Differences between partner countries

A number of differences regarding teachers' use of inquiry-oriented learning activities were found amongst the partner countries, consistent with the differences previously discussed in relation to the inquiry-related science objectives reported to be fostered by them. Thus there are no major differences amongst the teachers in the use of learning activities which promote children's observational and questioning skills, whereas there are for activities that involve children designing (or planning) and conducting simple investigations or projects (Figures 4.27 and 4.28). In particular, Finnish and Maltese teachers occupy the lower end of the spectrum in the use of these latter activities, and English teachers the upper end. Greek and German teachers seem to involve children more in the conduct of investigations but less in their planning.

Concerning the rest of the inquiry activities the variations are smaller but worth mentioning. For example, children employing simple equipment to gather data is more common in England, Greece and Portugal, but no so much in Finland, France and Malta, whereas children handling data to construct explanations is used more often than all other countries in Romania. Finally, Finnish together with Romanian and English teachers seem to favour most activities in which children communicate the results of their investigations and explanations. Greek teachers use significantly less such activities.

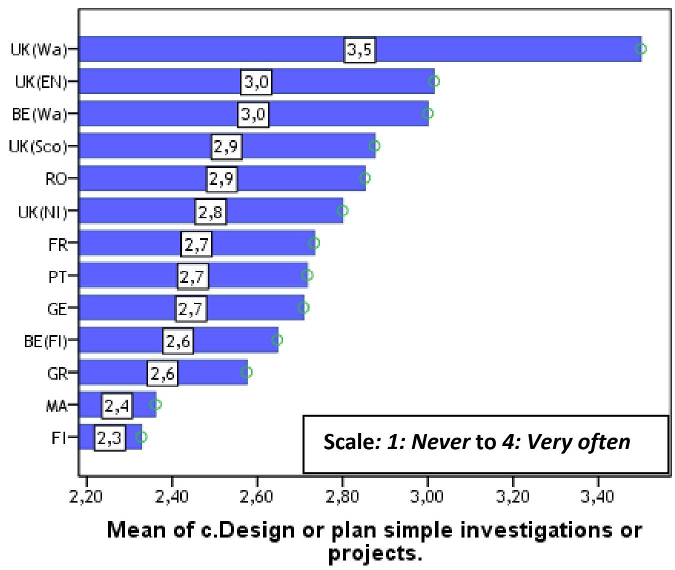

Figure 4.27. Frequency with which teachers use learning activities in which children design or plan simple investigations or projects: National samples' variations.

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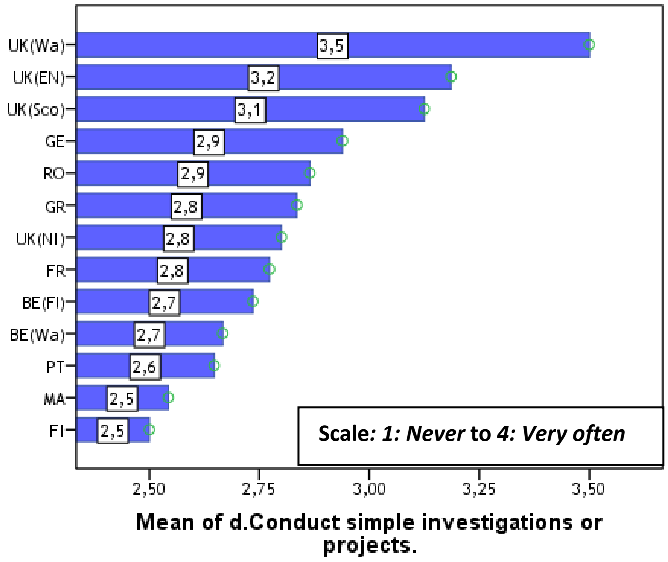

Figure 4.28. Frequency with which teachers use learning activities in which children conduct simple investigations or projects: National samples' variations.

Differences between preschool and early primary teachers

An independent-samples t-test showed significant differences (p<0.01) between preschool and primary teachers only in relation to the use of activities which promote the observational skills of children. These are used more frequently by preschool teachers than by early primary school teachers; 99.3% and 93% respectively use them quite or very often (Figure 4.29).

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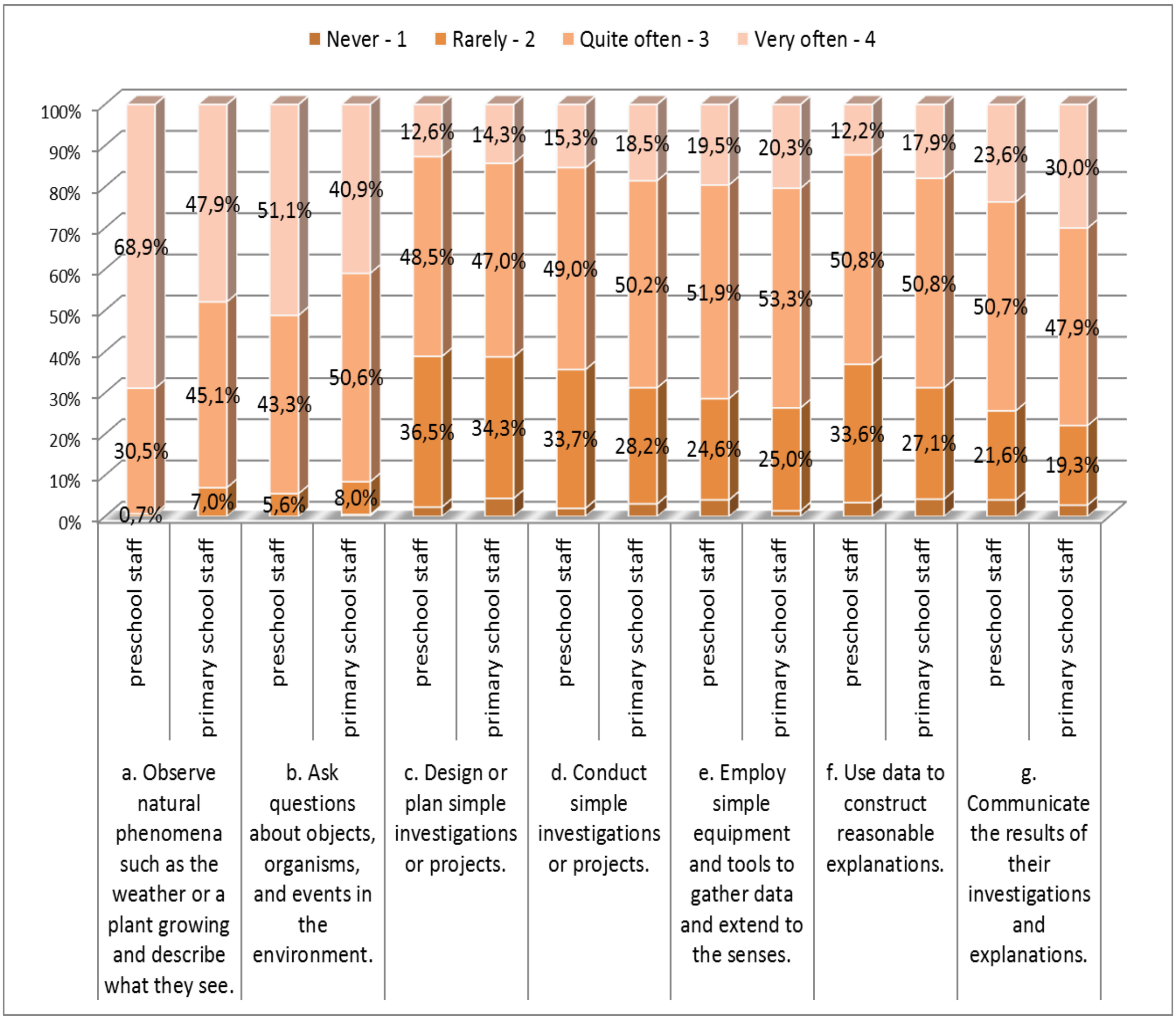

Figure 4.29. Preschool vs primary teachers: Frequency of use of inquiry-based science activities.

4.2.3.2. Teaching approach to science inquiry

The bar chart (Figure 4.30) that follows presents teachers' mostly used approach in regard to essential features of science inquiry. Although this question can be considered also under the following dimension of 'Pedagogy', since it focuses on a teaching approach more than on the kinds of learning activities used, we decided to include its discussion here as it naturally complements the previous discussion on the frequency of use of science inquiry activities in the early years classroom.

Teachers were provided with a table describing three possible variations (Open/Guided/Structured) for each of seven features of science inquiry in the classroom and were then asked to indicate which of the three variations mostly characterises their teaching practice. Their responses reveal that almost half of them prefer to use an 'open' approach when children

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formulate and communicate explanations based on evidence, whereas value a 'guided' approach in respect of all other features of IBSE (i.e. setting questions, identifying and analysing evidence, making connections to scientific knowledge and reflecting on the inquiry process). In the first case children decide and act feely and independently, in the latter children decide from a pre-selected by the teacher number of choices. Moreover, about a fifth of all teachers follow a 'structured' approach and choose to restrict children's agency when using any of these latter features of IBSE.

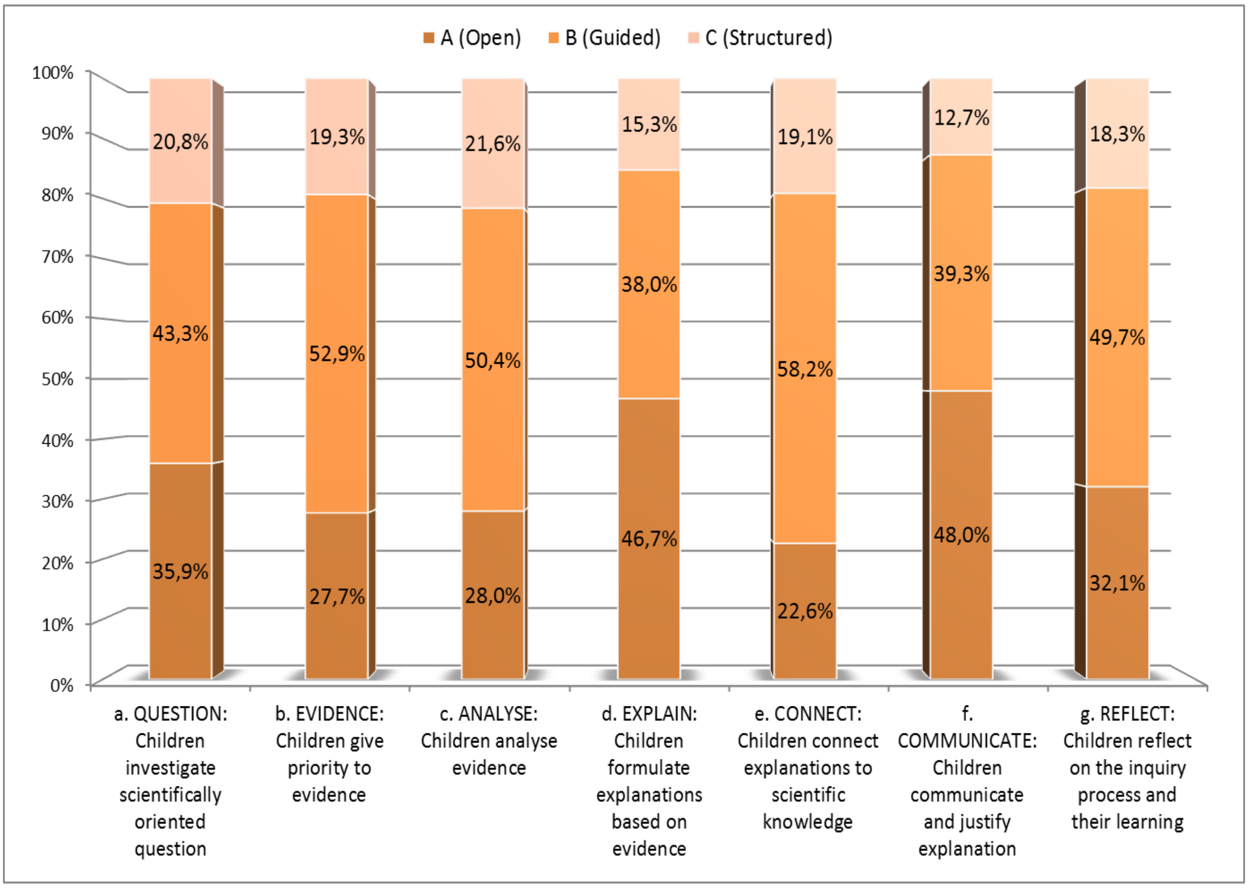

Figure 4.30. Inquiry approach used by teachers in early years science education.

Differences between partner countries

The preferred approach used by teachers with regard to most of the essential activities of IBSE, varies significantly (Pearson Chi-square test, $p<0.01$) among the partner countries. Exceptions are the activities in which children analyse evidence and reflect on the inquiry process and their learning, for which the variation is not significant and teachers overwhelmingly favour the guided or structured approach. Concerning the rest of the inquiry activities and excluding from the comparison the countries with samples of fewer than 45 teachers, we notice the following pedagogical trends (see also Tables in Appendix 7):

- Proportionally more teachers in Malta than in any other partner country favour a 'structured' approach across all inquiry activities.

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- Proportionally fewer teachers in Germany, than in any other partner country, claim to use a 'structured' approach when children identify the inquiry questions and evidence (4.2% and 6.7% respectively), and connect their explanations to scientific knowledge (8.9%). Equally, proportionally fewer teachers in Finland claim to use a 'structured' approach when children formulate and communicate explanations (4.0% respectively) about their inquiry.
- An 'open' approach to identifying inquiry questions and evidence is favoured by proportionally more teachers in the UK (England) (50.8% and 40.6% respectively) and fewer teachers in Portugal (8.2% when children identify inquiry questions) and Malta (14.9% when children identify inquiry evidence).
- An 'open' approach to formulating explanations is used by proportionally more Finnish (74.0%) teachers, and to communicating explanations by more German (64.4%) teachers. Proportionally fewer Maltese teachers (21.3% and 26.9% respectively) use either.
- Finally, 30.8% of Romanian teachers, proportionally more than in any other partner country, claim to use an 'open' approach when children connect explanations to scientific knowledge.

Differences between preschool and primary education

There are no significant differences (Pearson Chi-square test, $p<0.01$) between preschool and primary teachers in their preferred teaching approach to any of the essential features of inquiry identified (Figure 4.31).

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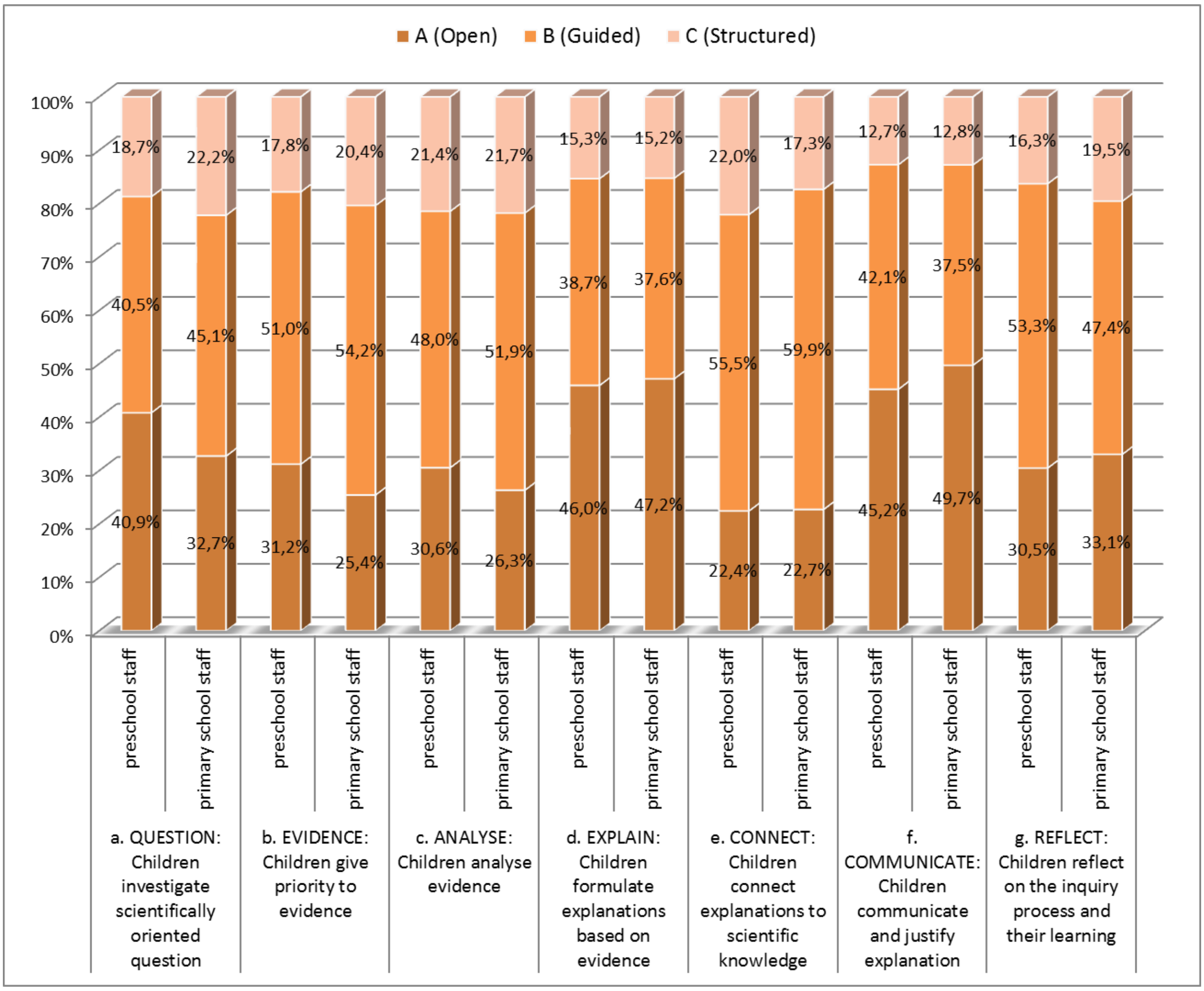

Figure 4.31. Preschool vs primary teachers: Inquiry approach used.

4.2.3.3. Creativity in inquiry-based learning activities

It was also thought important to capture teachers' views about the creativity potential of inquiry-based science activities, so we asked them to identify the three most likely to contribute to children's development of creativity, out of the list of the seven previously presented to them.

Figure 4.32 shows the overall percentage of teachers who chose each of the inquiry-based activities as 'creativity enabling'. Comparing Figures 4.32 and 4.26 above we get very interesting findings about the relationship between the IBSE activities teachers consider most 'creativity enabling' and the ones they use most frequently. The top two activities in both cases are the ones that involve children in the observation of natural phenomena and in asking questions about them. However, the next two in the 'creativity enabling' order, which involve children in the design (or plan) and conduct of simple investigations (or projects), are the least frequently used by teachers. Correspondingly, the activities that refer to children employing simple equipment and tools to gather data, using data to construct reasonable explanations, and communicating

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these explanations are considered as the least creative, but are used quite frequently. In particular, the largest discrepancy between teachers' frequency of use and perception of creativity potential regards these latter two activities, i.e. of using data to construct reasonable explanations, and of communicating these explanations. The proportion of teachers who use these activities quite or very frequently is close to three times the one of teachers who consider them as amongst the three potentially contributing to children's creativity development.

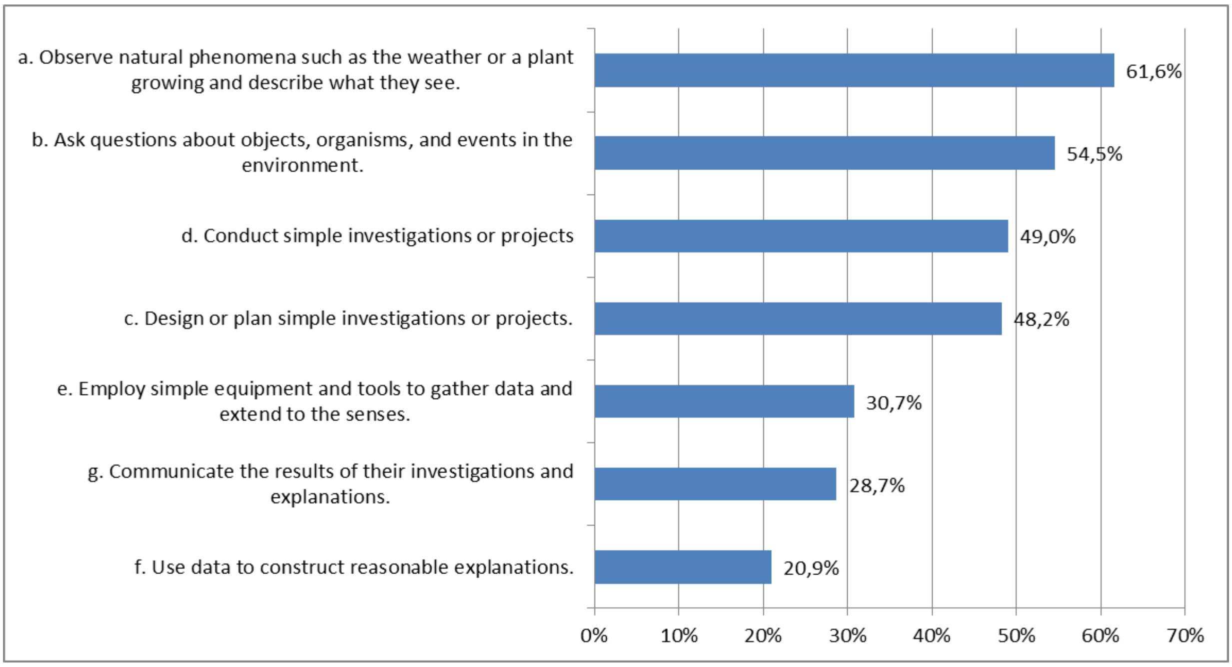

Figure 4.32. Top 3 'creativity enabling' inquiry-based science activities, according to all teachers.

	TOP THREE PRESCHOOL IBSE ACTIVITIES	N	%		TOP THREE EARLY PRIMARY IBSE ACTIVITIES	N	%
1	a. Observe natural phenomena such as the weather or a plant growing and describe what they see.	207	67,9%	1	a. Observe natural phenomena such as the weather or a plant growing and describe what they see.	244	57,1%
2	b. Ask questions about objects, organisms, and events in the environment.	168	55,1%	2	b. Ask questions about objects, organisms, and events in the environment.	231	54,1%
3	c. Design or plan simple investigations or projects.	140	45,9%	3	d. Conduct simple investigations or projects.	220	51,5%
4	d. Conduct simple investigations or projects.	139	45,6%	4	c. Design or plan simple investigations or projects.	213	49,9%
5	e. Employ simple equipment and tools to gather data and extend to the senses.	106	34,8%	5	g. Communicate the results of their investigations and explanations.	126	29,5%
6	g. Communicate the results of their investigations and explanations.	84	27,5%	6	e. Employ simple equipment and tools to gather data and extend to the senses.	119	27,9%
7	f. Use data to construct reasonable explanations.	50	16,4%	7	f. Use data to construct reasonable explanations.	103	24,1%

Table 4.1. Top 3 'creativity enabling' IBSE activities, according to preschool and early primary school teachers.

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Comparing the three top choices of 'creativity enabling' IBSE activities of preschool and early primary school teachers (Table 4.1), we do not notice any significant differences. The only activity for which there is more than 10% difference between the proportions of preschool and early primary teachers, who have selected it as one of their top three 'creativity enabling' activity, is the one involving children in the observation of natural phenomena. Similarly to what was found about the frequency of use of this activity, proportionally more preschool than early primary school teachers consider it as amongst the three top 'creativity enabling' IBSE activities.

4.2.4 Pedagogy: How is the teacher facilitating learning?

The section of the survey dedicated to pedagogy aims to gather data in order to explore the pedagogical synergies between inquiry-based science education (IBSE) approaches and creative approaches (CA), identified in the *Conceptual Framework* (D2.2). These synergies are:

- Play and exploration, recognising that playful experimentation / exploration is inherent in all young children's activity - such exploration is at the core of IBSE and CA in the early years.
- Motivation and affect, highlighting the role of aesthetic experience in promoting children's affective and emotional responses to science and mathematics activities.
- Dialogue and collaboration, accepting that dialogic engagement is inherent in everyday creativity in the classroom, plays a crucial role in learning in science and mathematics and is a critical feature of IBSE and CA, enabling children to externalise, share and develop their thinking.
- Reflection and reasoning, emphasising the importance of metacognitive processes, reflective awareness and deliberate control of cognitive activities, which may be still developing in young children but which is incorporated into early years practice, scientific and mathematical learning and IBSE.
- Questioning and curiosity, which is central to IBSE and CA, recognising across the three domains (science, mathematics, creativity) that creative teachers often employ open ended questions, and promote speculation by modelling their own curiosity.
- Problem solving and agency, recognising that through scaffolding the learning environment children can be provided with shared, meaningful, physical experiences and opportunities to develop their own questions as well as ideas about scientifically relevant concepts.
- Teacher scaffolding and involvement, which emphasises the importance of teachers mediating the learning to meet the child's needs, rather than feel pressured to meet a given curriculum.

The first five synergies were probed in survey questions Q25 to Q28, and the last two in questions Q31 (already discussed in section 4.2.2.2 above) and Q32. In questions Q25 to Q28 each of the synergies was represented by a set of learning/teaching contexts and approaches; teachers were asked to say how often they used these in their science teaching. The choice of these contexts is

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supported by the literature reviews underpinning the project's conceptual framework and are justified here only briefly, drawing directly from it, using relevant extracts.

Play and exploration, the first of the seven synergies identified, is represented by five learning/teaching contexts and approaches: open/unstructured play; role/pretend play; a physical exploration of materials; use of outdoor learning activities; and use of digital technologies. In seeking to interrogate the similarities between play and learning in the early years, Samuelsson and Carlsson (2008) comment that "pedagogy should not separate play and learning but draw upon the similarities in order to promote creativity in future generations". In particular, pretend play contexts which prompt children's imaginative engagement enhance their thinking, reasoning and understanding of concepts, according to Goswami and Bryant (2007). Similarly, many empirical studies within the wide field of science, mathematics and creativity research suggest that open-ended exploratory contexts are well suited to fostering learner creativity and learning in science and mathematics (Jeffrey, 2004; Burnard et al., 2006; Bonawitz et al., 2011; Cremin et al., 2006; Einarsdottir, 2003; Fawcett and Hay, 2004; Poddiakov, 2011). In promoting opportunities for exploration in the early years, the importance of a rich physical environment, use of the outdoor environment as well as use of digital technologies are highlighted to engage children's interest and foster their curiosity (French, 2004).

As evident from the figure below (Figure 4.33), 'physical exploration of materials' is the most commonly used (quite and very often) learning context by the large majority (87%) of teachers across all partner countries, followed by 'use of outdoor learning activities' (73.3%), 'open/unstructured play' (70.1%), 'role/pretend play' (68.5%) and 'use of digital technologies' (63.6%). However, an inter-item reliability test revealed that these five contexts and approaches identified in the theoretical conceptual framework do not constitute a statistically 'acceptable' construct (Cronbach's $\alpha=0.521 <0.7$) based on teachers' responses to them, which further means that they are not treated similarly by teachers.

Teaching/learning contexts and approaches linked to *motivation and affect* are: use of drama, stories, history, informal learning settings and cross-disciplinary contexts to teach science, by relating it to everyday life and incorporating children's prior experiences. Research in science, mathematics and creativity indicates that play based exploratory contexts afford rich opportunities for supporting the development of both positive attitudes and motivation**,** which are necessary conditions for science and mathematics learning to occur (Perrier and Nsengiyumva, 2003) and creativity to develop (Woods, 2001; Woods and Jeffrey, 1996). Additionally, creativity research highlights that utilising the widely recognised power of narrative and dramatic story making, as a playful imaginative context, can engage children imaginatively and thus foster their creativity in different domains (Bruner, 1986; Craft et al., 2012; Cremin et al., 2006; Paley, 2001; Sawyer, 2004a, 2004b). Finally, incorporating children's prior-knowledge and embedding activities into the children's everyday experiences can help children start to see connections between science and their close surroundings, which it is argued acts as a motivating factor (Koballa and Glynn, 2007; Kramer and Rabe-Kleberg, 2011).

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Interestingly, teachers in their answers treat very differently the items representing this synergy. On the one hand, only about half of the teachers in the sample use quite or very often drama in science (43.1%), teach science through history (51.7%), and take children to field trips and/or visits to science museums and industry (54.8%), thus making these contexts and approaches the least commonly used of the entire set. On the other hand, almost all teachers claim quite or very often to build on children's prior knowledge (94.8%) and relate science to everyday life (94.2%) in their science teaching, making these latter approaches the most commonly used of the entire set. These differences in teachers' answers for these items are also supported by the fact that the seven contexts and approaches pre-identified as representing the IBSE/CA synergy 'motivation and affect' do not constitute a statistically 'acceptable' construct (Cronbach's $\alpha=0.627 <0.7$).

Another area of synergy between the research literatures focused on creativity and on IBSE in science and mathematics is the significance of *dialogue and collaborative learning*. Much current creativity research recognises that creative processes are essentially social and necessarily collective and collaborative (see John-Steiner, 2000; Sawyer, 2006) and indicates that dialogic engagement is inherent in everyday creativity in the classroom (Littleton et al., 2005; Mercer and Littleton, 2007; Rojas-Drummond et al., 2006; Wegerif, 2005, 2010; Vass, 2007). Similarly communication is seen to be one of the critical features of IBSE, enabling children to externalise, share and develop their thinking in science and mathematics. If children are afforded opportunities to explore and work in small groups, this may make them more attentive to their own thoughts and the thoughts of others, encouraging monitoring and self-regulation (Larkin, 2006; Littleton et al., 2005) and thus deeper science and mathematics learning.

In the survey the *dialogue and collaboration* synergy was represented by the following three teaching/learning contexts and approaches: working in small groups; fostering collaboration; fostering classroom discussion and evaluation of alternative ideas. All three are reported as being used quite or very often by the large majority (93.2%, 92.5% and 89.0% respectively) of preschool and early primary teachers across all partner countries.

Fostering classroom discussion and evaluation of alternative ideas is an approach that also represents the IBSE/CA synergy of *reflection and reasoning*, since both in the context of IBSE participating in the process of evaluating ideas can foster an appreciation of scientific argumentation and explanation, and for creativity evaluation of ideas and reflection are considered important. This pedagogical synergy as previously shown is also used quite and very frequently by the great majority of teachers who participated in the survey. However, due both to its elusive nature and to its relatively sparse representation in the list of teaching/learning contexts and approaches presented to teachers in the survey, its deeper examination is referred to the next research phase, the in-depth field study.

Due to the very small and overlapping items considered under the above two synergies, no inter-item reliability was calculated.

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The *role of questions*, both children's and teachers' is another common area of research across science and mathematics education and creativity and is recognised as central within both IBSE and CA. Providing children with opportunities to develop their own questions plays a fundamental role in mediating children's thinking between everyday concepts gained through playful interaction and more formal scientific concepts (Fleer, 2009; Fleer and Ridgway, 2007). However, whilst it is widely accepted that young children are innately curious and have an impulse to question, it is important to consider that children's curiosity may not be expressed verbally, but through other modes, such as children's drawing, gestures, or even actions with materials (Glauert, 1996). Similarly, teacher questioning of different kinds and for different purposes can act as a support to children's inquiries and learning (Chappell et al., 2008; Harlen and Qualter, 2004); creative teachers often employ open ended questions, and promote speculation by modelling their own curiosity (Craft, 2002; Cremin et al., 2009; Robertson, 2002).

In the survey, *questioning and curiosity* was represented by four teaching/learning approaches: using questioning as a tool in science teaching; encouraging problem finding – e.g. children asking questions; encouraging different ways of recording and expressing ideas – oral, visual, digital, practical; and fostering imagination. Three of them are reportedly used quite or very frequently by the large majority of teachers: encouraging children to ask questions (94.9%); fostering imagination (93.9%); using questioning as a tool in science teaching (88.5%); whereas fostering children's multimodal expression is used less frequently by teachers (77.0%). An inter-item reliability test revealed that these four contexts and approaches identified in the theoretical conceptual framework do not constitute a statistically 'acceptable' construct based on teachers' responses to them. In particular, 'fostering imagination' and 'encouraging different ways of recording and expressing ideas' are the approaches that are less well correlated with the construct (Corrected Item-Total Correlation <0.3).

Finally, the role of *problem solving and agency* is central to IBSE (National Research Council, 2000) as well as widely recognised within CA to education. There are debates in the literature (Kirschner et al., 2006; Cindy, et al., 2007) concerning the role of the teacher in scaffolding young children's problem finding and solving in IBSE. On the other hand, a number of studies in the creativity research literature (Craft et al., 2012; Cremin et al., 2006; Cremin et al., 2009; Jeffrey, 2005; Raggl, 2006; Sugrue, 2006; Woods and Jeffrey, 1996) collectively suggest that children's creative engagement in finding their own problems, problems which they wish to explore or solve is central to creativity, and links closely to their curiosity and questioning stance examined earlier. In the survey this synergy, by means of the relevant teaching/learning approaches, was found to be widely used as before by teachers across the partner countries: encouraging problem finding (94.9%); encouraging problem solving (93.6%); encouraging children to try out their own ideas in investigations (83.4%); but less so fostering autonomous learning (77.5%). As for the rest of the synergies an inter-item reliability test revealed that these four contexts and approaches identified in the theoretical conceptual framework do not constitute a statistically 'acceptable' construct based on teachers' responses to them.

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Overall, the teaching/learning contexts and approaches that are less often used, i.e. used quite or very frequently by fewer than 75% of teachers in the consortium countries, are (from smaller to larger frequency):

- c. Drama (under the synergy of *motivation and affect*)
- e. Using history to teach science (e.g. transport, the work of scientists) (under the synergy of *motivation and affect*)
- i. Taking children on field trips and/or visits to science museums and industry (under the synergy of *motivation and affect*)
- u. Using digital technologies with children for science teaching and learning (under the synergy of *play and exploration*)
- b. Role/Pretend play (under the synergy of *play and exploration*)
- a. Open/unstructured play (under the synergy of *play and exploration*)
- h. Using outdoor learning activities (under the synergy of *play and exploration*)
- d. Teaching science from stories (under the synergy of *motivation and affect*)

Figure 4.33. Frequency of use of creative teaching/learning contexts and approaches in early years science.

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Notwithstanding the recognition that IBSE and CA both include attention to problem solving in exploratory contexts, in which questions, collaboration, motivation and reflection play a significant role, the efficacy of these approaches depend in large part on the teacher's role, scaffolding children's learning. Scaffolding has been considered beneficial for young children fostering their independence as inquirers and problem-solvers (Rittle-Johnson and Koedinger, 2005; Metz, 2004), their creativity as possibility thinkers (Cremin et al., 2006; Craft et al., 2012), their conceptual knowledge (Coltman et al., 2002), and their strategies (Secada et al., 1983), and meta-cognitive strategies (Aleven and Koedinger, 2002). Moreover, Bonawitz et al. (2011) investigated the implications of explicit instruction on exploratory play and suggested that delaying instruction until the learner has had a chance to investigate and inquire on their own or with others could promote innovation and discovery. The work of other scholars also highlights the pedagogic practice of respecting children sufficiently to stand back from their endeavours in order to observe their interests, needs and direction of learning and then build upon this (Fawcett and Hay, 2004; Rinaldi, 2006; Tobin et al., 2011). This suggests that using IBSE and CA to foster creativity and problem solving requires professional restraint and well developed skills of close observation. Hyvönen (2008) too highlights the role of teacher as 'allower', implying some degree of standing back and avoiding too much intervention, though she also mentions other roles: leader, afforder, coordinator, supporter, tutor, motivator and facilitator.

Given the importance of this synergy (*teacher scaffolding and involvement*) a special question (Q32) was devoted to it in the survey. Teachers' responses (Figure 4.34) indicate that they overwhelmingly see themselves as facilitators of children's own inquiry (92.3% agree or strongly agree), delaying instruction until the learner has had a chance to investigate and inquire on their own or with others (89.2% agree or strongly agree). They are a little more reticent to allow children to find solutions on their own (87.5% agree or strongly agree), but strongly reject (29.9% agree or strongly agree) the suggestion that they should first act as demonstrators of the correct solution before children get a chance to try out by themselves.

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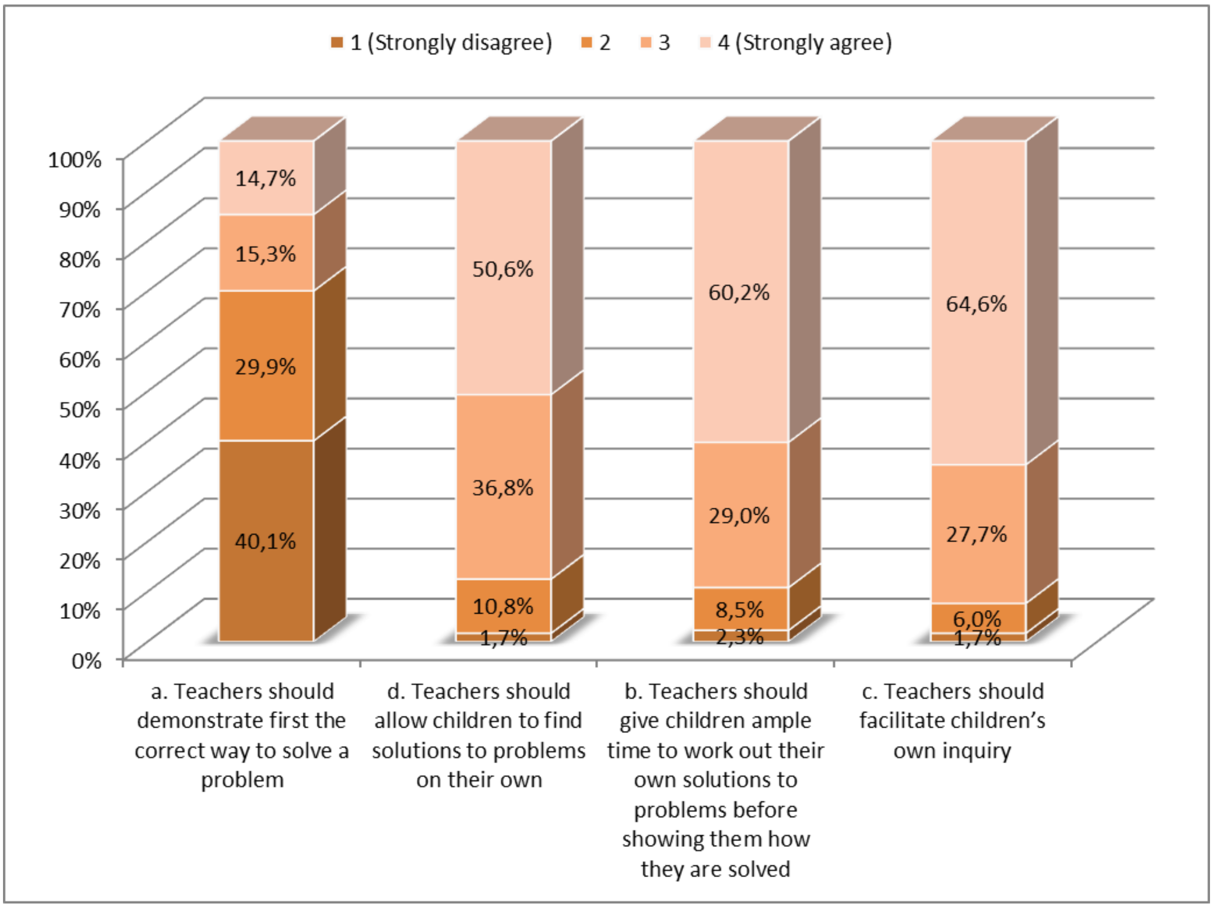

Figure 4.34. The role of teacher in fostering inquiry skills.

Differences between partner countries

A one-way ANOVA test showed significant statistical differences amongst the partner countries in the use their samples of teachers make of 15 out of the 22 teaching/learning contexts and approaches presented to them (Figures 4.35-4.40). Very interestingly from the project's point of view, the contexts and approaches for which there are no significant statistical differences, i.e. there is more homogeneity, amongst the responses of the different national samples, are:

- h. Using outdoor learning activities (under the synergy of *play and exploration*)
- l. Fostering collaboration (under the synergy of *dialogue and collaboration*)
- m. Encouraging different ways of recording and expressing ideas – oral, visual, digital, practical (under the synergy of *questioning and curiosity*)
- r. Fostering imagination (under the synergy of *questioning and curiosity*)
- n. Encouraging problem finding – e.g. children asking questions (under the synergies of *questioning and curiosity* and *problem solving and agency*)
- o. Encouraging problem solving – e.g. children solving practical tasks (under the synergy of *problem solving and agency*)

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- p. Encouraging children to try out their own ideas in investigations(under the synergy of *problem solving and agency*)

In other words teachers' pedagogical practices across the partner countries are more in agreement in the areas of *problem solving and agency* and *questioning and curiosity* – two very central synergies between IBSE and CA - and only partly in the areas of *play and exploration* and *dialogue and collaboration.*

In the remaining contexts and approaches under the synergy *play and exploration*, we see interesting differences in the use of open/unstructured play and role/pretend play (Figure 4.34). Excluding countries with samples of under 44 teachers, the majority of French and Finnish teachers in the former case and French and German in the latter monopolise the one end of the spectrum with rare or no use of these contexts, with the majority of Greek and Romanian teachers at the other end of the spectrum with quite frequent or very frequent use of them.

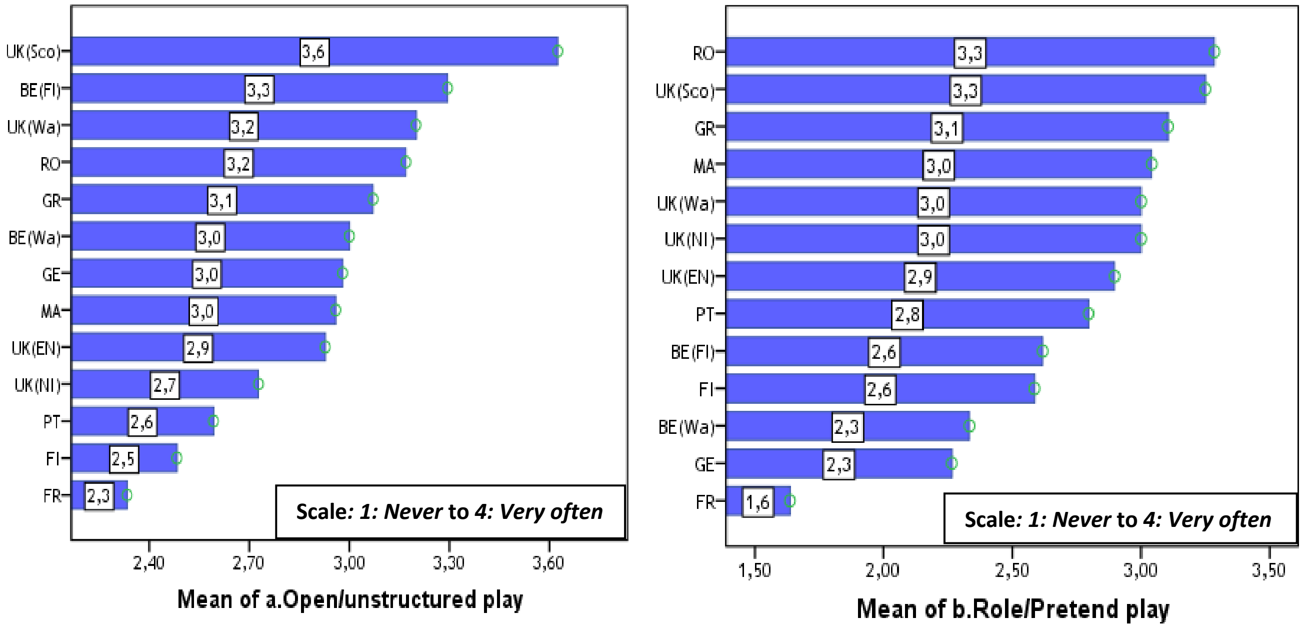

Figure 4.35. Frequency with which teachers use 'open/unstructured' and 'role/pretend' play as science teaching/learning contexts: National samples' variations.

In the use of a physical exploration of materials, Finnish and Portuguese teachers report the relatively lowest (but positive) frequency and Flemish and English teachers the highest. This can be contrasted with the use of digital technologies (Figure 4.36), for which Finnish, German and French teachers report the lowest (and negative) frequency and Maltese and English teachers the highest.

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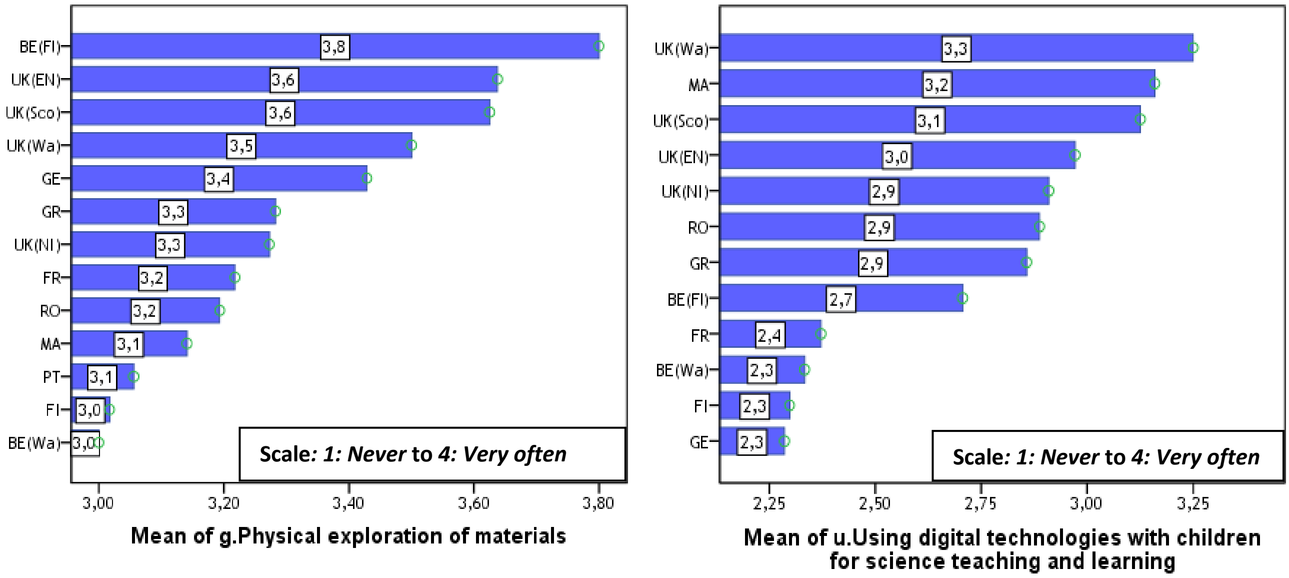

Figure 4.36. Frequency with which teachers use 'physical exploration of materials' and 'digital technologies' for science teaching and learning: National samples' variations.

The differences between partner countries in relation to the use of contexts and approaches linked with *motivation and affect* present an additional interest, since the overall results show that most of the relevant contexts get the lowest use by teachers, whilst the relevant approaches the highest use (Figures 4.37-4.38). The use of drama for example seems to be quite or very frequent only in preschool and early primary science classrooms in Greece and Malta. The use of history to teach science is also quite or very frequent in Greece and Malta as well as in Portugal and Romania. On the other hand, taking children to field trips and science museum visits is a practice quite or very frequently used by the majority of teachers in most partner countries with the exception of Malta and France. The French teachers actually report the lowest frequency of use for all *motivation and affect* science teaching/learning contexts, even for 'integrating science with other curricular areas' where all other national samples of teachers in their large majority report a quite or very frequent use.

France also scores significantly (at the 0.05 level) lower (though still positively) than all other countries in the consortium in the use of the *motivation and affect* science teaching approaches which build on children's prior experiences and relate science to everyday life. Both approaches seem to be the most frequently prevailing practices in England (Figure 4.39).

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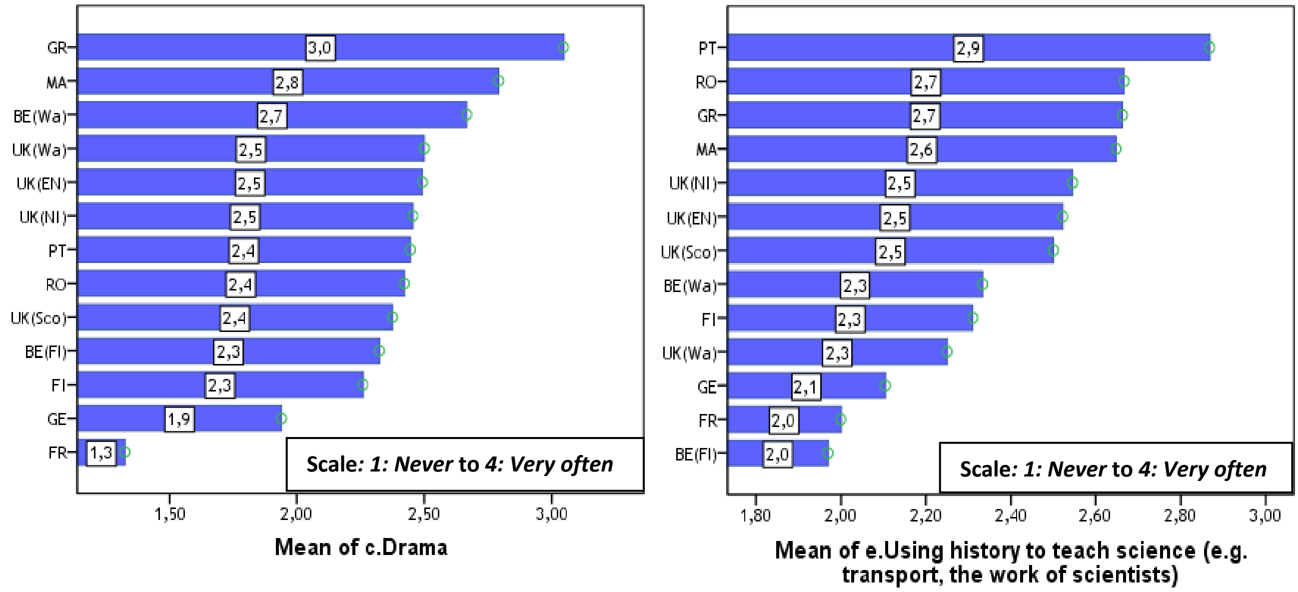

Figure 4.37. Frequency with which teachers use 'drama' and 'history' to teach science: National samples' variations.

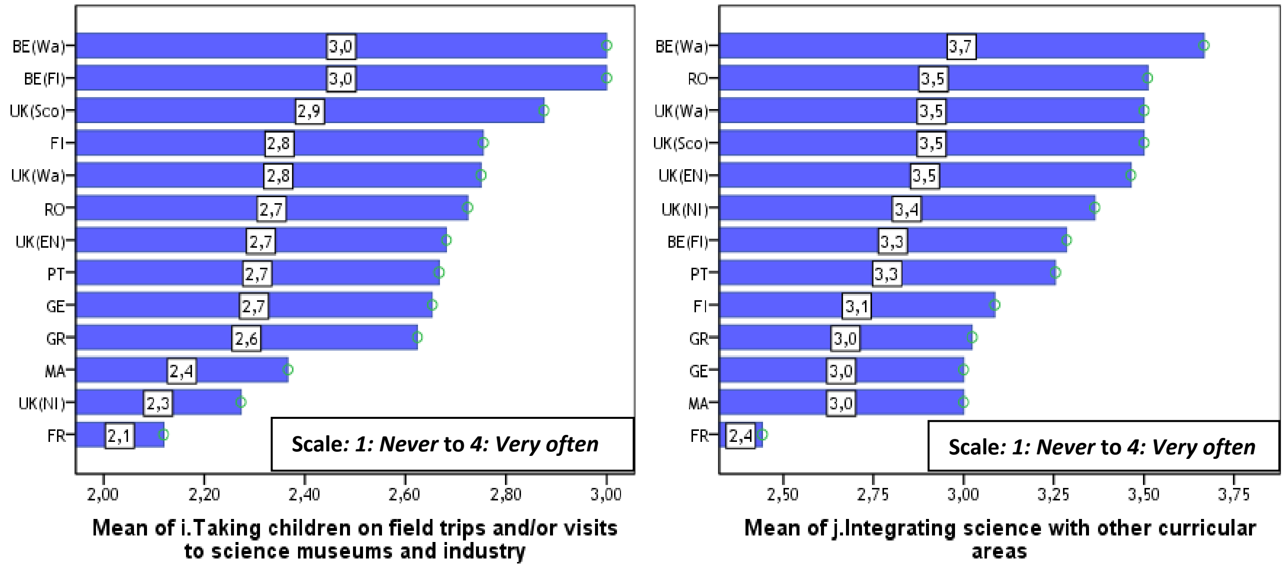

Figure 4.38. Frequency with which teachers 'take children on science field trips' and 'integrate science with other curricular areas': National samples' variations.

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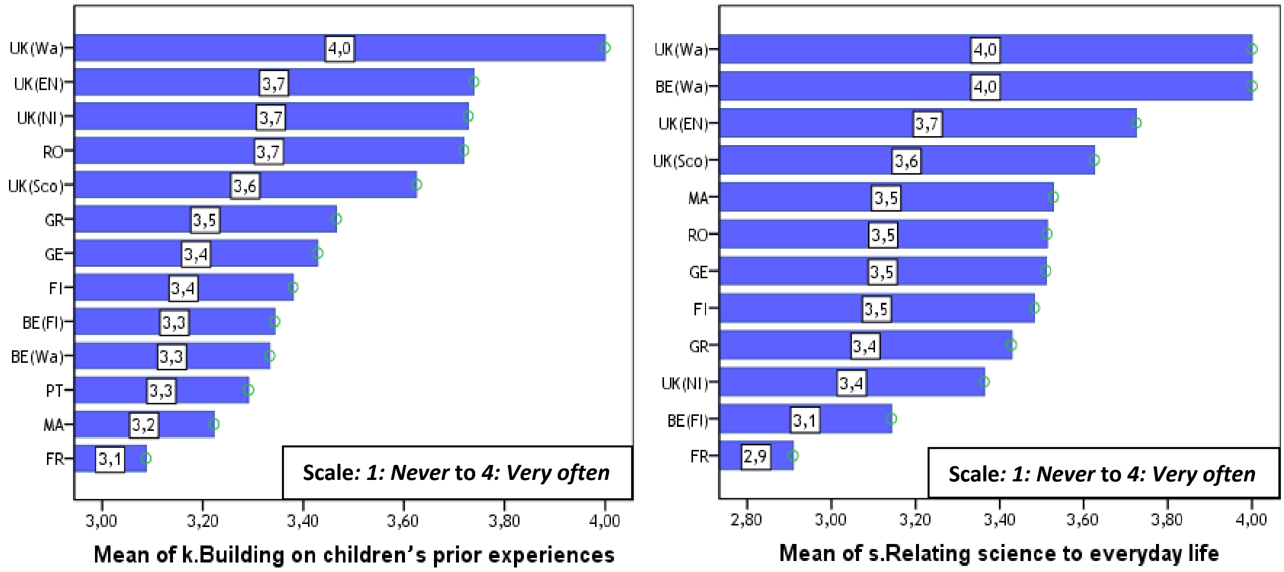

Figure 4.39. Frequency with which teachers 'build on children's prior experiences' and 'relate science to everyday life': National samples' variations.

For the contexts under *dialogue and collaboration*, it is worth mentioning that although there are no significant differences amongst the national teacher samples in their fostering of collaboration in young children, there are differences in the frequency with which they encourage children to work in small groups and discuss and evaluate their alternative ideas – the latter also linked to *reflection and reasoning*. The former is a practice less frequently used in Finland and the latter in Germany. Both are most frequently used in England and Romania (Figure 4.40).

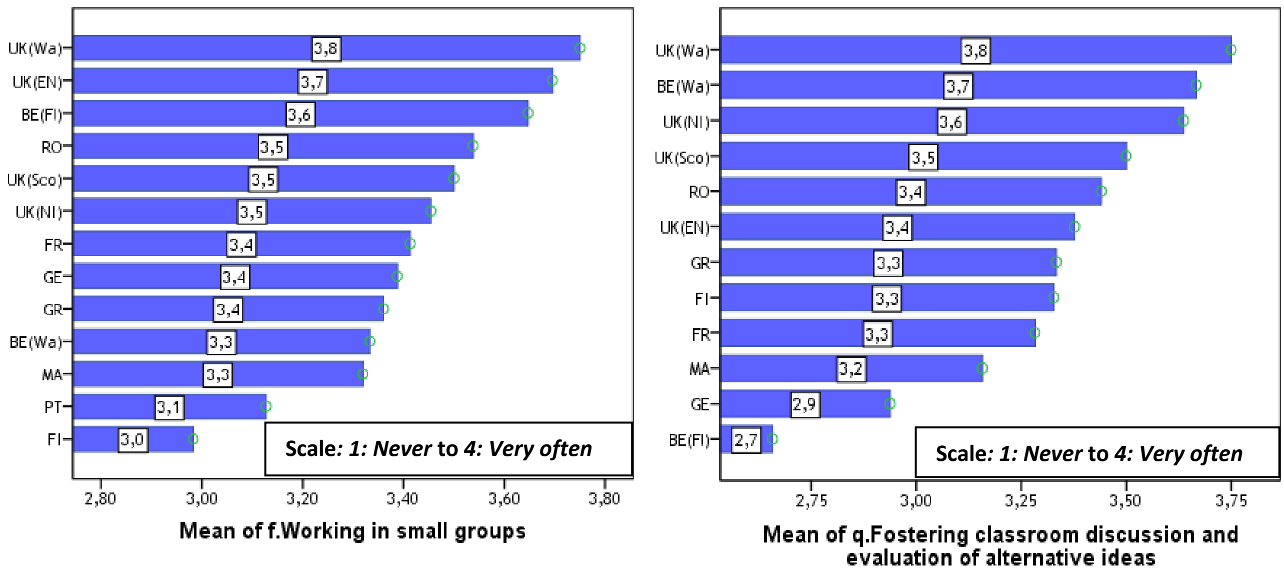

Figure 4.40. Frequency with which teachers encourage 'working in small groups' and 'classroom discussion and evaluation of alternative ideas': National samples' variations.

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Finally, the area of *teacher scaffolding and agency* in inquiry seems to reveal entrenched pedagogical differences amongst the partner countries. Excluding samples of fewer than 30 teachers we notice the following (Figure 4.41):

- A very small majority of the Romanian teachers (52.2%) in the sample agree or strongly agree that 'teachers should demonstrate first the correct way to solve a problem', whereas all sampled German teachers disagree or strongly disagree with it.
- All French teachers agree or strongly agree that 'teachers should facilitate children's own inquiry', whereas a little more than a fifth (22.7%) of the Maltese teachers disagree or strongly disagree with it.
- All Flemish teachers agree or strongly agree that 'teachers should give children ample time to work out their own solutions to problems before showing them how they are solved', whereas a little more than a quarter (28.3%) of Portuguese teachers disagree or strongly disagree with it.
- All Flemish teachers also agree or strongly agree that 'teachers should allow children to find solutions to problems on their own', but almost a third (31.8%) of Greek teachers disagree or strongly disagree with it.

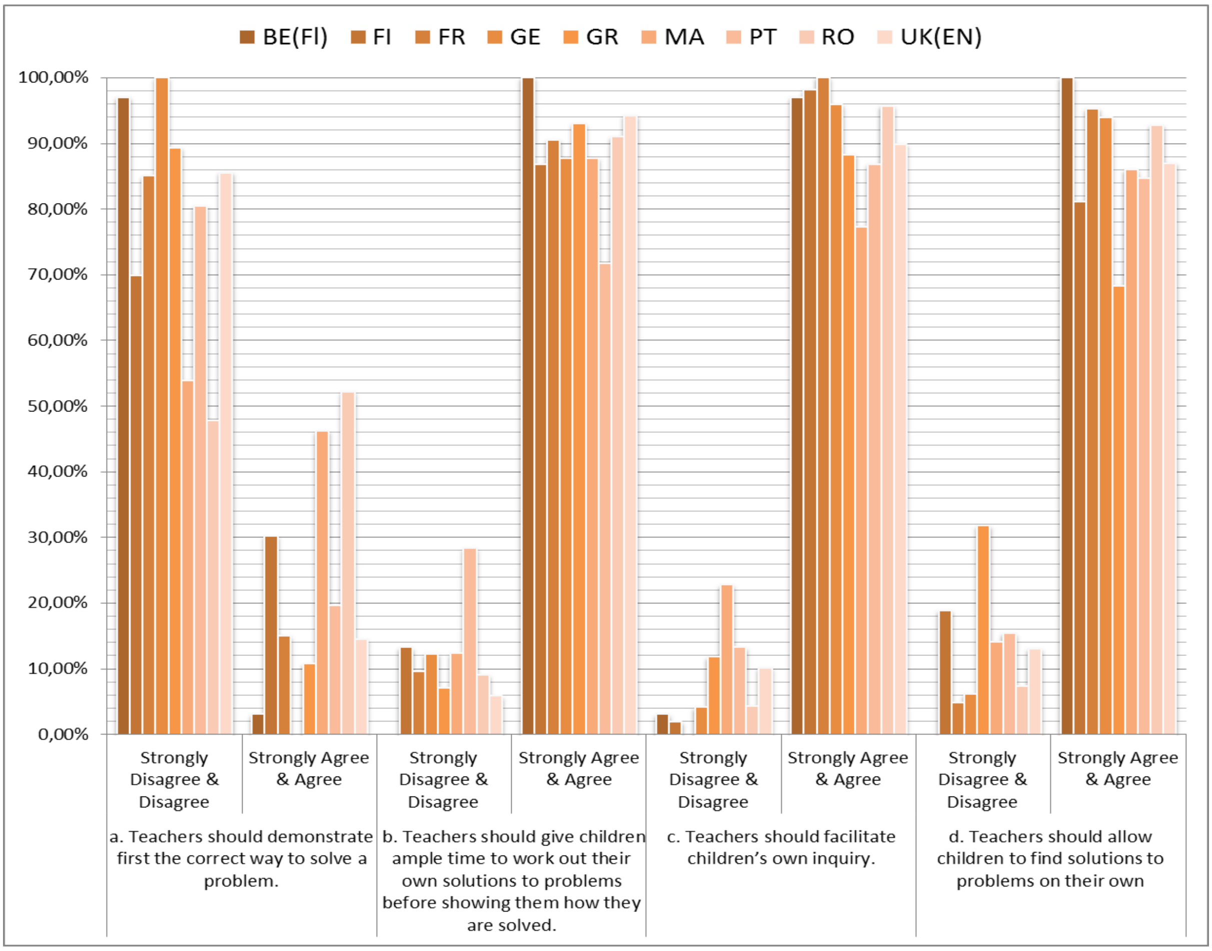

Figure 4.41. Teachers' role in inquiry: National samples' variations.

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Differences between preschool and primary education

An independent samples t-test revealed the following significant differences ($p<0.05$) between preschool and primary school staff in the use they make of creative contexts and approaches in the teaching and learning of science (Figures 4.42-4.43):

- Preschool staff seem to make more frequent use of:
    - Open/unstructured play
    - Role/Pretend play
    - Drama
    - Teaching science from stories
    - Physical exploration of materials
    - Using outdoor learning activities
- Primary school staff seem to make more frequent use of:
    - Fostering classroom discussion and evaluation of alternative ideas
    - Relating science to everyday life

Concerning the ways teachers perceive their role in scaffolding inquiry, an independent t-test showed that overall significantly ($p<0.01$) more preschool teachers than primary teachers see themselves as facilitators of children's own inquiry. Moreover, significantly ($p<0.05$) more preschool teachers agree that they should give children ample time to work out their own solutions to problems before showing them how they are solved (Figures 4.42-4.43).

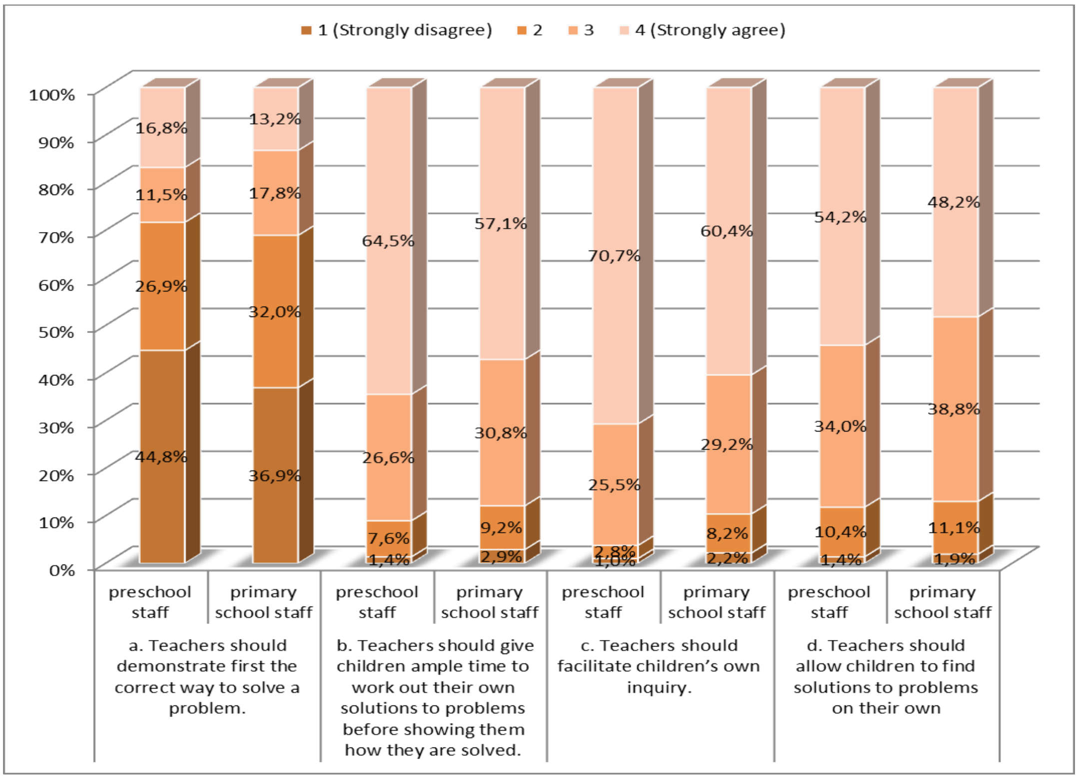

Figure 4.42. Differences between preschool and primary teachers' perceived role in inquiry.

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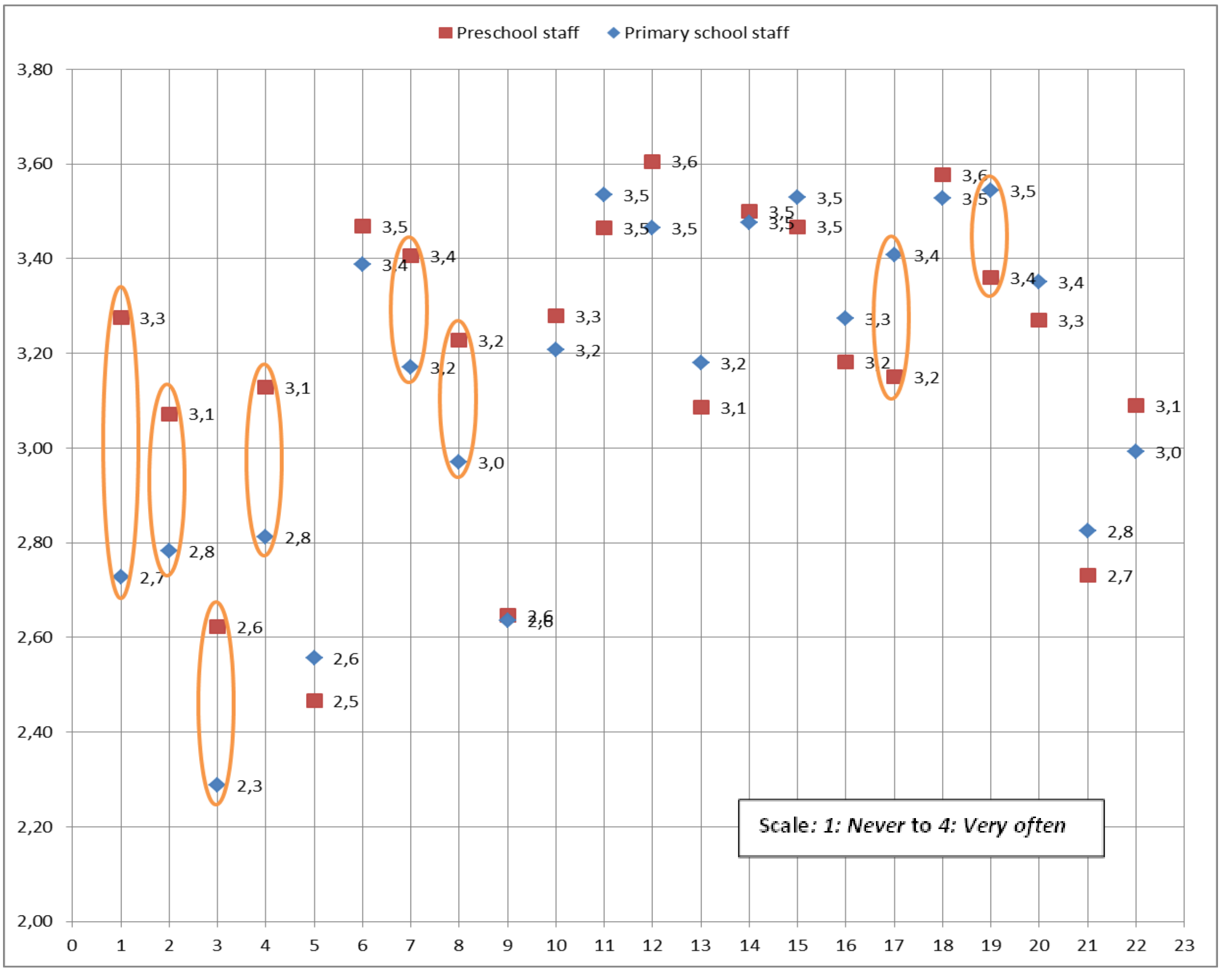

1: Open/unstructured play
2: Role/Pretend play
3: Drama
4: Teaching science from stories
5: Using history to teach science (e.g. transport, the work of scientists)
6: Working in small groups
7: Physical exploration of materials
8: Using outdoor learning activities
9: Taking children on field trips and/or visits to science museums and industry
10: Integrating science with other curricular areas
11: Building on children's prior experiences
12: Fostering collaboration
13: Encouraging different ways of recording and expressing ideas – oral, visual, digital, practical
14: Encouraging problem finding – e.g. children asking questions
15: Encouraging problem solving – e.g. children solving practical tasks
16: Encouraging children to try out their own ideas in investigations
17: Fostering classroom discussion and evaluation of alternative ideas
18: Fostering imagination
19: Relating science to everyday life
20: Using questioning as a tool in science teaching
21: Using digital technologies with children for science teaching and learning
22: Fostering autonomous learning

Figure 4.43. Differences between preschool and primary teachers' use of creative teaching/learning contexts and approaches in science.

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The role of creative teaching/learning contexts and approaches in early years science and mathematics education

Although all the science and mathematics education contexts and approaches presented to teachers to report about their frequency of use in the classroom (see responses discussed above) have been identified as 'creativity enabling' in the project's theoretical conceptual framework (Deliverable D2.2), it was thought as important to explore teachers' own conceptions about these contexts and approaches and their potential for children's creativity development. Therefore in questions Q26 and Q27 of the survey we asked teachers to choose up to three contexts and three approaches they thought as most likely to contribute to the development of children's creativity.

Figure 4.44 and 4.45 show the overall percentage of teachers who chose each of the science education contexts and approaches presented to them respectively amongst the top three potentially contributing to the development of children's creativity. Comparing Figure 4.44 with Figure 4.33 above we can see that the relative order in which the 'creativity enabling' science contexts appear in both bar charts is almost identical. In other words, the contexts considered by most teachers amongst the three most 'creativity enabling' ones, are the ones also used most frequently. For example, relatively more teachers (52.3%) believe that children actively exploring material to extend their senses is one of the three teaching contexts that has the potential to foster creativity in children; this context is also reportedly used most frequently by them – 40.2% of teachers use it very frequently. 'Integrating science with other curricular areas' is also a science context which is highly perceived as potentially creative by many teachers (43.6%) and also used very frequently by 37.4% of teachers. Similarly, the two contexts considered by the fewest teachers amongst the three most 'creativity enabling' ones are 'using history to teach science' (5.4%) and 'drama' (14.8%), used very frequently by only 11.0% and 13.5% of teachers respectively. The only context that does not follow this trend is 'working in small groups', which whereas being the most frequently used of all contexts (49.3% of teachers use it very frequently), comes fourth in the order of the most perceived 'creativity enabling' three contexts – 36.86% of teachers have chosen it as such.

Comparing now the three top choices of science 'creativity enabling' contexts of preschool and early primary school teachers, we notice interesting differences. Table 4.2 highlights the contexts for which there is more than 10% difference between the proportions of preschool and early primary teachers who have selected each as one of their top three 'creativity enabling' science contexts. 'Open/unstructured play' and 'role pretend play' are contexts that are considered amongst the top three 'creativity enabling' by more preschool than early primary teachers, mirroring the trends in their frequency of use by them (see Figure 4.43). On the other hand 'using outdoor learning activities' and 'integrating science with other curricular areas' are contexts that are considered amongst the top three 'creativity enabling' by more early primary than preschool teachers, in contrast with the trends in their frequency of use by them (see Figure 4.43). Since all these contexts have been identified as central and important candidates for fostering learner

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creativity in science and mathematics learning it will be interesting for the *Creative Little Scientists* project to probe deeper into teachers' conceptualisations and practice regarding these.

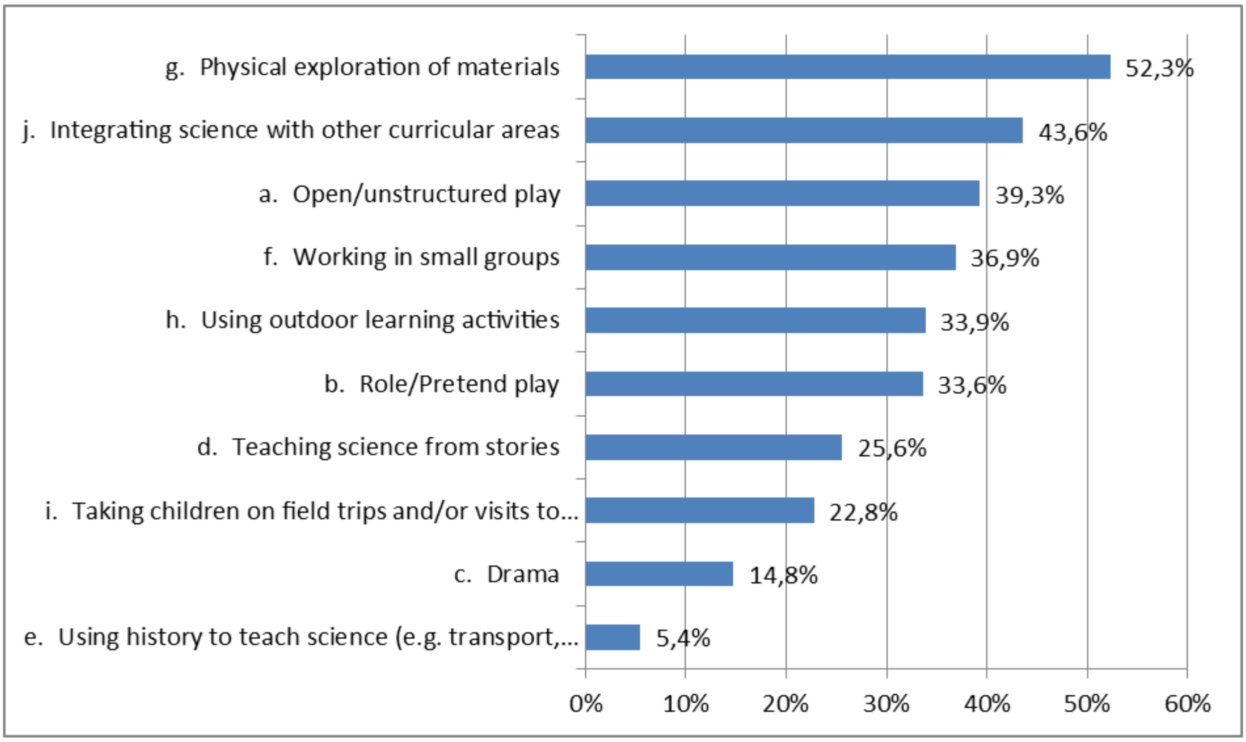

Figure 4.44. Top 3 'creativity enabling' science education contexts, according to all teachers.

TOP THREE PRESCHOOL SCIENCE CREATIVE CONTEXTS		N	%	TOP THREE EARLY PRIMARY SCIENCE CREATIVE CONTEXTS		N	%
1	g. Physical exploration of materials	160	52,12%	1	g. Physical exploration of materials	226	52,44%
2	a. Open/unstructured play	160	52,12%	2	j. Integrating science with other curricular areas	206	47,80%
3	b. Role/Pretend play	123	40,07%	3	h. Using outdoor learning activities	168	38,98%
4	j. Integrating science with other curricular areas	116	37,79%	4	f. Working in small groups	162	37,59%
5	f. Working in small groups	110	35,83%	5	a. Open/unstructured play	130	30,16%
6	d. Teaching science from stories	89	28,99%	6	b. Role/Pretend play	125	29,00%
7	h. Using outdoor learning activities	82	26,71%	7	i. Taking children on field trips and/or visits to science museums and industry	103	23,90%
8	i. Taking children on field trips and/or visits to science museums and industry	65	21,17%	8	d. Teaching science from stories	100	23,20%
9	c. Drama	47	15,31%	9	c. Drama	62	14,39%
10	e. Using history to teach science (e.g. transport, the work of scientists)	12	3,91%	10	e. Using history to teach science (e.g. transport, the work of scientists)	28	6,50%

Table 4.2. Top 3 'creativity enabling' science education contexts, according to preschool and early primary school teachers.

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Considering now teachers' choices for the three top 'creativity enabling' science approaches (Figure 4.45) in relation to their declared use of them we do not see the same trends as we did with the three top 'creativity enabling' contexts. For example, 'encouraging children to try out their own ideas in investigations' is an approach considered amongst the top three 'creativity enabling' by the largest proportion of teachers (52.0%), but not the most frequently used by them – 36.3% use it very frequently. On the other hand 'building on children's prior experiences' and 'fostering collaboration' are the most frequently used approaches (56.1% and 55.8% of teachers respectively use them very frequently), but only 26.0% and 22.3% respectively consider them as having potential for nurturing children's creativity. Similarly, 'using questioning as a tool in science teaching' is used very frequently by 44.4% of teachers, but is considered a potentially 'creative' learning approach by only 8.4% of them. These differences have clear implications for teacher education development and will be explored in further stages of the project.

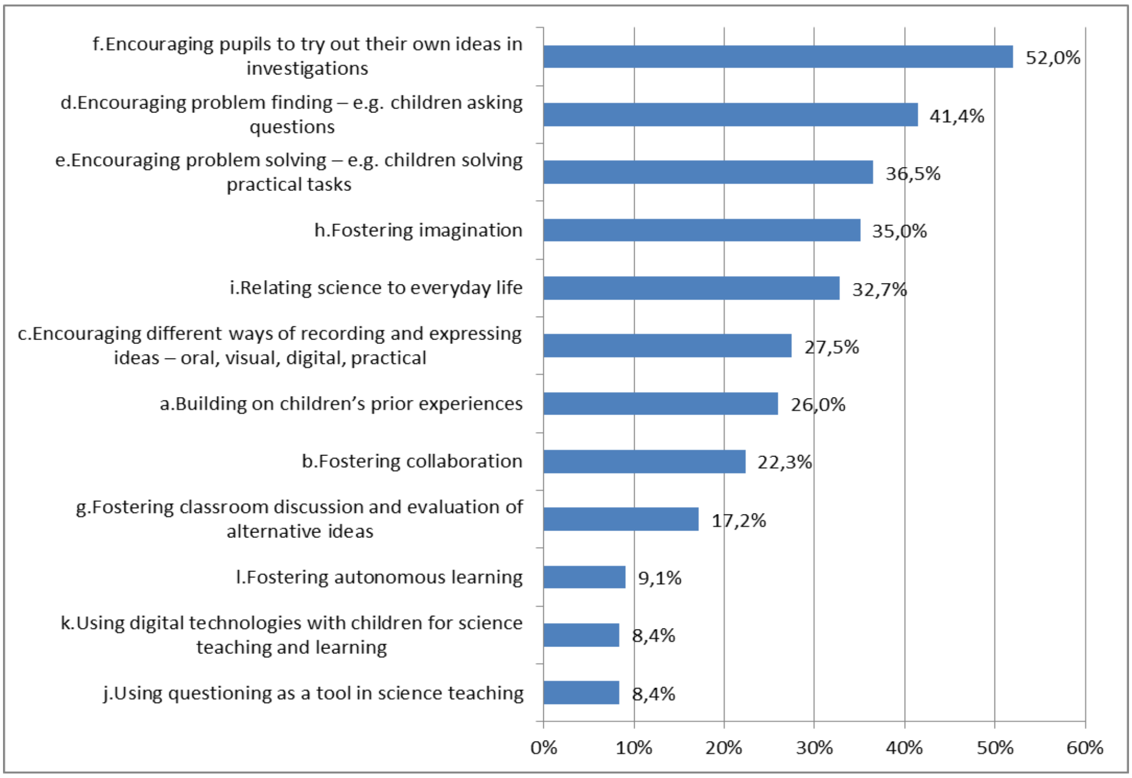

Figure 4.45. Top 3 'creativity enabling' science education approaches, according to teachers.

Comparing now the three top choices of science creative approaches of preschool and early primary school teachers (Table 4.3), we do not find as substantial differences (i.e. more than 10%) between the two groups as we did in the case of their choices of science 'creative' contexts.

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TOP THREE PRESCHOOL SCIENCE CREATIVE APPROACHES		N	%	TOP THREE EARLY PRIMARY SCIENCE CREATIVE APPROACHES		N	%
1	f. Encouraging pupils to try out their own ideas in investigations	168	54,55%	1	f. Encouraging pupils to try out their own ideas in investigations	216	50,12%
2	h. Fostering imagination	121	39,29%	2	d. Encouraging problem finding – e.g. children asking questions	187	43,39%
3	d. Encouraging problem finding – e.g. children asking questions	119	38,64%	3	e. Encouraging problem solving – e.g. children solving practical tasks	161	37,35%
4	e. Encouraging problem solving – e.g. children solving practical tasks	109	35,39%	4	i. Relating science to everyday life	145	33,64%
5	i. Relating science to everyday life	97	31,49%	5	h. Fostering imagination	138	32,02%
6	a. Building on children's prior experiences	93	30,19%	6	c. Encouraging different ways of recording and expressing ideas – oral, visual, digital, practical	118	27,38%
7	c. Encouraging different ways of recording and expressing ideas – oral, visual, digital, practical	85	27,60%	7	a. Building on children's prior experiences	99	22,97%
8	b. Fostering collaboration	70	22,73%	8	b. Fostering collaboration	95	22,04%
9	g. Fostering classroom discussion and evaluation of alternative ideas	50	16,23%	9	g. Fostering classroom discussion and evaluation of alternative ideas	77	17,87%
10	l. Fostering autonomous learning	33	10,71%	10	j. Using questioning as a tool in science teaching	41	9,51%
11	k. Using digital technologies with children for science teaching and learning	23	7,47%	11	k. Using digital technologies with children for science teaching and learning	39	9,05%
12	j. Using questioning as a tool in science teaching	21	6,82%	12	l. Fostering autonomous learning	34	7,89%

Table 4.3. Top 3 'creativity enabling' science education approaches, according to preschool and early primary school teachers.

Bringing together the results discussed above about teachers' conceptualisations of the three most 'creativity enabling' contexts and approaches we can conclude the following:

- Teachers overall appreciate the role of *dialogue and collaboration* in their practice, but fail to see their potential for creativity development in children.
- There is an uneven treatment of the contexts and approaches grouped under the synergy *motivation and affect*. The contexts of 'drama' and 'using history to teach science' are used the least frequently and are least considered as 'creativity enabling'. The approaches of 'building on children's prior experiences' and 'relating science to everyday life' on the other hand are amongst the most frequently used, though still not considered as similarly 'creativity enabling'. Finally, the cross-disciplinary teaching of science ('integrating science with other curricular areas') is a context used frequently by both preschool and early primary school teachers, but not considered equally as 'creativity enabling' by them; many more early primary than preschool teachers consider this context as 'creativity enabling'.
- There is also an uneven treatment of the contexts and approaches grouped under the synergy *play and exploration*. Preschool use significantly more than early primary school teachers 'open/unstructured play' and 'role/pretend play', and more also conceptualise these as 'creativity enabling'. On the other hand both groups agree in the frequent use and 'creative' perception of 'physical exploration of materials'. Finally, the outside the

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classroom ('using outdoor learning activities') context is used more frequently by preschool teachers, but is considered as 'creativity enabling' by more early primary teachers.

- Almost all *problem solving and agency* contexts and approaches are thought of amongst the most 'creativity enabling' by a large number of teachers, who also report to use them quite or very frequently. However 'fostering autonomy in learning' is both not relatively much used and not perceived as a very 'creativity enabling' approach.
- Concerning the areas of *questioning and curiosity*, there is correspondence between teachers' use of practices that encourage children to ask questions and foster their imagination and teachers' perceptions of these practices as 'creativity enabling'. However, the same cannot be said for the use of questioning by teachers and their encouraging of different ways of recording and expressing ideas. Although both practices are reportedly used quite or very often by the large majority of teachers, they are not considered amongst the three most 'creativity enabling' by many of them. Especially the use of questioning as a tool for science teaching is thought of 'creativity enabling' by only 8.39%, whereas 88.52% use it quite or very frequently. This big difference, given the importance of modelling and fostering by teachers of positive attitudes toward curiosity and questioning, rather points to an important gap that needs to be bridged by teacher education.
- A similar but smaller gap exists for the approach of 'fostering classroom discussion and evaluation of alternative ideas' under the IBSE/CA synergy of *reflection and reasoning*. The proportion of teachers who use this practice quite or very frequently greatly surpasses (88.99%) this that believes that it may contribute significantly to the development of children's creativity (17.2%).

The above results raise interesting questions and identify knowledge gaps which need to be shed light into and probed deeper in the in-depth field study the project *Creative Little Scientists* will undertake in the next research phase.

4.2.5 Assessment: How is the teacher assessing how far children's learning has progressed, and how is s/he using this information to inform planning and develop practice?

Internationally the tension between formative and summative uses of assessment in relation to assessment for learning *versus* assessment for comparative purposes, is evident. There is pressure on teachers to address specific assessment criteria rather than assess the holistic development of the individual, which the increase in formative assessment strategies has helped to ameliorate. Attempting to meet both purposes in the classroom is complex, particularly when summative uses of assessment, e.g. using tests, may need to be undertaken using context-free approaches. Calls have been made for the development of multimodal approaches to assessment in early mathematics and science activity (e.g. Glauert, 2009) that attend to, for example, children's gestures, speech or visualisations, and digital technology offers increasingly holistic ways of

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capturing children's engagement. Similarly within creativity, efforts have been made in the last two decades toward understanding and assessing creativity as complex (Feldusen and Ban, 1995), involving multiple components (Amabile, 1983). In the context of the early years this has meant an emphasis on children's learning in context, close observation and documentation, sometimes from multiple perspectives (Rinaldi, 2006; Project Zero and Reggio Children, 2001).

Given the above tensions and emphases identified in the literature, the project's conceptual framework (Deliverable D2.2, p69) has suggested that in relation to early years science and mathematics assessment the project could examine:

- The formative and summative ways in which assessment is used in science and mathematics in the early years;
- The involvement of children in assessment processes;
- The development of multimodal approaches to assessment sensitive to young children's capabilities and learning processes;
- The role of context and authenticity of assessment tasks;
- Broadening the assessment and evaluation of science and mathematics through employing a creativity lens in the context of inquiry;
- The person/people considered to be responsible for making judgements in assessing creativity in science and mathematics.

The following part of the *Report on First Survey of School Practice* presents the responses teachers provided to the survey section dedicated to assessment. Following the above recommendations the questions in this section aim to examine: the ways in which formative and summative assessment are used in science and mathematics teaching in early years; the involvement of children in assessment processes; the use of multimodal approaches to assessment; the role of context and authenticity of assessment tasks; and the person/people considered to be responsible for making judgments in assessing science and mathematics.

4.2.5.1 Priorities for assessment

Teachers were asked to indicate the importance of a number of priorities for assessment. These priorities correspond to two separate dimensions of science learning, cognitive and affective. The cognitive dimension includes acquiring knowledge, developing understanding and reaching scientific inquiry competences, while the affective is about fostering positive attitudes and increase of interest in science learning and science in general.

As can be seen in Figure 4.46 affective assessment priorities are considered as the most important out of all priorities for assessment, based on teachers' responses. Both items – 'positive attitudes and increase of interest in learning science'; and 'positive attitudes and increase of interest in science' - connected to affective assessment priorities are considered quite or very important by the overwhelming majority of teachers - 93.6% and 93.2% respectively. On the other hand, cognitive priorities, such as acquiring knowledge and understanding of science ideas and

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processes, including competences of and understandings about scientific inquiry, are considered as quite or very important by many fewer teachers, though still the clear majority of them (i.e. over 55%). Even amongst these cognitive assessment priorities there seems to be a preference amongst teachers for the ones that refer to science processes (73.7%) and inquiry competences (69.7%) and less for the ones that refer to science ideas (facts, concepts, laws and theories) and understanding about how science and scientists work (57.6%). This ranking of science assessment priorities in order of importance by teachers is consistent with the frequency they pursue the corresponding aims and objectives in their science teaching, discussed above in section 4.2.1.2.

Checking the inter-item reliability of the items grouped as 'cognitive assessment priorities' we noticed that the resulting reliability (Cronbach's alpha α=0.673) is not statistically 'acceptable'. However, this rises beyond the 0.7 threshold (α=0.761) and becomes 'acceptable' if the item "understandings about scientific inquiry (e.g. how science and scientists work)" were to be excluded from the group. This finding supports the above analysis, as it indicates that out of all 'cognitive' priorities teachers responded differently to this priority. Furthermore, looking at the inter-item reliability of all the assessment priorities, we noticed that this is also below the 'acceptable' threshold (α=0.662), the item on the assessment of 'positive attitudes and increase of interest in science' being only weakly related to the rest (Corrected Item-Total Correlation 0.250 <0.3).

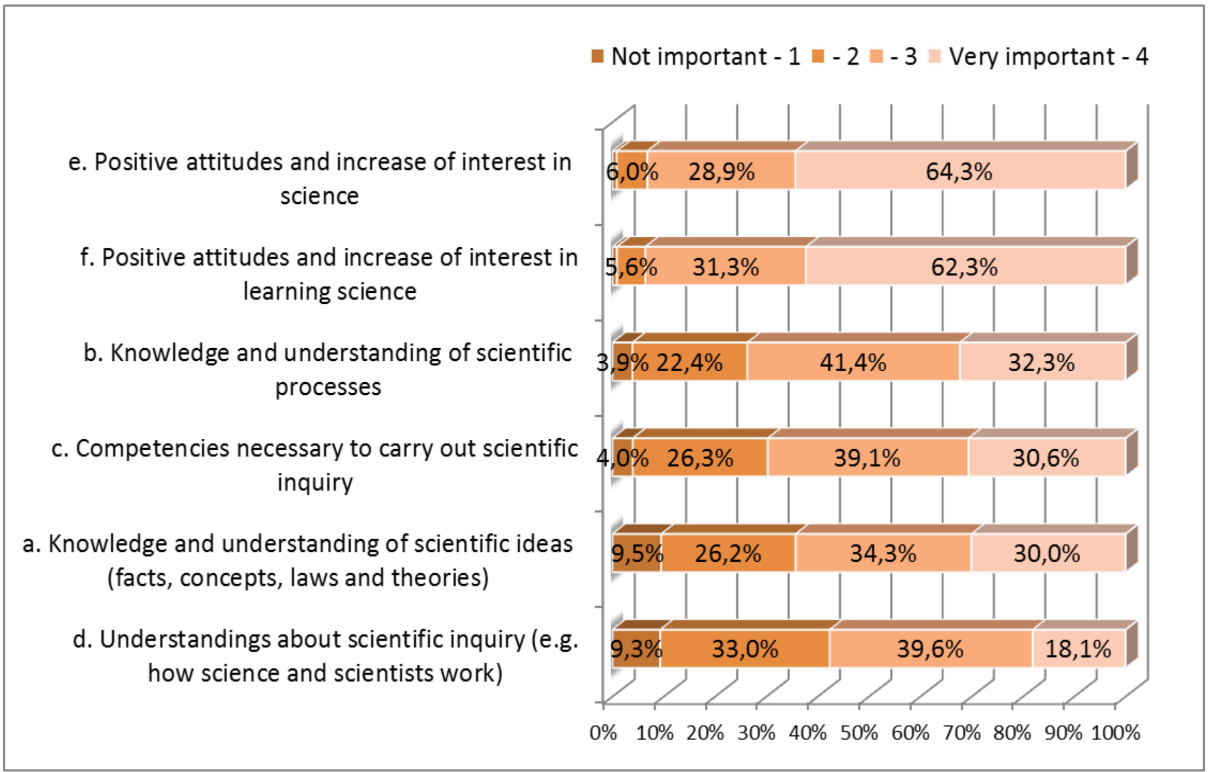

Figure 4.46. Importance of assessment priorities in preschool and early primary school science, according to teachers.

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Differences between partner countries

Excluding countries with fewer than 30 teachers in their sample, Romania rated higher than all other partner countries the importance of all science assessment priorities. The importance of affective assessment priorities is also rated similarly high by English, German and Portuguese teachers and statistically significantly ($p<0.05$) lower by Maltese and French teachers (Figure 4.47).

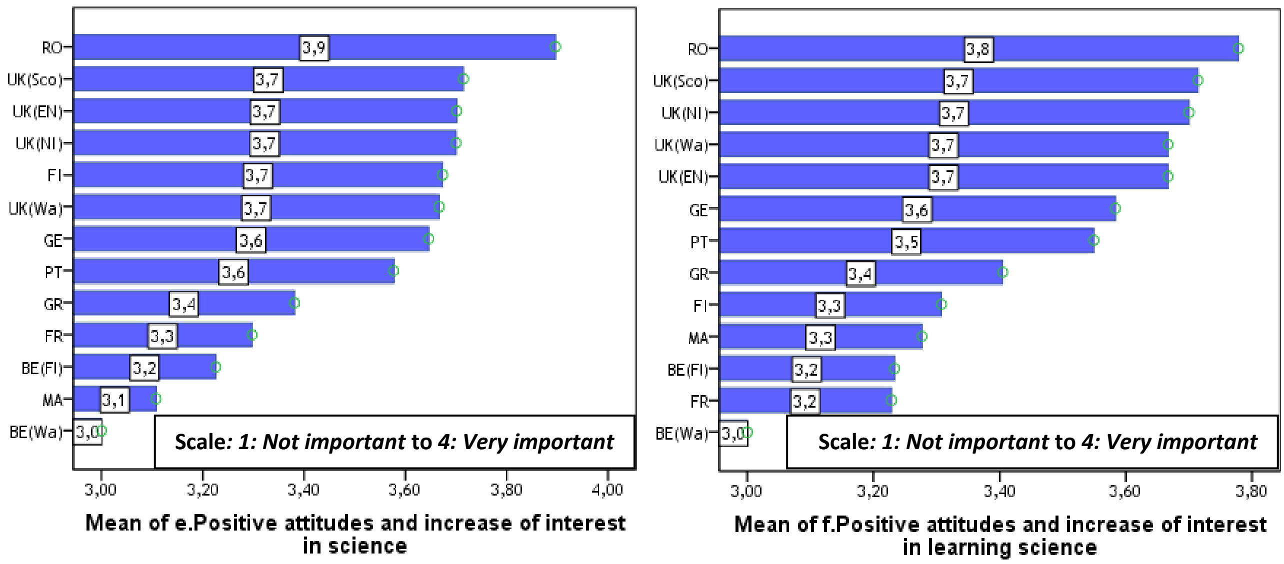

Figure 4.47. Importance of affective assessment priorities, according to teachers: National samples' variations.

As already mentioned, sampled teachers in all partner countries place the importance of assessing children's 'understandings about scientific inquiry' lower than all other priorities; significant variations exist only between Romanian teachers at the higher end and Flemish, Finnish and Maltese teachers at the lower end (Figure 4.48). Finnish and Maltese teachers also rate lower than teachers in other partner countries the importance of assessing inquiry competencies. German teachers on the other hand rate very differently the assessment importance of understandings about scientific inquiry and of competences to carry out scientific inquiry; they consider the former of average importance (2.6 – from 1 to 4) and the latter of clear importance (3.1 – from 1 to 4). Finally, French and Flemish teachers place a relatively lower importance on the cognitive assessment priorities that refer to children's knowledge of scientific ideas and processes than on those referring to understandings about and competences of scientific inquiry, and in this they differ significantly from Romanian and Finnish teachers. The latter place considerably lower importance on the assessment of understandings about and competences of scientific inquiry.

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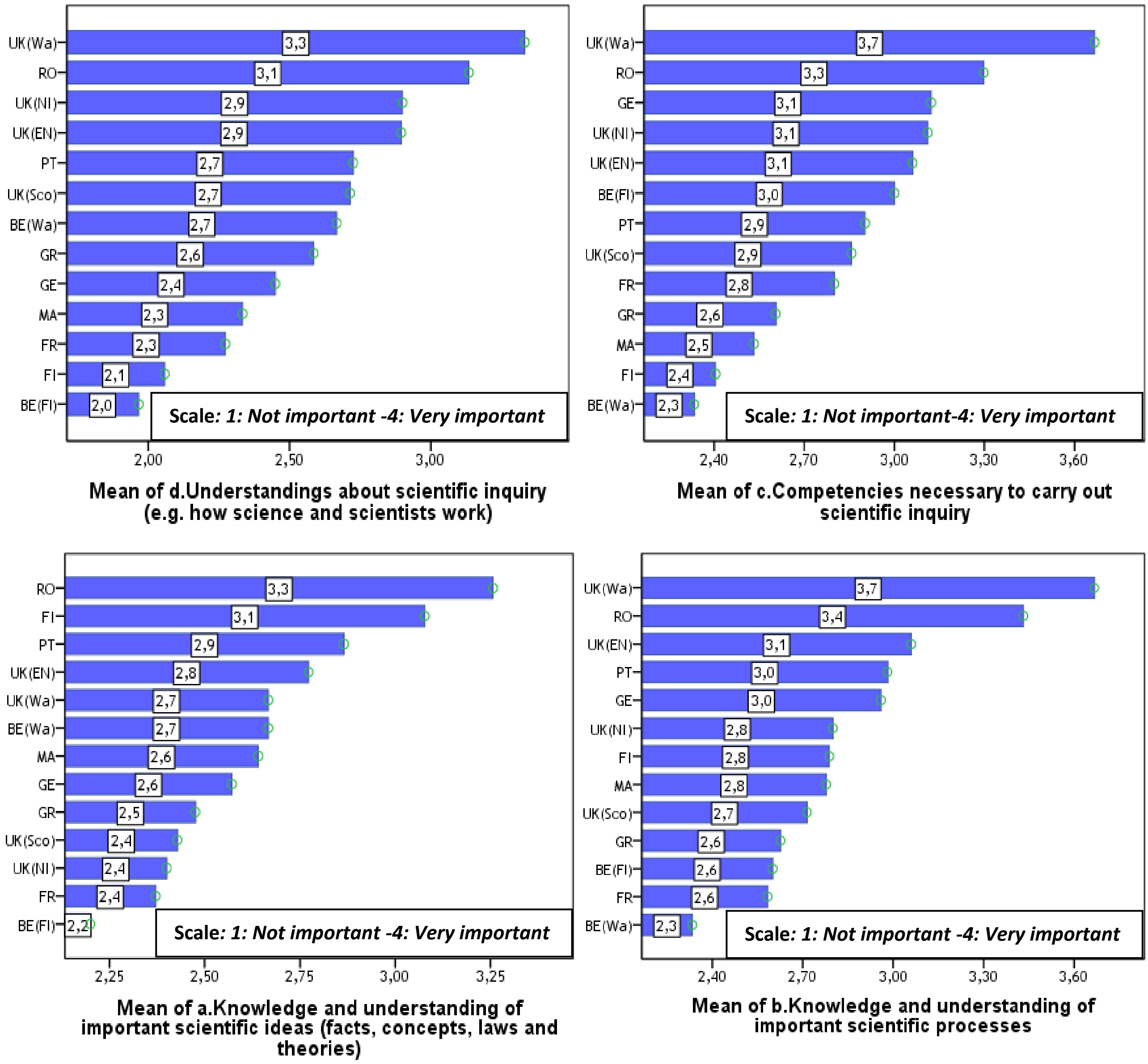

Figure 4.48. Importance of cognitive assessment priorities, according to teachers: National samples' variations.

Differences between preschool and primary education

Comparing the responses of preschool teachers to the ones of early primary teachers, we found no significant differences (t-test, $p<0.01$) in the importance attributed to all assessment priorities, but those concerning children's knowledge of important scientific ideas and processes. These are considered as more important by primary than preschool teachers, as it might be expected. In particular, the biggest difference amongst the two groups was found in relation to the assessment of children's knowledge of scientific ideas, which is considered important or very important by 71.8% of primary but only 53.1% of preschool teachers (Figure 4.49).

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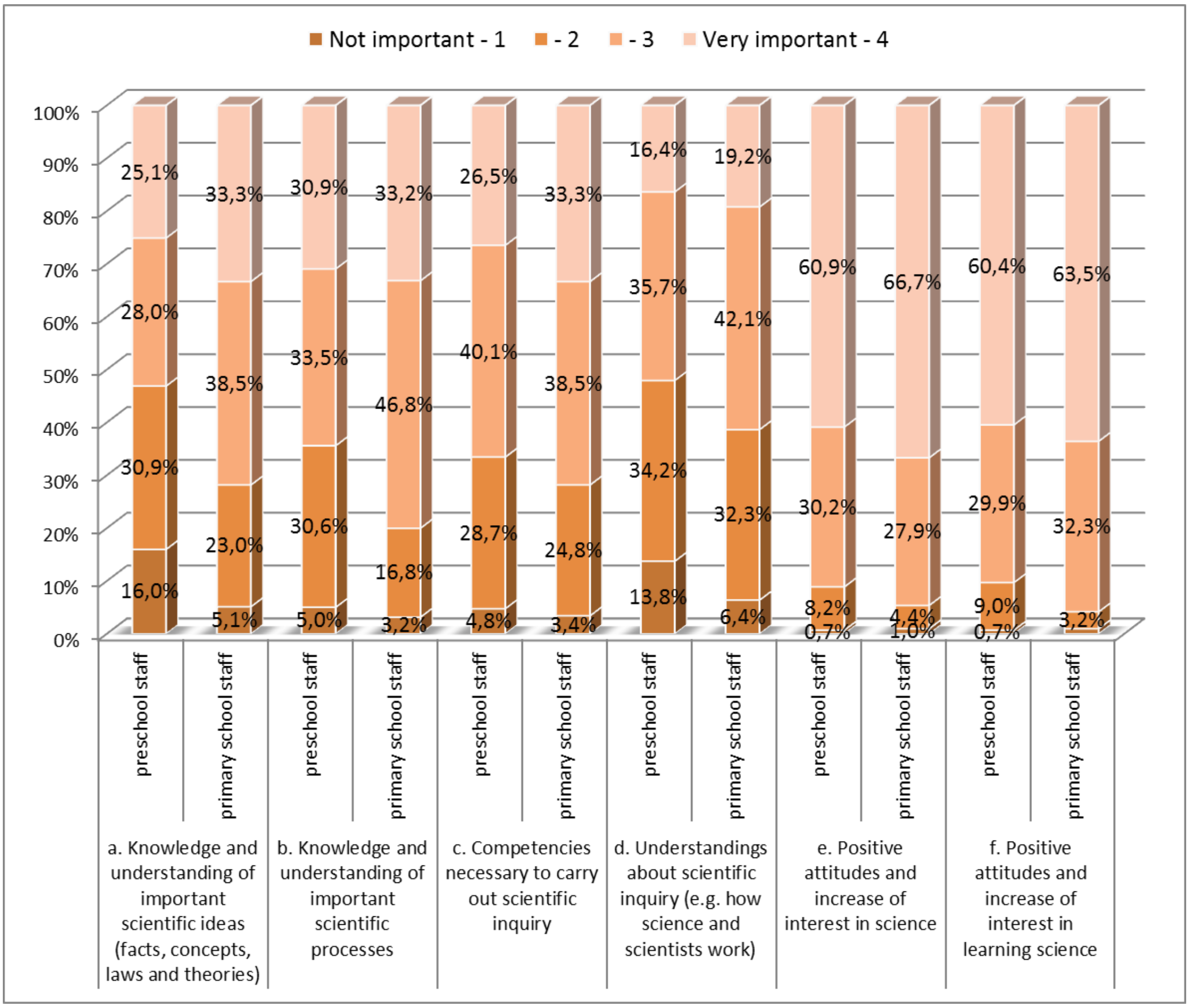

Figure 4.49. Differences between preschool and primary teachers' science assessment priorities.

4.2.5.2 Assessment of creative dispositions in science

Teachers were also asked about the frequency with which they praise/reward a number of creative dispositions in their pupils: their sense of initiative; motivation; ability to come up with something new; ability to connect what they learnt during the science lessons with topics in other subjects; imagination; curiosity; ability to work together; thinking skills. An impressive proportion (more than 90%) of the sample of all teachers across the partner countries said to be praising and rewarding all these dispositions in their pupils in science quite or very frequently (Figure 4.50). The most frequently (quite and very often) rewarded dispositions are children's ability to work together (97.8%), a finding consistent with previous findings of the analysis, and children's sense of initiative (96.7%). It would be interesting for the coming stages of the project, especially the in-depth field work, to look into how teachers praise these characteristics and how this praise is received by their pupils.

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Finally, all items grouped under this question on children's 'creative dispositions' were found to be very strongly inter-related (Cronbach's alpha α=0.902), which indicates that they could form a construct.

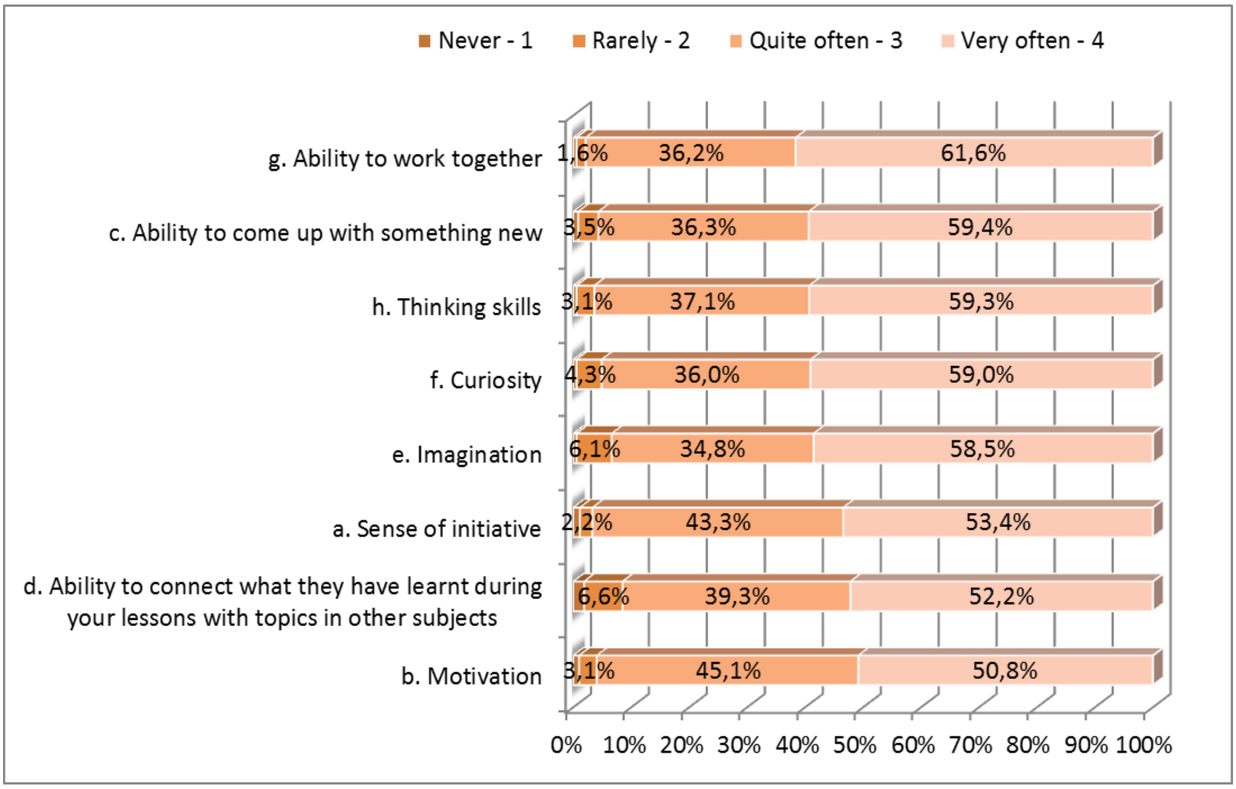

Figure 4.50. Frequency with which teachers reward/praise children's creative dispositions in their science teaching.

Differences between partner countries

Amongst the sampled teachers of all partner countries (Figure 4.51), only French teachers systematically praise/reward less frequently all eight creative dispositions presented to them, as part of their science assessment. In particular, they praise/reward children's imagination and ability to come up with something new significantly ($p<0.05$) less frequently than all other national samples of teachers. On the other hand, Romanian teachers, joined in most cases also by Greek and/or Maltese teachers praise/reward significantly ($p<0.05$) more frequently than others most of these creative dispositions. With reference to these three overall high averaging in the assessment of creativity national samples, English and German sampled teachers average significantly lower than all three of them in the use of praise/reward of children's imagination, and their ability to connect what they have learnt in science with topics in other subjects respectively. Moreover, English teachers average significantly lower than the Romanian teachers also in the assessment of children's sense of initiative and ability to come up with something new, and German teachers in the assessment of children's sense of initiative and thinking skills.

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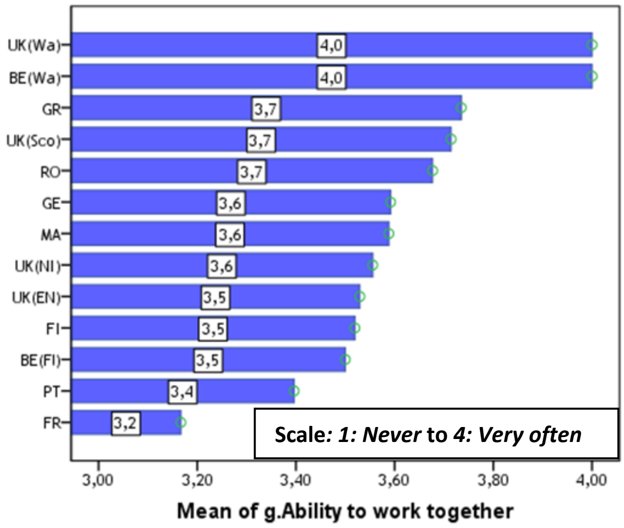

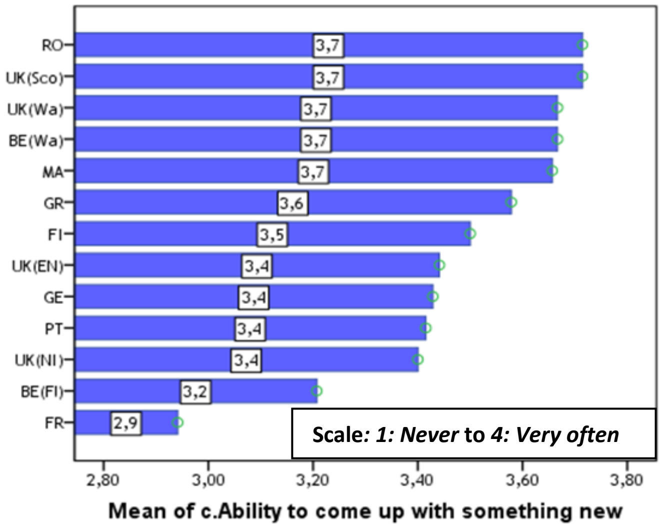

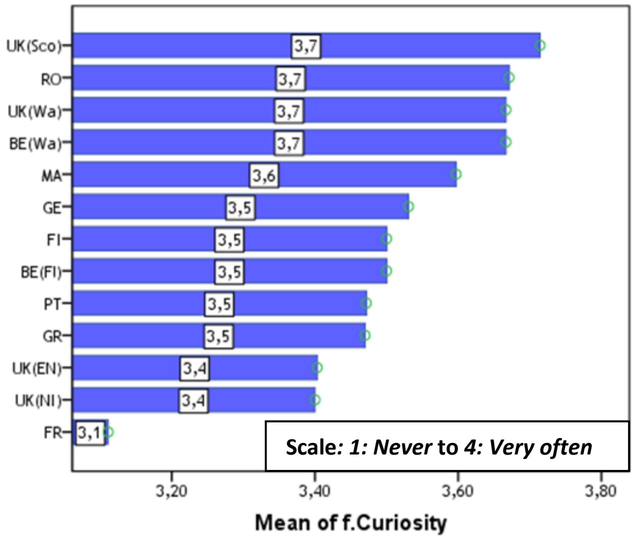

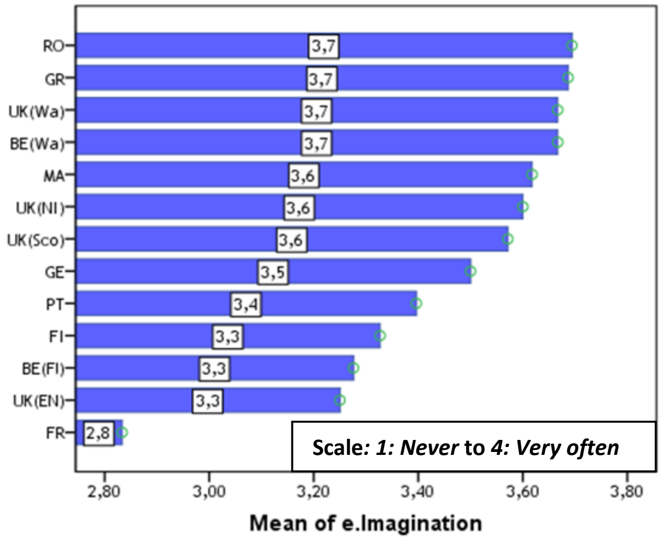

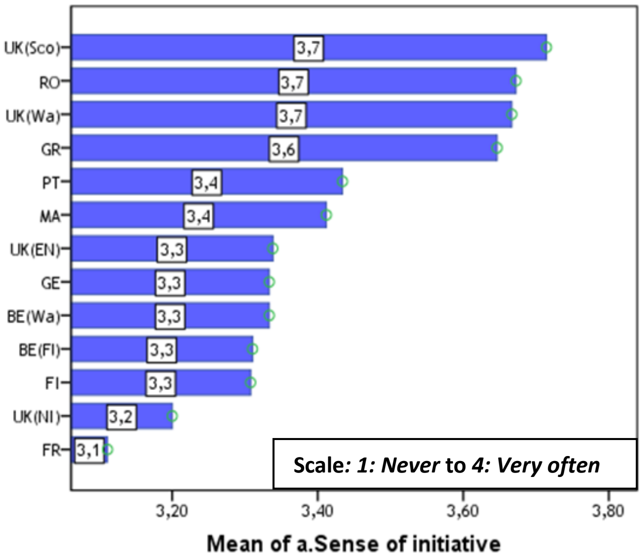

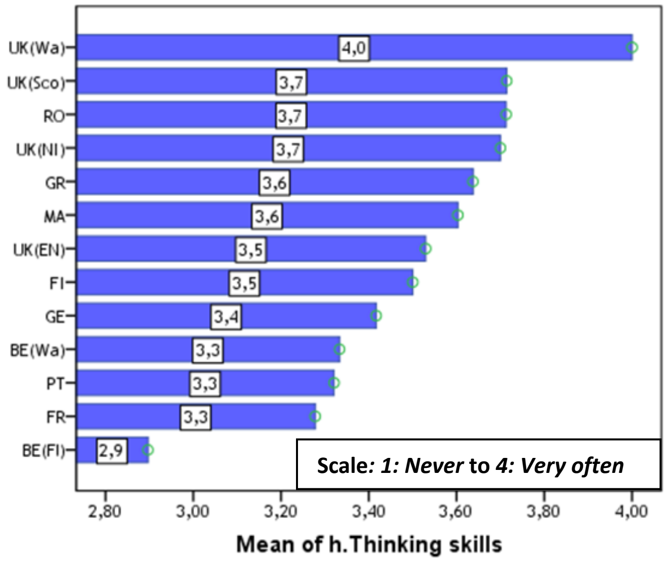

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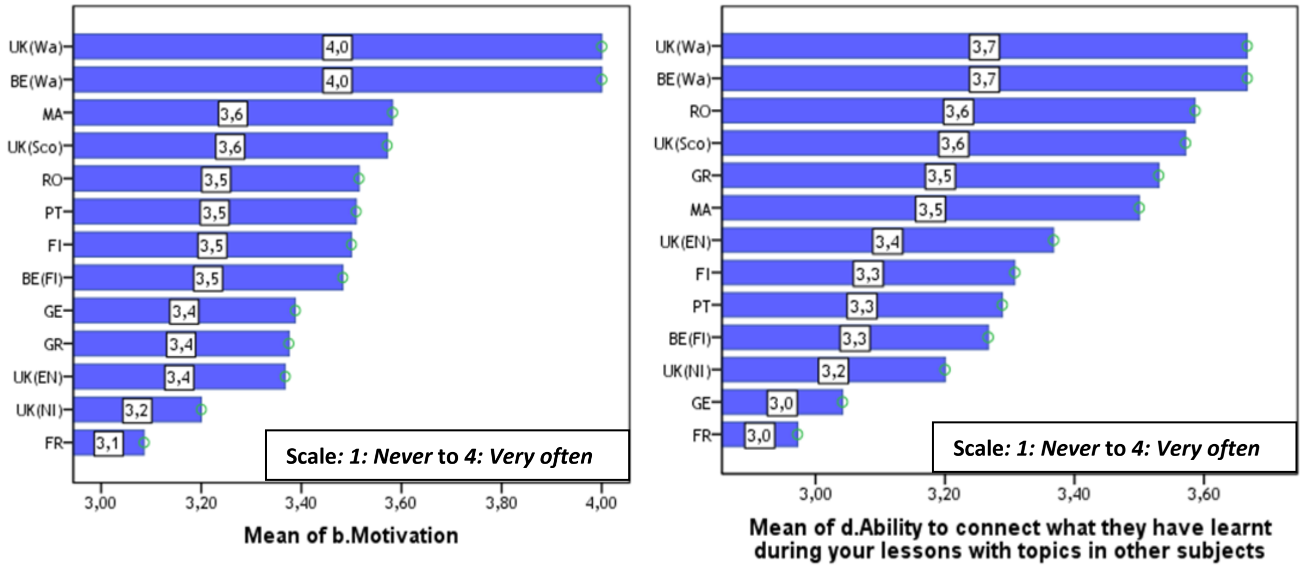

Figure 4.51. Frequency with which teachers reward/praise children's creative dispositions in their science teaching: National samples' variations.

Differences between preschool and primary education

An independent samples t-test showed that preschool and primary teachers' practice in terms of the assessment of children's creative dispositions in science differ very little and significantly ($p<0.01$) only in relation to the assessment of curiosity, which preschool teachers report to be using a little more frequently than early primary school teachers (Figure 4.52).

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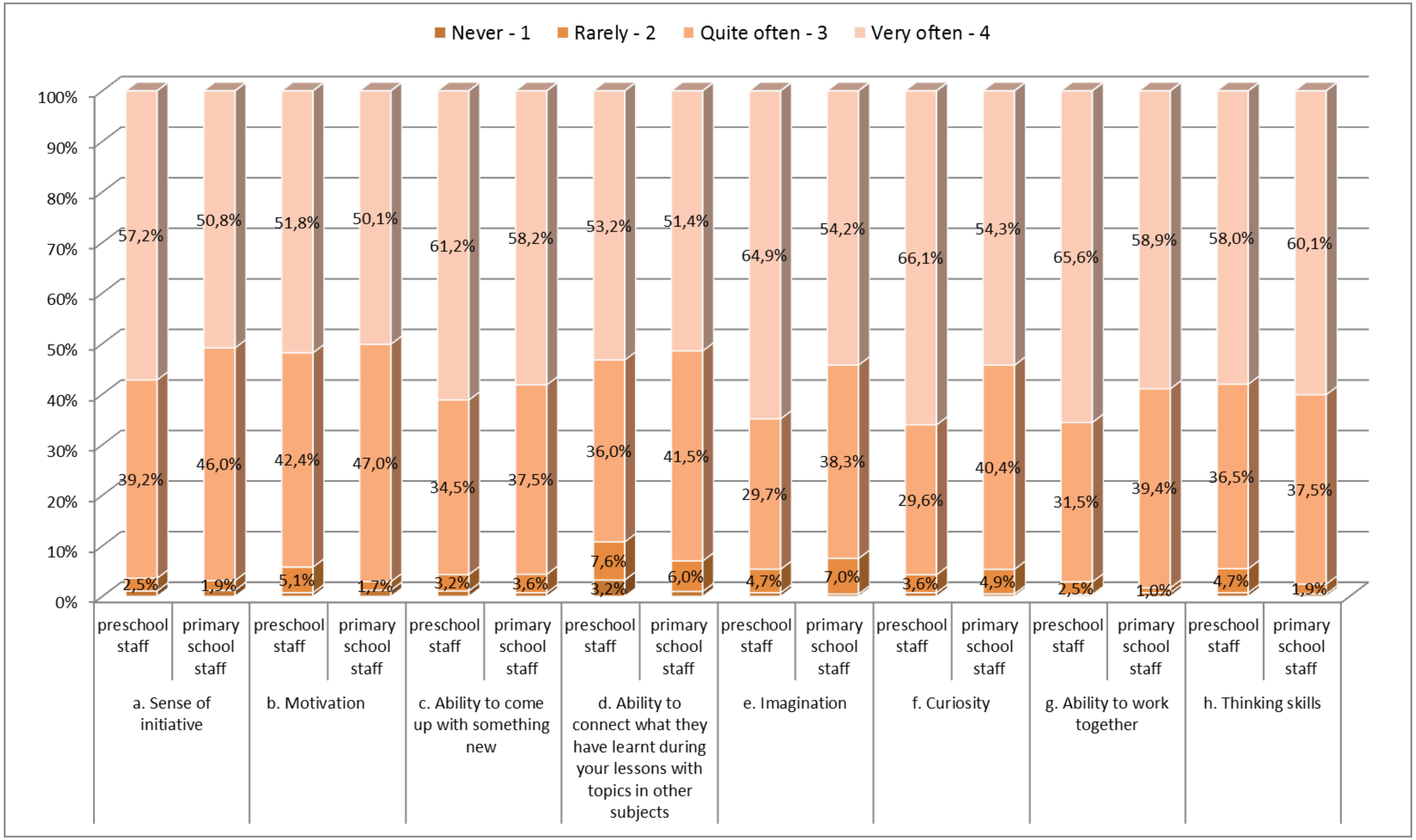

Figure 4.52. Differences between preschool and primary teachers' assessment of creative dispositions in science.

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4.2.5.3 Assessment ways and processes

Figure 4.53 shows the frequency with which teachers use a variety of assessment ways and processes in science. Overall, the majority of the sampled teachers report to be assessing children quite or very often during classroom interaction (89.9%), attending to the pictures and other visual materials they produce (70.9%) as well as to their gestures or physical activity (67.8%), and using questions in-context (66.3%), authentic problem-based tasks (65.1%) and portfolios (collection of evidence of children's work and progress) (64.9%). All these point to a formative emphasis of science assessment by teachers for the particular age range examined by *Creative Little Scientists*. Having said this, only about half the teachers surveyed use the formative approaches of self assessment (i.e. ask children to reflect on their own learning and progress) or peer assessment (i.e. ask children to correct each other's work and give each other feedback) quite or very frequently (56.4% and 50.7% respectively). It should be noted that these two items characterize also assessment where the locus of the judgment is on children rather than on teachers. It would be interesting to find out if this lower frequency of use of these approaches by teachers is due to their lack of expertise in the use of such approaches, or to teachers considering them as inappropriate for this age group of children.

The latter seems to be one of the reasons for teachers downplaying the use of any form of tests, open question or closed question ones (53.0% and 27.7% respectively use them quite or very often), checklists for classroom observations (44.8%) and homework (35.2%) as forms of assessment evidence. All these forms are also often associated with summative approaches of assessment which thus do not appear to be as prevalent in preschool and early primary school practices.

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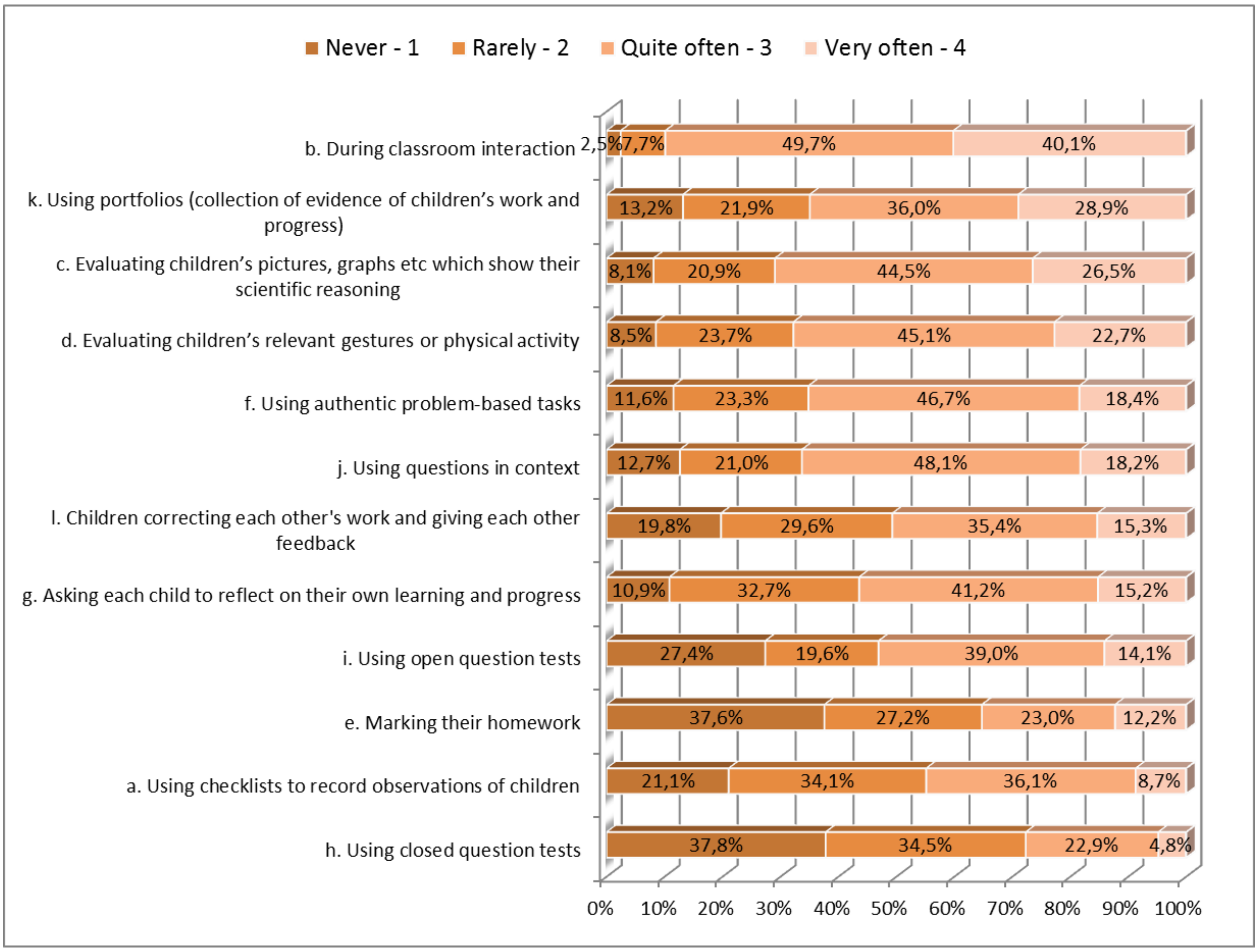

Figure 4.53. Frequency with which teachers use various assessment ways and processes in their science teaching.

Differences between partner countries

Significant variations amongst partner countries appear in the frequency of use of all assessment ways and processes presented to their teachers (Figure 4.54). Excluding the samples of fewer than 39 teachers, the following findings stand out:

- German teachers assess children during classroom interaction significantly less frequently ($p<0.05$) than all other national samples.
- Greek teachers evaluate children's visual representations of scientific reasoning significantly ($p<0.05$) more frequently than most (5 out of 7) other national samples. Finnish and German teachers on the other hand evaluate them significantly less frequently than four out of the other seven national samples. German teachers also evaluate children's gestures and physical activity significantly less frequently ($p<0.05$) than most (5 out of 7) other national samples.
- Maltese teachers use authentic problem based tasks significantly ($p<0.05$) less frequently than four out of the other seven national samples.

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- English teachers use questions in context significantly ($p<0.05$) more frequently than most (5 out of 7) other national samples, whereas Finnish and Greek teachers use them significantly less frequently than most.
- English teachers also use children self assessment significantly ($p<0.05$) more frequently than most (5 out of 7) other national samples.
- Maltese teachers use children peer assessment less often than rarely and significantly ($p<0.05$) less frequently than almost all (6 out of 7) other national samples. On the other hand, Romanian teachers use it overall quite often and significantly ($p<0.05$) more than all others.
- Romanian teachers also use portfolios of children's work and progress overall more than quite often and significantly ($p<0.05$) more frequently that almost all (6 out of 7) other national teacher samples, whereas French, Finnish and Maltese teachers use them infrequently and significantly ($p<0.05$) less frequently than three other national samples.
- Romanian teachers are also relatively keener in the use of summative tests and homework as forms of assessment evidence. They use open question tests significantly more frequently than almost all (6 out of 7) other partner countries' teachers; closed question tests significantly more than Greek, German and Finnish teachers; and homework significantly more than Greek, German and English teachers. On the other hand, German teachers are consistently the lowest users of all these summative forms of assessment evidence.

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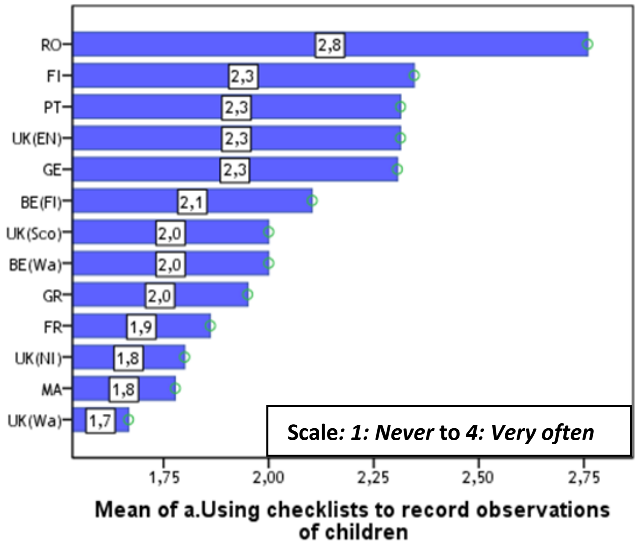

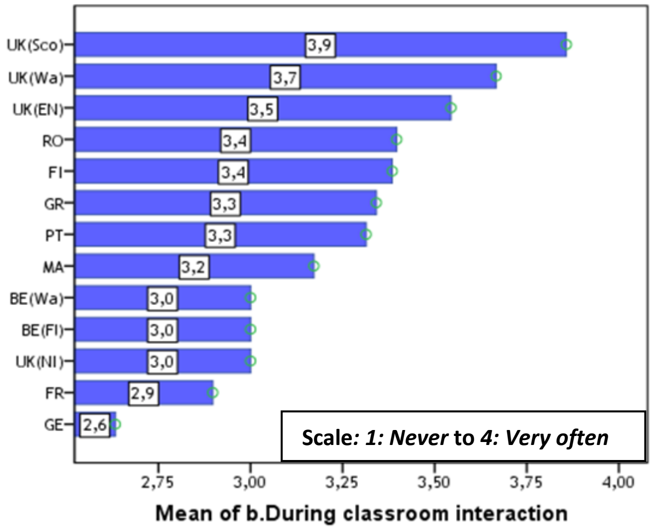

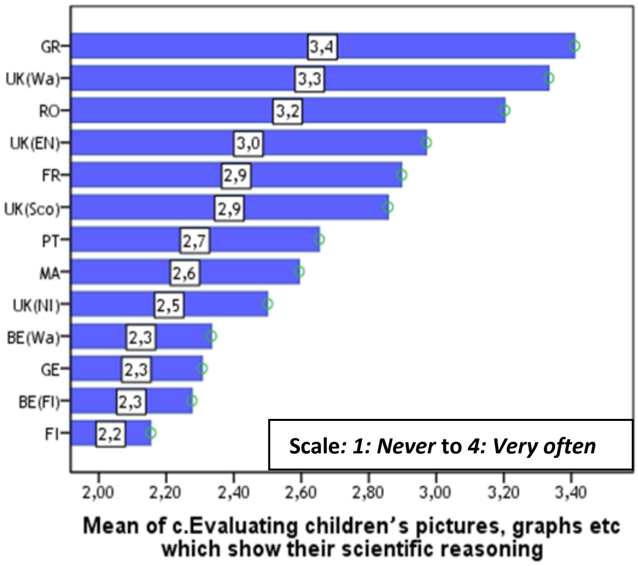

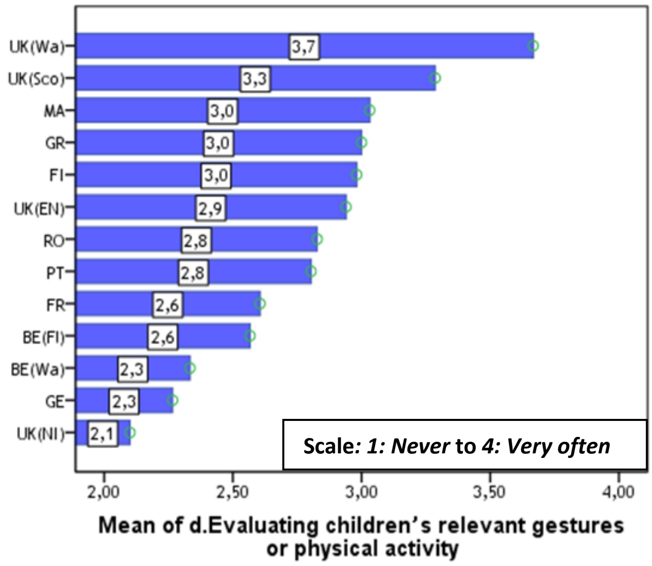

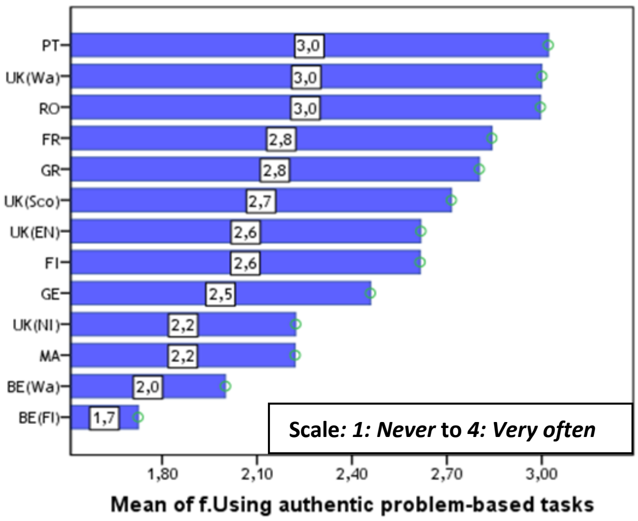

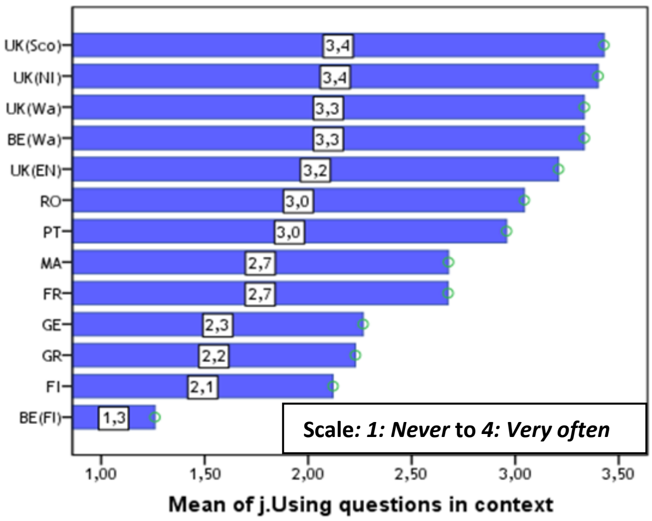

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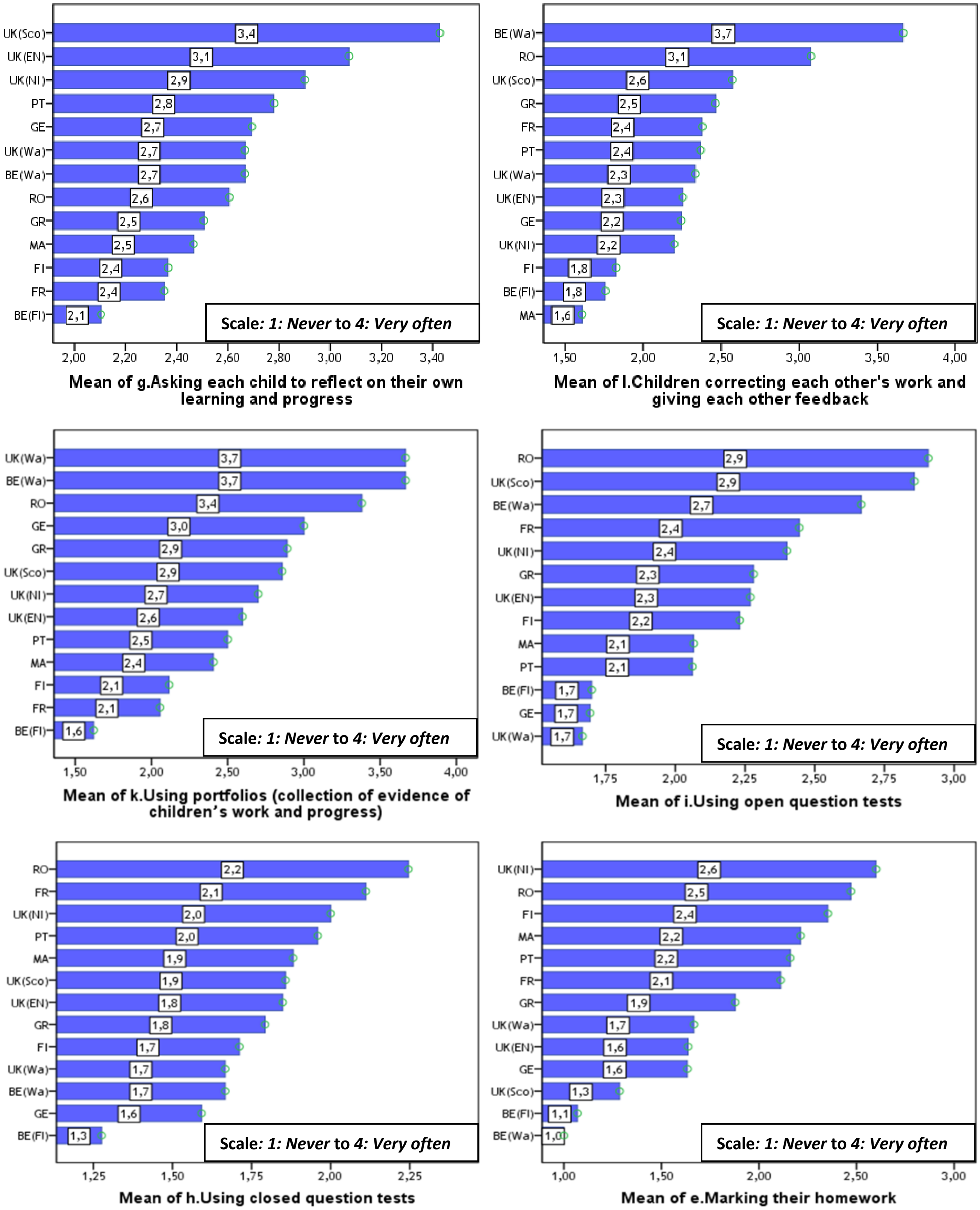

Figure 4.54. Frequency with which teachers use various assessment ways and processes in their science teaching: National samples' variations.

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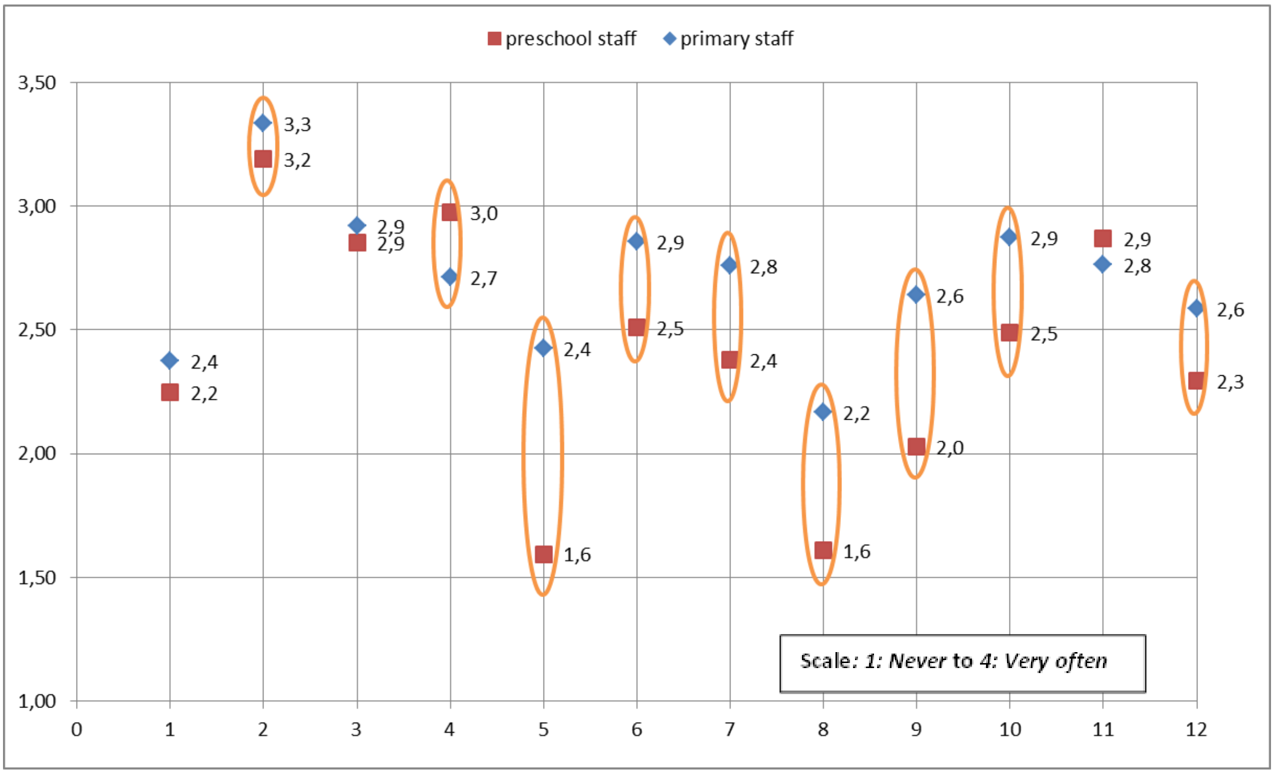
Differences between preschool and primary education

Figure 4.55 shows the differences between preschool and early primary school teachers in the frequency of use they make of various assessment ways and processes. Primary teachers appear to be doing significantly ($p<0.01$) more frequently the following:

- Assessing children during classroom interaction
- Marking children's homework
- Using authentic problem-based tasks
- Asking each child to reflect on their own learning and progress
- Using closed question tests
- Using open question tests
- Asking children to correct each other's work and give each other feedback



1: Using checklists to record observations of children
2: During classroom interaction
3: Evaluating children's pictures, graphs etc which show their scientific reasoning
4: Evaluating children's relevant gestures or physical activity
5: Marking their homework
6: Using authentic problem-based tasks
7: Asking each child to reflect on their own learning and progress
8: Using closed question tests
9: Using open question tests
10: Using questions in context
11: Using portfolios (collection of evidence of children's work and progress)
12: Children correcting each other's work and giving each other feedback

Figure 4.55. Differences between preschool and primary teachers' assessment ways and processes.

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The largest difference was noticed for the practice of 'marking homework', which primary teachers use with average frequency, whereas preschool teacher use between never and rarely. On the other hand, the only practice which is significantly more used by preschool teachers is the evaluation of children's visual representations of their scientific reasoning. This is an interesting finding from the project's viewpoint, as both fostering and attending to children's multimodal expression has been found to support creative learning and inquiry.

4.2.5.4 Assessment functions/purposes

The tension between formative and summative assessment is one of the main interests the project wishes to explore in regard to assessment, so teachers were presented with a number of assessment objectives usually associated with formative and summative assessment processes, to say how often they use them. Figure 4.56 shows all sampled teachers replies and suggests no overall clear predominance of formative or summative purposes in their assessment practices. The majority of teachers report to be using assessment quite or very frequently for all these functions/purposes, but mostly to identify ways to improve child science learning (79.3%) and monitor regularly individual children's or cohorts of children's progress towards a set of desirable science learning outcomes (76.1%). Identifying areas for improvement in teaching (69.1%); providing feedback to children and parents (68.6% and 65.0% respectively); and monitoring children's year-to-year progress (61.0%) are all assessment functions used quite or very often by 60% to 70% of teachers, whereas setting learning targets with children (55.3%), improving the science curriculum (53.3%) and grouping children for instruction (53.3%) are quite or very frequently used by a little more than half of the teachers.

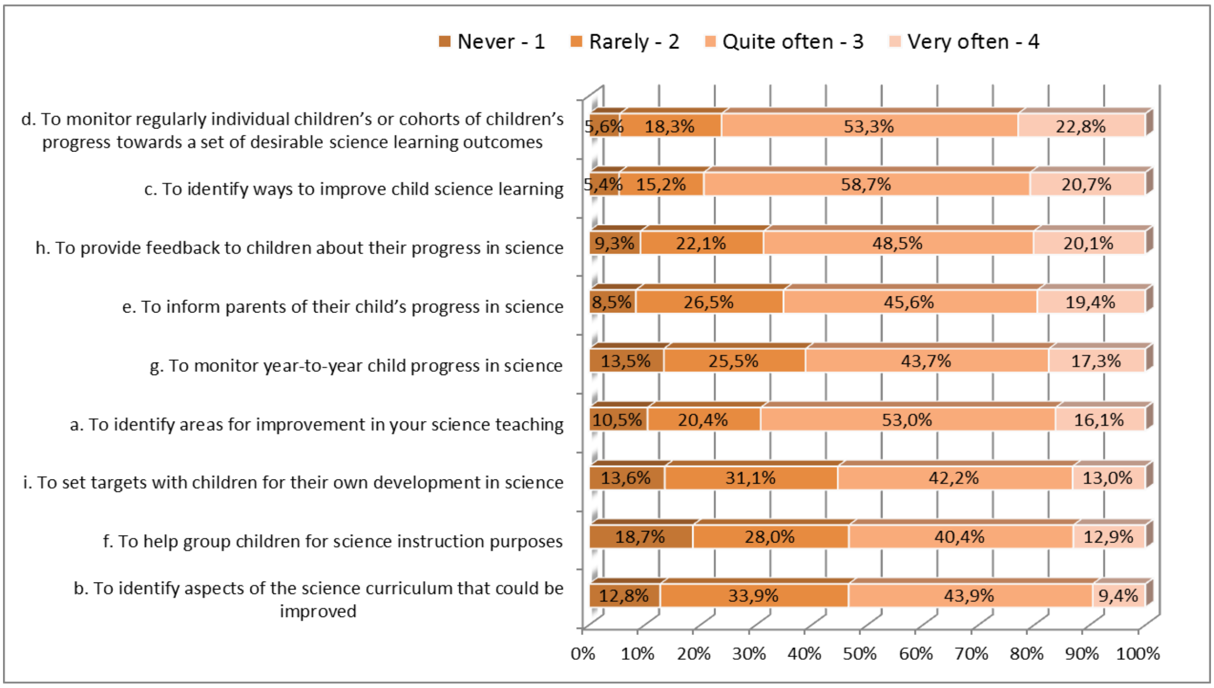

Figure 4.56. Frequency with which teachers use assessment in their science teaching to fulfill a number of formative and summative purposes.

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Differences between partner countries

Significant variations amongst partner countries appear in the frequency of use of all science assessment functions presented to their teachers (Figure 4.57). Excluding the samples of fewer than 37 teachers, the following findings stand out:

- On the high end of the spectrum Finnish and Romanian teachers use assessment to identify ways to improve children's science learning, and to monitor regularly children's progress towards a set of science learning outcomes significantly ($p<0.05$) more frequently ($p<0.05$) than their German and Maltese counterparts on the low end of the spectrum. The latter two use assessment for monitoring children's progress significantly ($p<0.05$) less frequently than most (5 out of 7) other national samples.
- The formative function of using assessment to identify areas for improvement in science teaching is used rarely and significantly ($p<0.05$) less frequently than all other national samples by German teachers. French and Maltese teachers also use this function infrequently and less than most (5 out of 7) other national samples. English, Finnish, Greek and Romanian teachers, all use it significantly more than German, French and Maltese teachers.
- Finnish teachers report to provide feedback to children about their progress in science between quite often and very often, and significantly more frequently than almost all (6 out of 7) other national samples of teachers. Teachers in Greece however are not so used to do this, which is significantly less often than most (4 out of 7) other partner countries' teachers.
- Romanian teachers are mostly used to inform parents of their children's progress in science, significantly ($p<0.05$) more so than almost all other partner countries' teachers. On the other hand, German and Maltese teachers report using assessment for this purpose the least frequently.
- German teachers also only rarely use assessment to monitor year-to-year children's progress in science, significantly ($p<0.05$) less often than most (5 out of 7) other national samples of teachers.
- Setting science learning targets in consultation with children is an assessment function used quite frequently by Romanian teachers, and significantly ($p<0.05$) more frequently than English, Greek, German and Maltese teachers who do this with average and low frequency.
- English teachers report to be using assessment to modify the science curriculum overall quite often and significantly more than Maltese, Finnish and German teachers who do this with average or low frequency. The latter in particular, take up this purpose significantly ($p<0.05$) less frequently than all other teachers.
- Finally, using assessment to group children for instruction purposes is a practice embraced on the one hand by Romanian teachers quite often and significantly ($p<0.05$) more frequently than all other samples; and on the other, by German teachers very rarely and significantly ($p<0.05$) less frequently than almost all (6 out of 7) other teachers.

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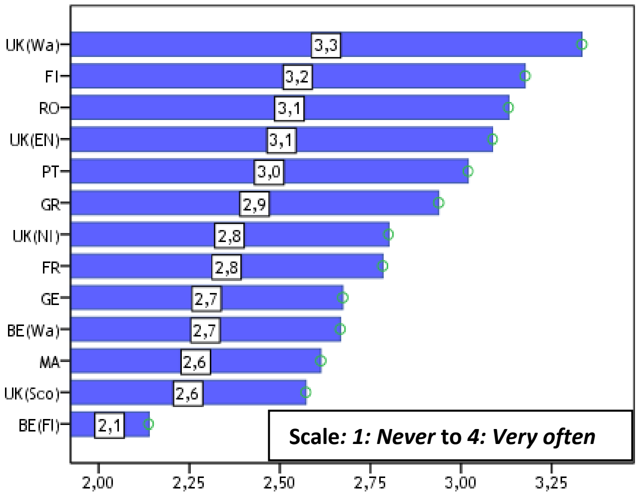
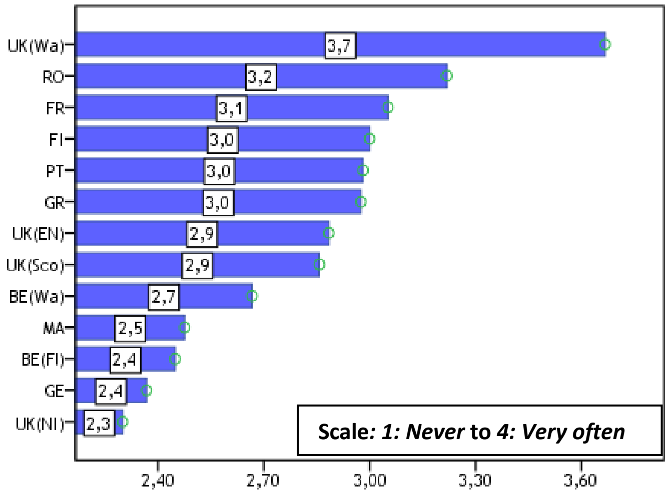
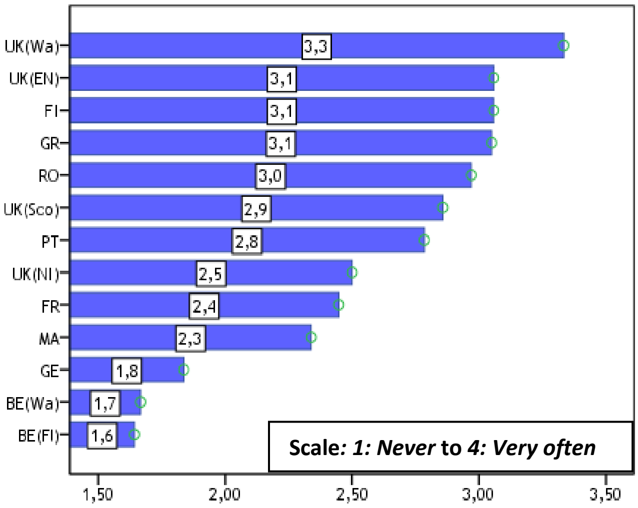


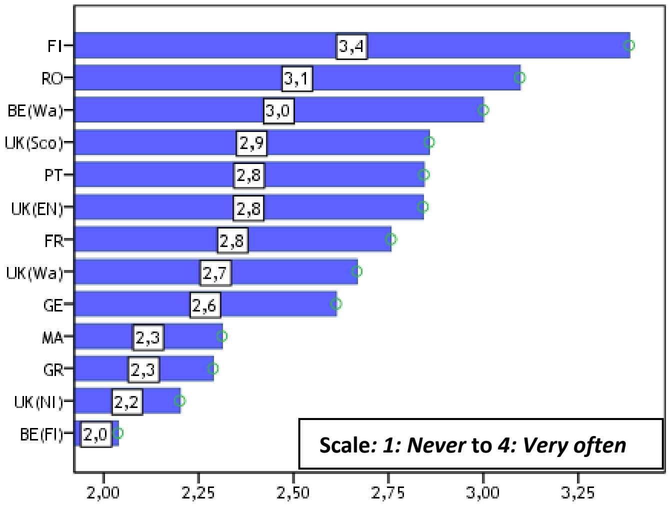
Mean of c.To identify ways to improve child science learning



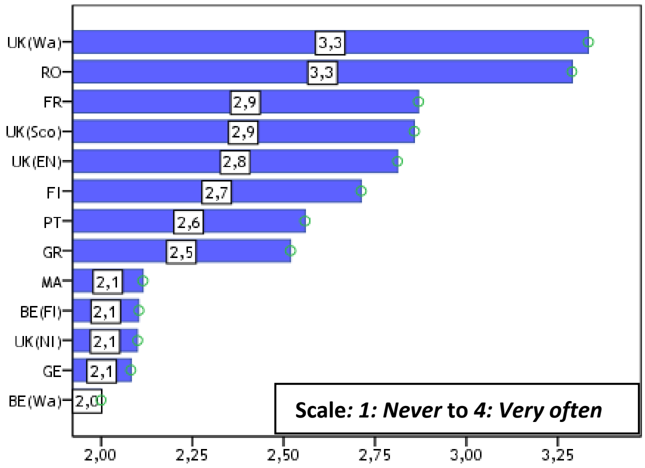
Mean of d.To monitor regularly individual children's or cohorts of children's progress towards a set of desirable science learning outcomes



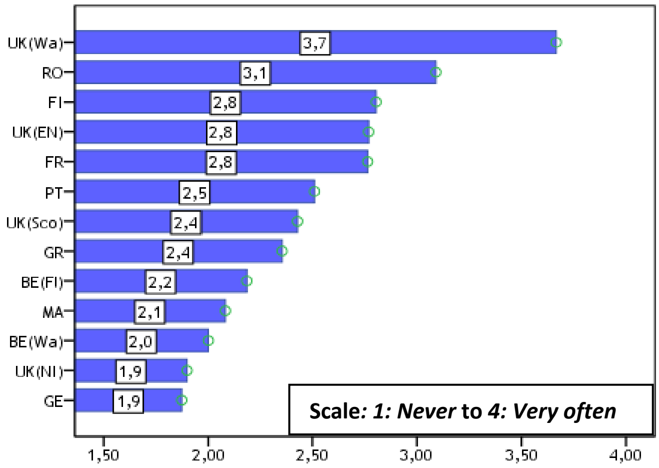
Mean of a.To identify areas for improvement in your science teaching



Mean of h.To provide feedback to children about their progress in science



Mean of e.To inform parents of their child's progress in science



Mean of g.To monitor year-to-year child progress in science

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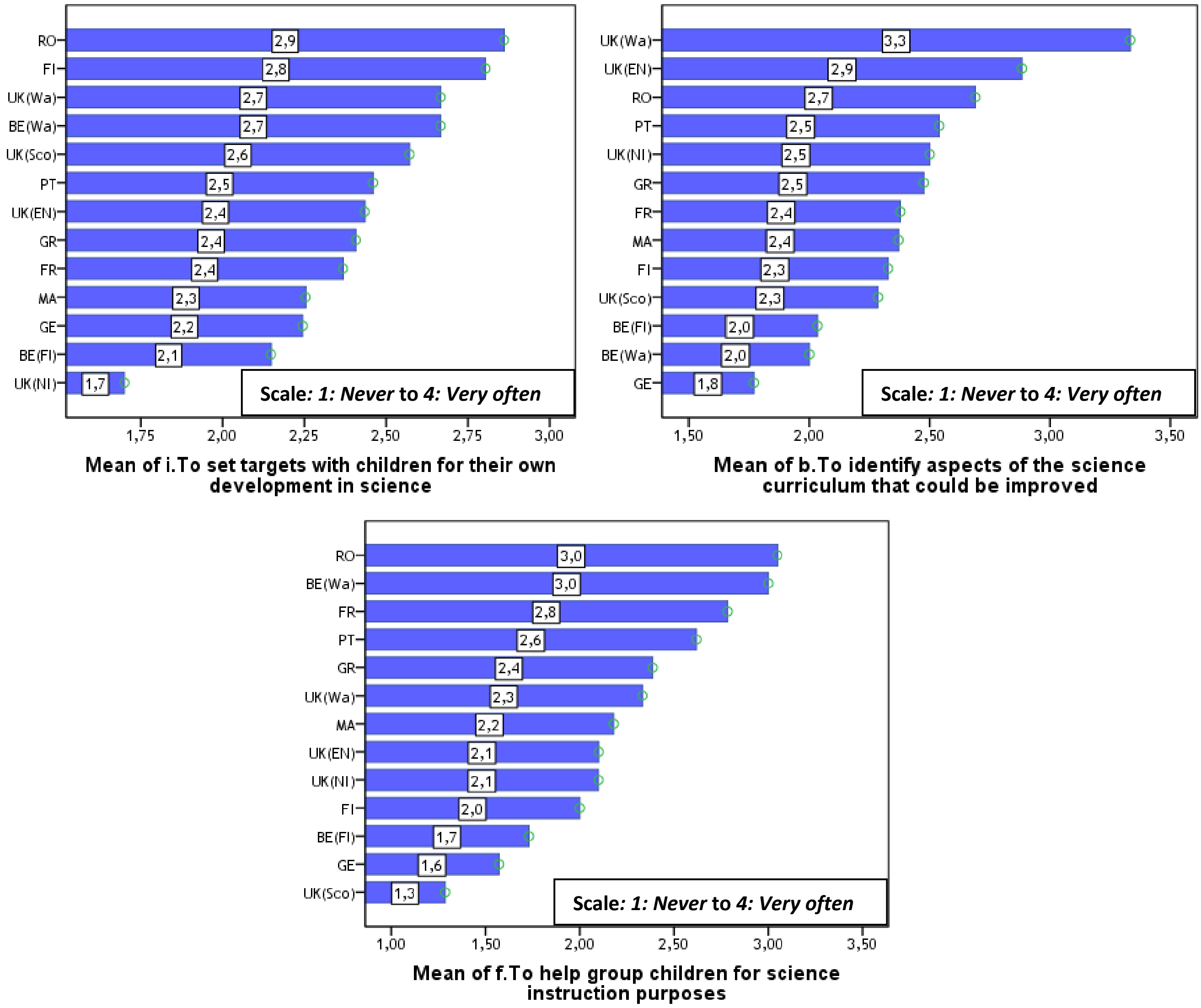

Figure 4.57. Frequency with which teachers use assessment for various purposes in their science teaching: National samples' variations.

Differences between preschool and primary education

Figure 4.58 shows the differences between preschool and early primary school teachers in the frequency they use assessment for various purposes. Primary teachers appear to be using assessment significantly ($p<0.01$) more frequently for most of the functions that are traditionally associated with child-centered formative objectives, that is to:

- identify areas for improvement in the teaching of science;
- identify ways to improve child science learning;
- monitor regularly children's progress towards a set of desirable science learning outcomes;
- provide feedback to children about their progress in science; and
- set targets with children for their own development in science.

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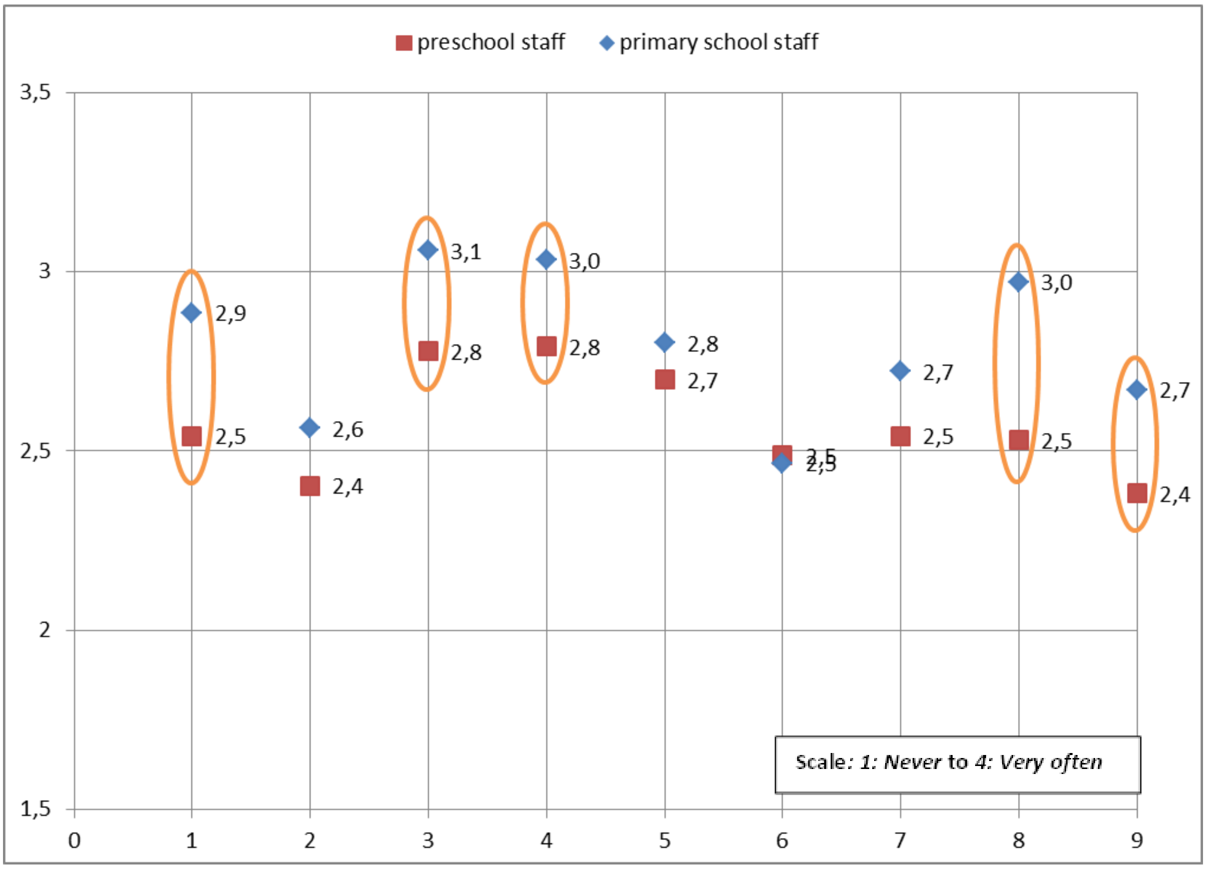
The latter two practices have a particular interest for the project as they place the child as the direct recipient of assessment results. It would be interesting to investigate further the reasons behind these differences between preschool and primary school teachers.



1: To identify areas for improvement in your science teaching
2: To identify aspects of the science curriculum that could be improved
3: To identify ways to improve child science learning
4: To monitor regularly individual children's or cohorts of children's progress towards a set of desirable science learning outcomes
5: To inform parents of their child's progress in science
6: To help group children for science instruction purposes
7: To monitor year-to-year child progress in science
8: To provide feedback to children about their progress in science
9: To set targets with children for their own development in science

Figure 4.58. Differences between preschool and primary teachers' science assessment purposes.

4.2.5.5 Differences between assessment of science and assessment of mathematics

Respondents were asked to highlight any differences between science and mathematics in the assessment strategies and processes they use. In the majority of National Reports no significant findings were presented, only in the reports for Belgium, Greece, Romania and Scotland comparisons between the assessment of the two disciplines were mentioned.

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The overall picture of assessment in science and mathematics is common for the largest part of teachers who completed the survey. Most of the teachers did not find significant differences for assessment purposes. In Greece for example, teachers suggest that the two subjects could form a common one which would be assessed in the exact same manner. Scottish teachers on the other hand, although they cannot spot major differences between the two subjects in assessment practice, they do note that mathematics tends to be more assessment focused than science. A portion of Romanian teachers also cannot find any differences in assessing science and mathematics. *“The approaches used in science are proving to be effective in the case of mathematics too”*, a Romanian teacher answered.

The main difference stressed by respondents is that mathematics is easier to assess since most activities that are carried out have a right or wrong answer. Teachers point out that the nature of mathematics as a discipline is *“more objective”* -in the words of a teacher from Flanders-, or *“more strict”* -in the words of a Romanian teacher- than science.

4.3 Contextual factors

4.3.1 Curriculum-related factors

4.3.1.1 Content: What are children learning?

A review of the National Reports suggests a number of differences in the presentation and nature of curriculum content for science in partner countries. As also mentioned in the *Report on Mapping and Comparing Recorded Practices* (D3.2), in preschool, science is generally included within broader areas of learning such as ‘Discovery of the World’ (France) or ‘Child and the Environment’ (Greece) or ‘Knowledge and Understanding of the World’ (UK (Wales)), and thus integrated cross-curricular approaches to learning and teaching are advocated. In addition, in a number of instances there is limited specification of subject specific content for science in this phase of education. The emphasis is rather on the development of skills and attitudes in the context of content selected to build on children’s interests and prior experiences (for example Belgium (Flanders), France, Finland, Germany, Malta and UK (England)).

In early primary school, many countries continue to specify science within broader areas of learning (Belgium (Flanders), Finland, Germany, Greece, UK (Northern Ireland and Wales)), whereas in others, science is presented as a separate area of learning (for example Belgium (Wallonia), France, Malta, Romania). In both cases, there is much greater emphasis on the development of specific concepts associated with learning objectives for the primary age phase.

In comparison to science, mathematics is more commonly set out as a distinct area of learning in partner countries at both phases of education, and receives greater attention in preschool. However, in some countries (e.g. UK (Wales)) it is also treated as a cross-curricular dimension, with its application to general science knowledge emphasized (Romania). (For more detailed analysis of the curriculum content in the partner countries see Deliverable D3.2 *Report on Mapping and Comparing Recorded Practices*).

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4.3.1.2 Location: Where are children learning?

Respondents were asked to provide certain characteristics of the schools they are based in. These were the location of the school, the approximate number of students attending and whether it is a public or private institution. The results for these questions are presented in section 4.1.1 of this report.

4.3.1.3 Grouping: With whom are children learning?

The focus of this dimension is on whether children are allocated to age or ability groups for learning, whether they are learning individually or in small groups, and the average class size they are part of.

As we saw in section 4.2.5.4 (Figure 4.56) just over half of the teachers (53.3%) in the total sample report to use quite or very often assessment to group children for science instruction purposes, which suggests, though not explicitly, the overall infrequent use of ability groups for learning. This practice is embraced most frequently by Romanian teachers and least frequently by German teachers (Figure 4.57).

In addition, in section 4.2.4 (Figure 4.33) we saw that working in small groups is an approach used quite or very frequently by the large majority (93.1%) of all sampled teachers, most frequently used in England and Romania and least frequently in Finland (Figure 4.40).

Figure 4.59 below shows that the majority of survey participants (61.0%) teach in classrooms which have between 21 and 30 children. Figure 4.60 shows how this situation varies in the different partner countries. Excluding the samples with fewer than 46 teachers: France has the most (82.6%) teachers teaching in classes of 21-30 children and Germany the fewest (46.9%). Additionally, UK (England), followed by Romania, have the largest percentage of teachers in classes of more than 30 children (14.7% and 11.2% respectively), and Greece, followed by Finland, the largest proportion of teachers in classes of fewer than 16 children (21.9% and 20.0% respectively). Various reasons, including geographical reasons, not examined by this project, account for these differences amongst partner countries.

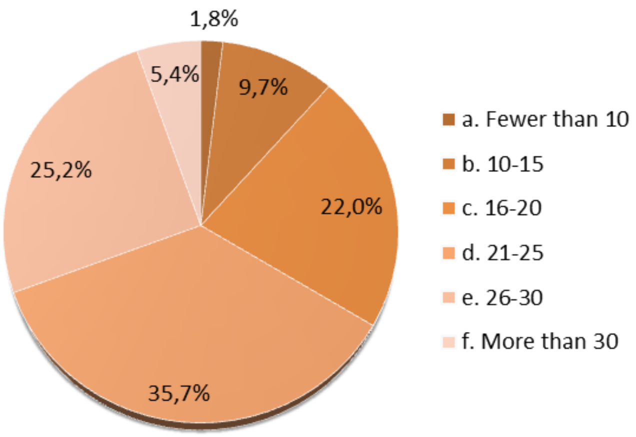

Figure 4.59. Size of classes in which sampled teachers teach.

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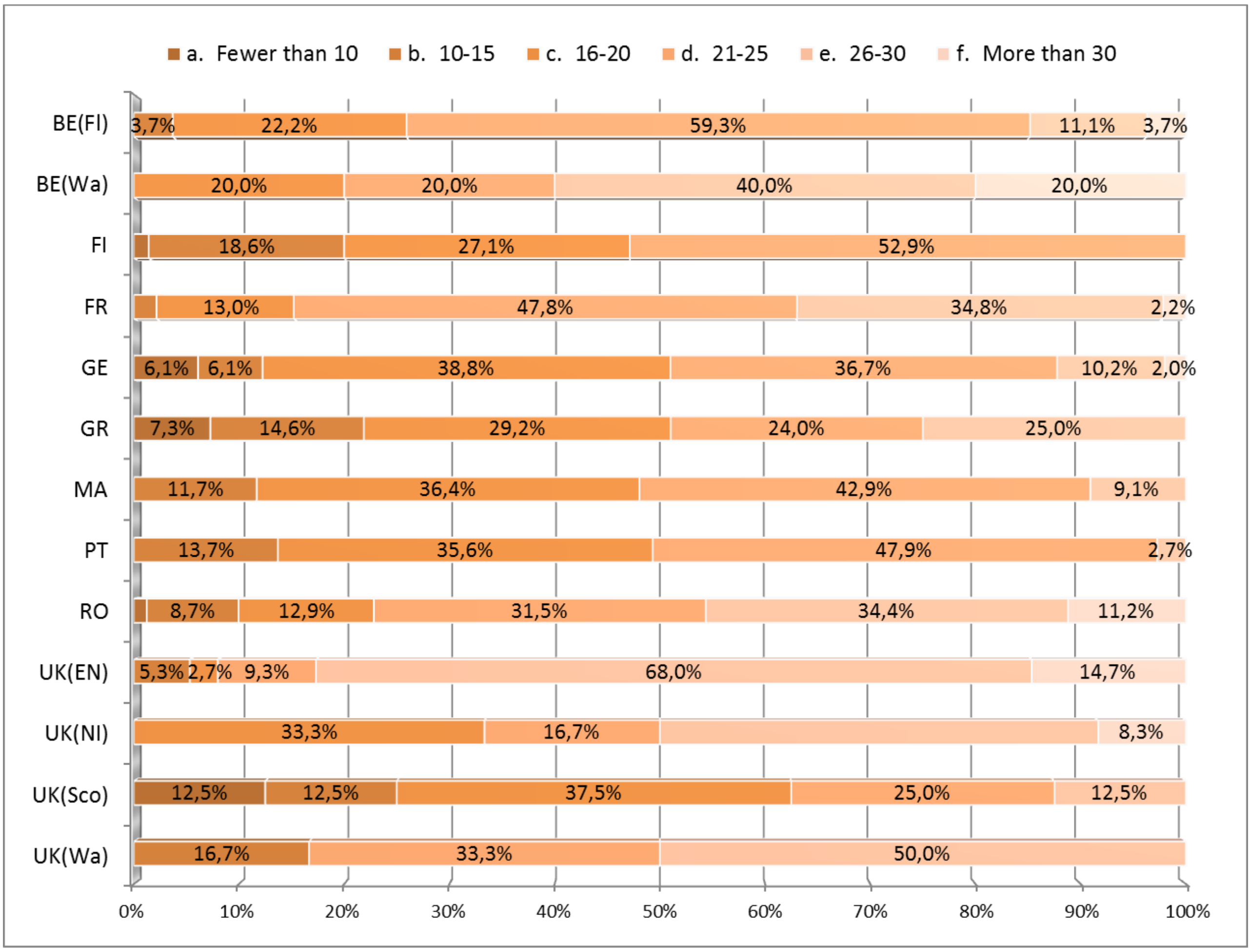

Figure 4.60. Size of classes in which sampled teachers teach, per partner country.

A chi-square test (Pearson chi-square) shows no significant difference (p<0.01) between preschool and early primary teachers in the size of their classes (Figure 4.61).

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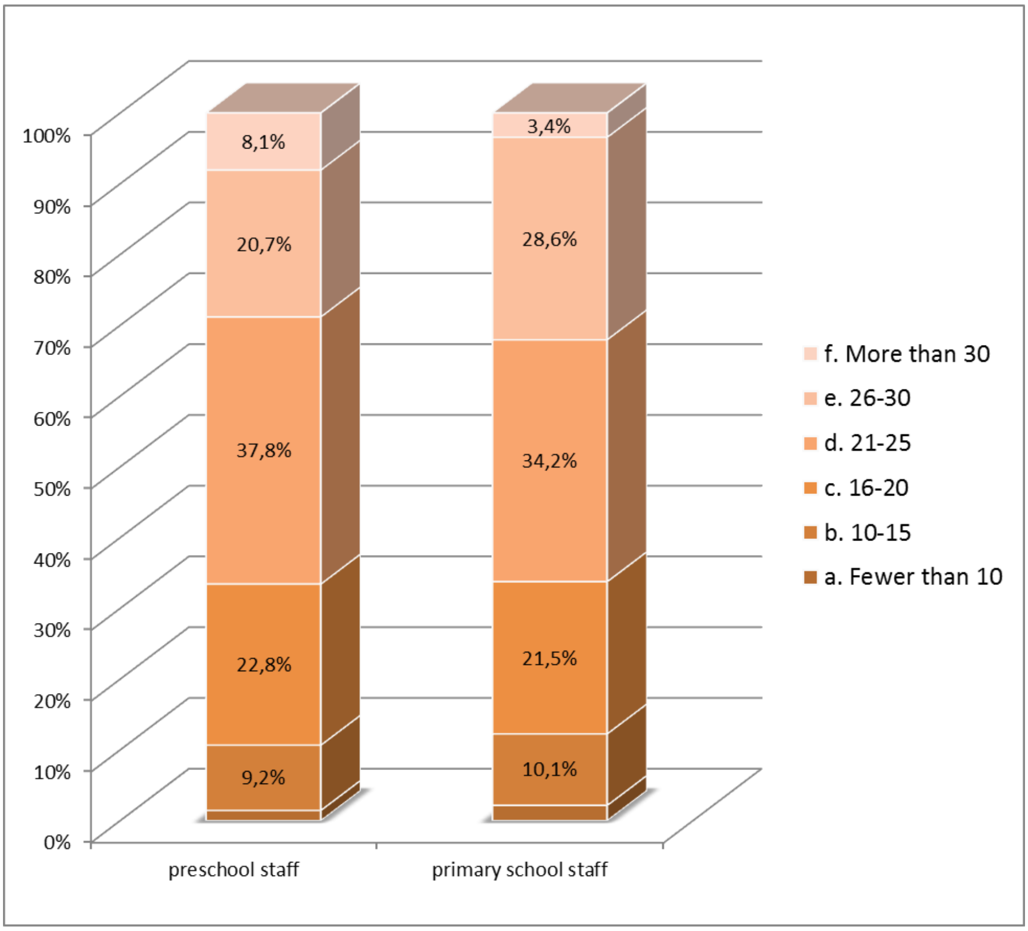

Figure 4.61. Differences between preschool and primary teachers' size of classes.

4.3.1.4 Time: When are children learning?

Teachers' responses about the amount of time dedicated to teaching science and mathematics per week point out that overall more time is spent teaching mathematics than science (Figure 4.62). About 70% of the respondents (69.6%) declare spending 3 hours or more per week teaching mathematics, whereas a similar proportion (72.2%) declares spending 2 hours or less per week teaching science.

Examining the situation in the various partner countries we find that:

- Maltese teachers seem to spend the fewest hours per week in the teaching of science whereas Finnish teachers spend the most.
- Finnish and UK (English) teachers also spend the most hours per week for the teaching of mathematics, whereas Belgium (Flemish) teachers spend the fewest.

Finally comparing preschool to primary school teachers (Figure 4.63), we see that in primary education more time is spent to both science and mathematics than in preprimary education. However, the increase in time spent for the teaching of mathematics is significantly more than for

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the teaching of science between the two phases. Only 10.5% but 59.7% of early primary teachers report to be teaching mathematics and science respectively for 2 hours or less per week.

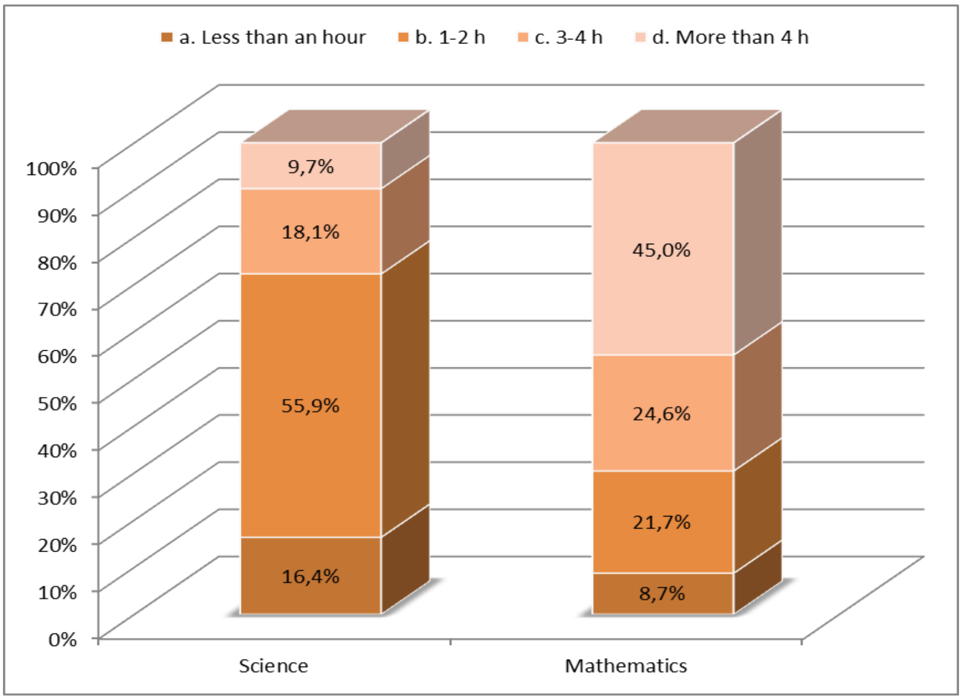

Figure 4.62. Time spent by sampled teachers in the teaching of science and mathematics per week.

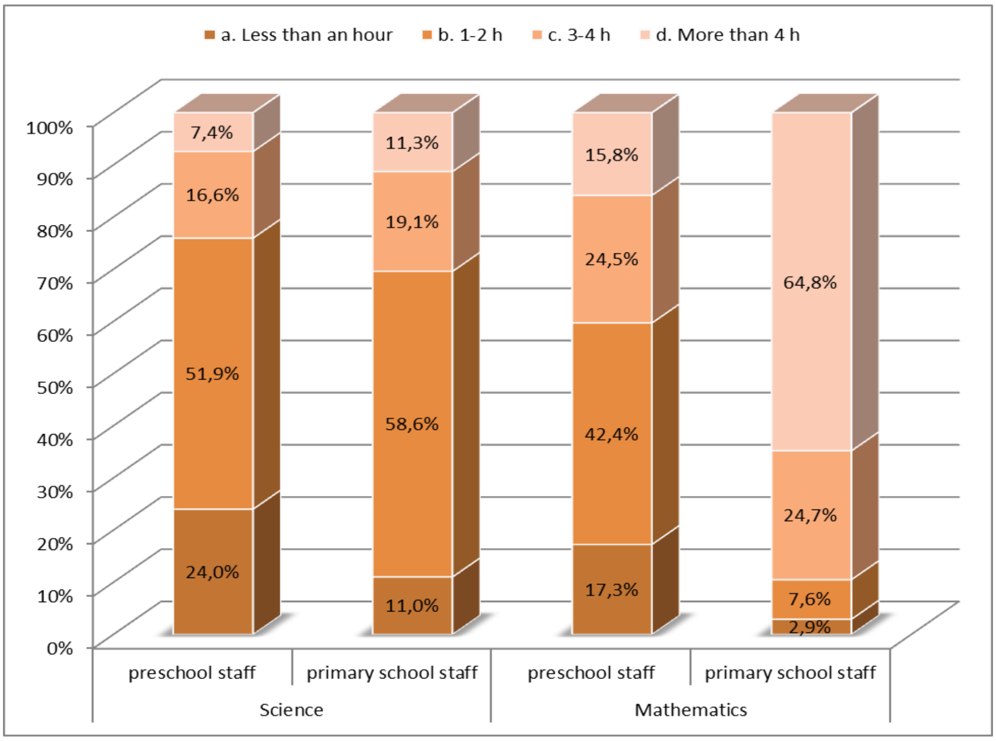

Figure 4.63. Differences between preschool and primary teachers in the time they spend teaching science and mathematics per week.

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4.3.1.5 Materials and resources: With what are children learning?

According to the literature reviewed in the project's conceptual framework a wide range of materials in the classroom, including digital technologies, can be motivating and offer different ways for young children to represent ideas and express their thinking. Research in science, mathematics and creativity also highlights the importance of a rich physical environment and the use of the outdoor environment in promoting opportunities for exploration in the early years.

The materials used in the science and mathematics classroom are therefore closely linked with the ones of the 'Learning Activities' and 'Pedagogy' dimensions and could be easily seen as belonging to the 'Teaching, Learning and Assessment' strand, as well as to the 'Contextual Factors' strand. In this document 'Materials and Resources' are included in the latter strand, as the survey focused more on their availability at school level and less on their use in the classroom, which is investigated more thoroughly in the in-depth field study in WP4.

Figures 4.64 and 4.65 show how well the sampled teachers thought their schools are resourced for science and mathematics teaching in terms of a number of materials. Over 60% of the sampled teachers considered fairly or very good the availability of computers (66.6%) and relevant library materials (65%) for science teaching, and of instructional materials (e.g. textbooks) (67.5%), computers (65.1%) and equipment and materials for hands-on exploration in the classroom (e.g. sorting activity games, rulers) (62.1%) for mathematics teaching. Support personnel for teaching or for technical issues in both science and mathematics is overall the least available resource in schools according to teachers.

About the use of these resources Figure 4.66 shows that overwhelmingly teachers use materials prepared by themselves (92.6% use them quite or very often) or downloaded from the internet (87.9% use them quite or very often) for the teaching of science and mathematics. Interestingly about 80% use quite or very frequently equipment and materials for hands-on exploration in the classroom (e.g. magnets, building blocks, sorting activity games, rulers) despite the fact that only a little over 60% (for mathematics) and a little over 50% (for science) reported that their schools are fairly or well equipped in these resources. The declared frequency of use of audio visual materials, relevant library materials, ICT science resources and student textbooks for science also exceeds significantly (paired samples t-test, $p<0.01$) the reported availability of these resources in schools by their teachers. On the other hand, the availability of computers and other digital technologies (such as interactive whiteboards) appears to match and exceed respectively their use in schools. Finally, materials prepared collaboratively by teachers in the school are the least commonly used resource by teachers after digital technologies.

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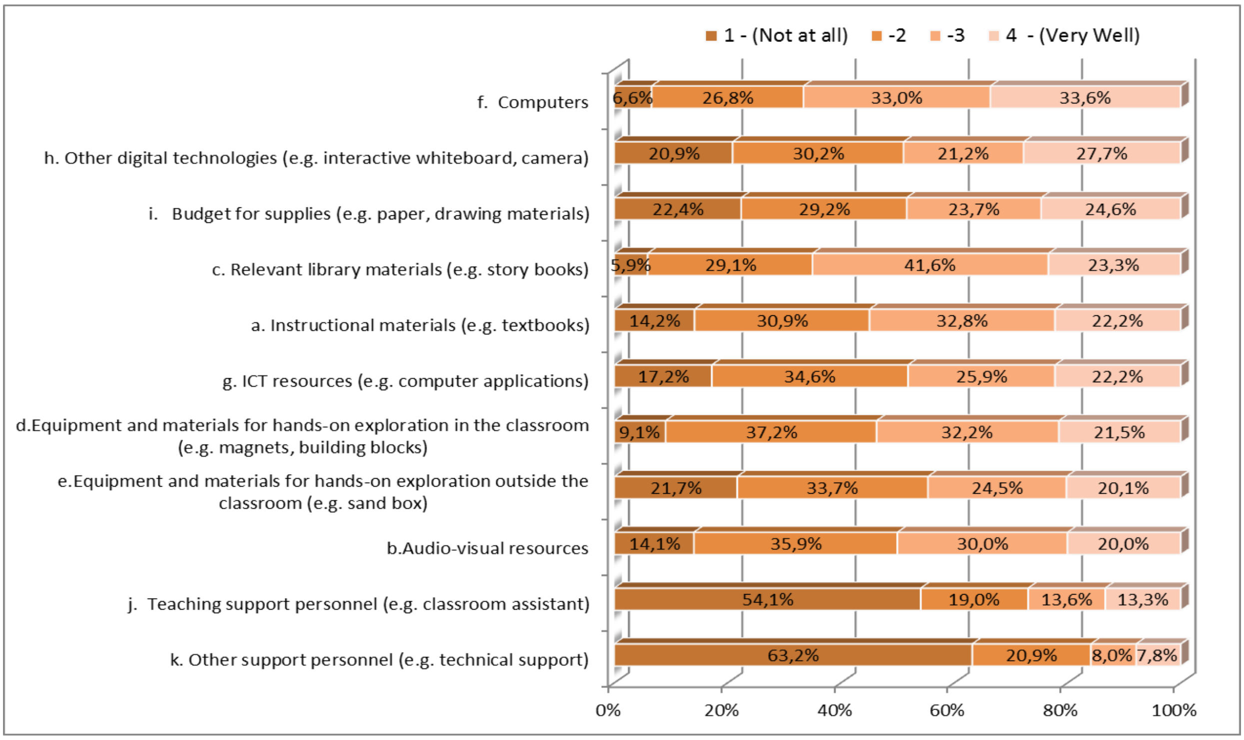

Figure 4.64. How well schools are resourced for science education.

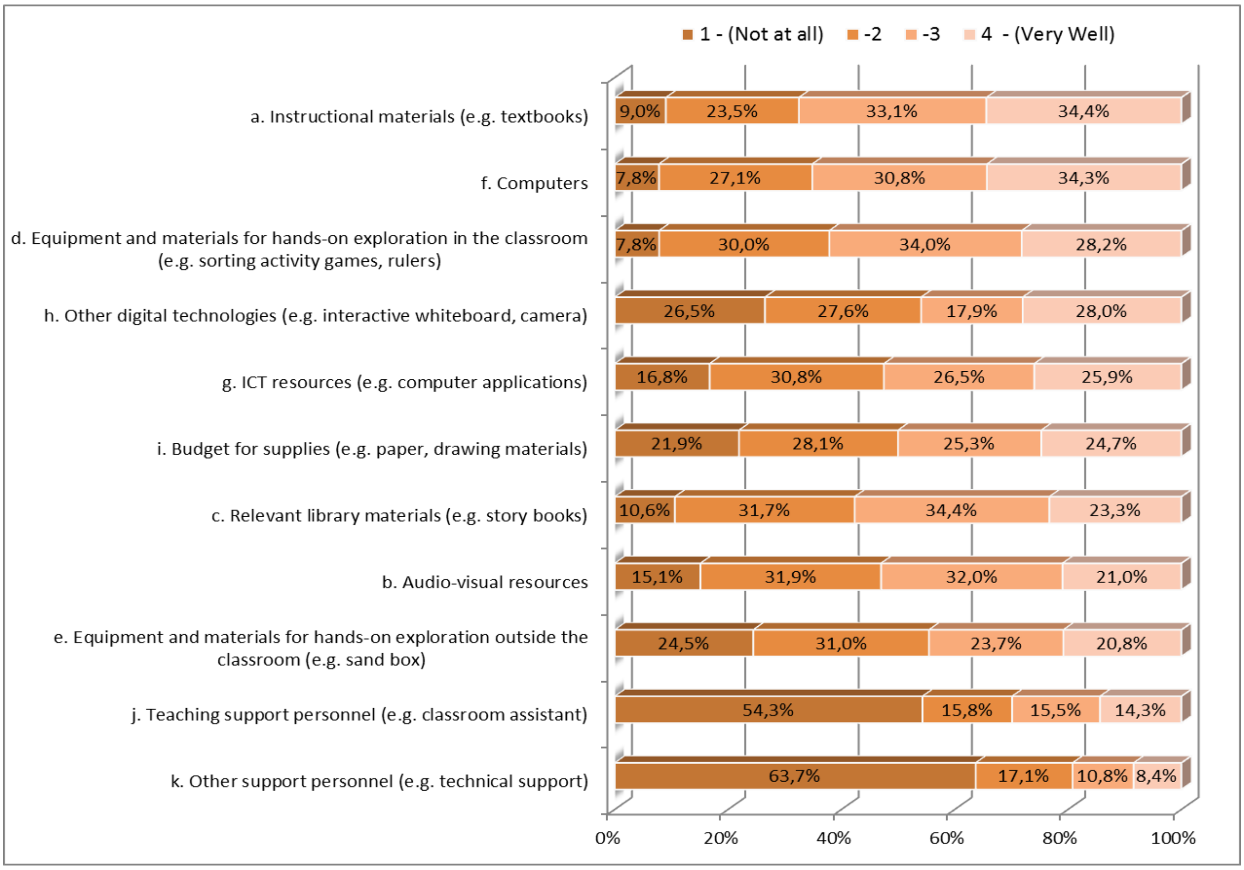

Figure 4.65. How well schools are resourced for mathematics education.

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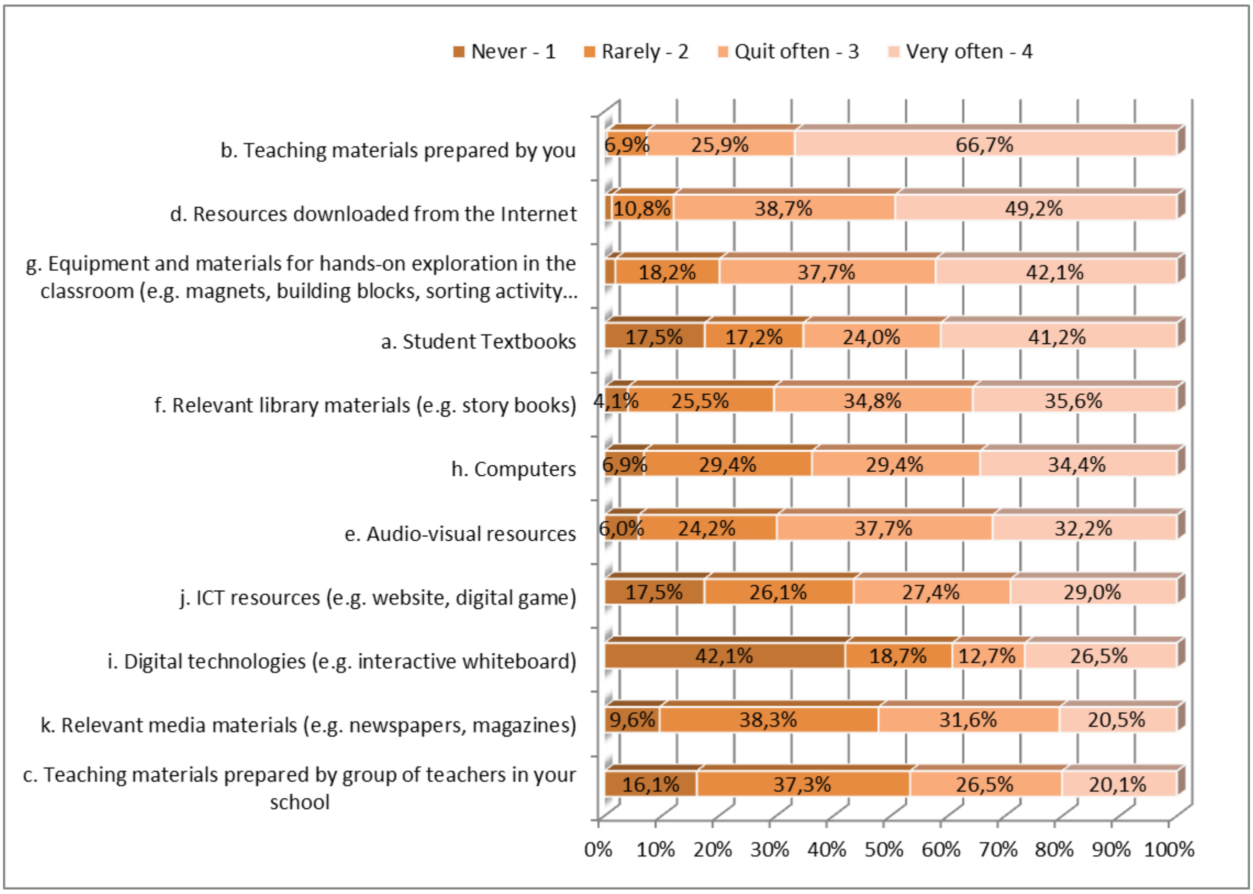

Figure 4.66. Frequency of use of various resources in science and mathematics education.

Differences in the availability of materials and resources for science and mathematics in schools

We then examined whether there is any significant difference in the availability of materials and resources for science and mathematics teaching in schools, using a paired samples t-test. According to teachers, schools are significantly ($p<0.01$) better resourced in:

- instructional materials, equipment and materials for hands-on exploration in the classroom, and ICT resources (e.g. computer applications) for mathematics than science;
- relevant library materials, and digital technologies (e.g. interactive whiteboard, camera) for science than mathematics.

Differences between partner countries

Differences between partner countries in terms of how well schools are resourced for science and mathematics education according to their teachers, were detected for all kinds of materials and resources. Consequently differences were also found in the frequency of their use. Figure 4.67 shows these differences for a selection of resources chosen for their special interest to the project, or because they proved interesting cases in the overall analysis above.

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Excluding the samples of fewer than 39 teachers, the following findings stand out:

- In terms of **instructional materials (e.g. textbooks)** Finnish schools are in the group of sampled schools which according to their teachers are significantly ($p<0.05$) better resourced both for science and mathematics education; English and French schools on the other hand are in the equivalent least resourced group. Romanian and Greek schools join the Finnish in the best resourced group for instructional materials for science, and Maltese schools join the Finnish in the best resourced group for instructional materials for mathematics. English, French, Portuguese and Romanian schools are the worst resourced for mathematics education and significantly worse than the Maltese and Finnish ones. The findings about the use of student textbooks match on the whole those about the availability of instructional materials in the various partner countries' schools. Moreover, the findings about the frequency of use of **teaching materials developed by teachers themselves** are also consistent with the above, since Finnish teachers appear to use them significantly ($p<0.05$) less frequently than teachers in 6 out of the 7 partner countries (Greece, Romania, France, UK (England), Portugal and Malta).
- Schools in Finland and Romania are comparatively best resourced and schools in France and England comparatively worst resourced in **relevant library materials** for science and mathematics. In particular French schools are significantly ($p<0.05$) less resourced according to the majority of teacher samples (Greek, Romanian, Finnish, Portuguese and Maltese). The findings about the use of relevant library materials match on the whole those about their availability in the various partner countries' schools; only Greek teachers report using them significantly more than their availability in schools.
- Concerning **equipment and materials for hands-on exploration in the classroom** English schools head the groups of schools with comparatively most resources, for both science and mathematics, joined by German schools in the case of science and Finnish schools in the case of mathematics. Romanian schools are significantly worse resourced in this kind of resources for science and mathematics than schools in five other partner countries (Greece, Germany, Finland, UK(England) and Malta). The findings about the use of these resources matches on the whole those about their availability in the various partner countries' schools; only Finnish teachers report using them significantly less than their availability (at least for mathematics) in schools
- The findings for English schools are similarly best resourced in the case of **equipment and materials for hands-on exploration outside the classroom**, and French and Greek schools comparatively least resourced, for both science and mathematics.
- According to their teachers, schools in Malta and England are fairly well equipped in **ICT resources** for science and mathematics and significantly better than schools in 6 out of the 7 partner countries (Greece, Germany, Romania, Finland, France and Portugal). Teachers in these countries also make the most frequent use of ICT resources in comparison to these other 6 partner countries.

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- Finally, only English schools appear to have a fairly good availability of **teaching support personnel** for science and mathematics and comparatively better than all other 7 partner countries (Greece, Germany, Romania, Finland, France, Portugal and Malta). On the other hand, in France, Romania and Greece this kind of personnel seems hardly to exist.

Differences between preschool and primary education

Comparing the science and mathematics resources of pre-primary and primary schools in the overall sample we found the following few significant (t-test, $p<0.01$) differences:

- Primary schools are overall better resourced than preschools in computers and technical support personnel for both science and mathematics education, and in instructional materials for mathematics.
- Preschools on the other hand are overall better resourced than primary schools in relevant library materials (e.g. story books) for science.
- Primary teachers overall use more frequently student textbooks, digital technologies and ICT resources.
- Preschool teachers on the other hand overall use more frequently relevant library materials and resources for hands-on exploration in the classroom.

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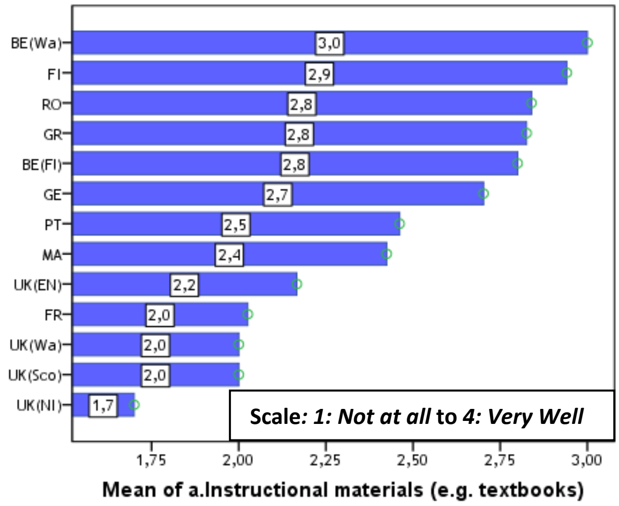
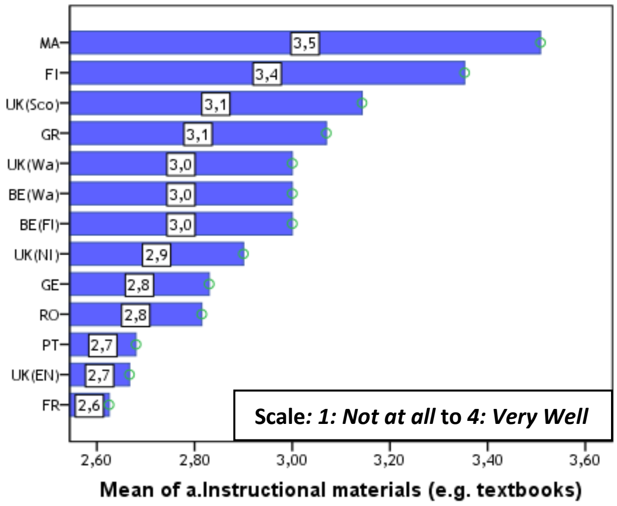
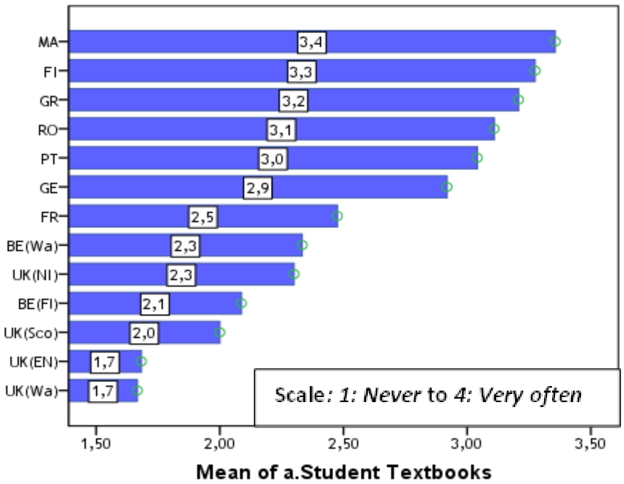
Availability of instructional materials for Science



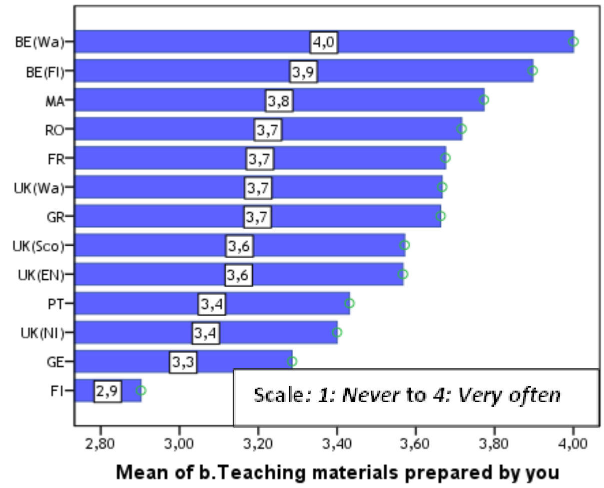
Availability of instructional materials for Mathematics



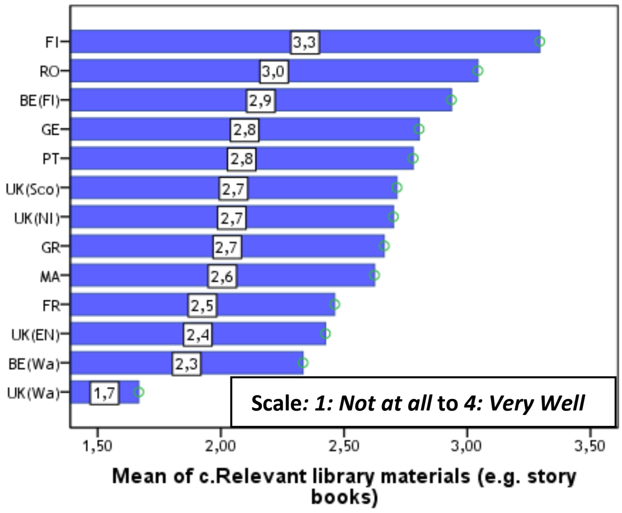
Use of student textbooks for Science and Mathematics teaching



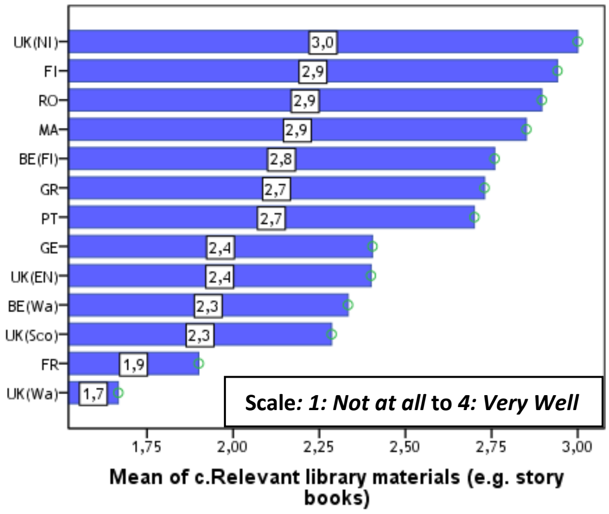
Use of teaching materials prepared by teachers for Science and Mathematics teaching



Availability of library materials for Science



Availability of library materials for Mathematics



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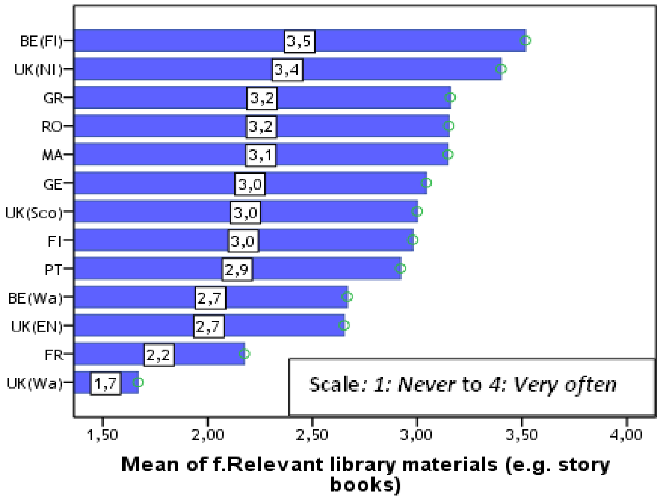
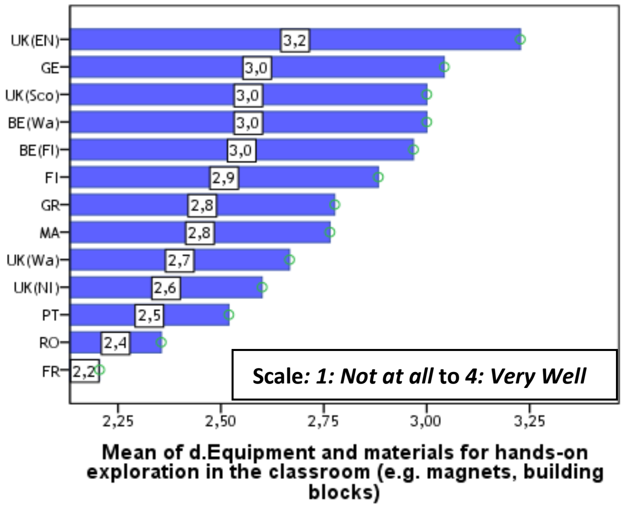
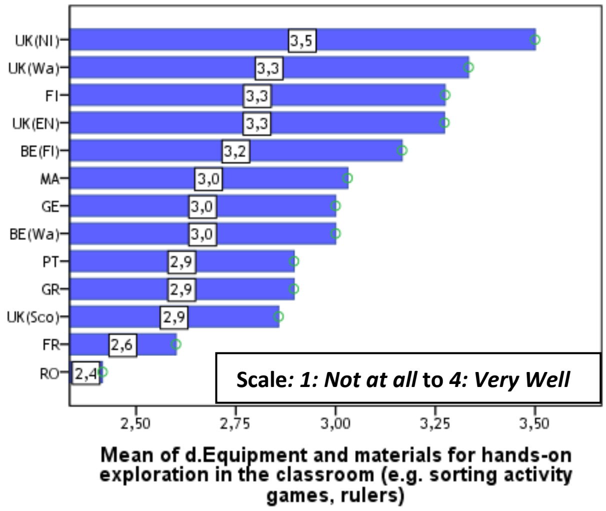
Use of library materials for Science and Mathematics teaching



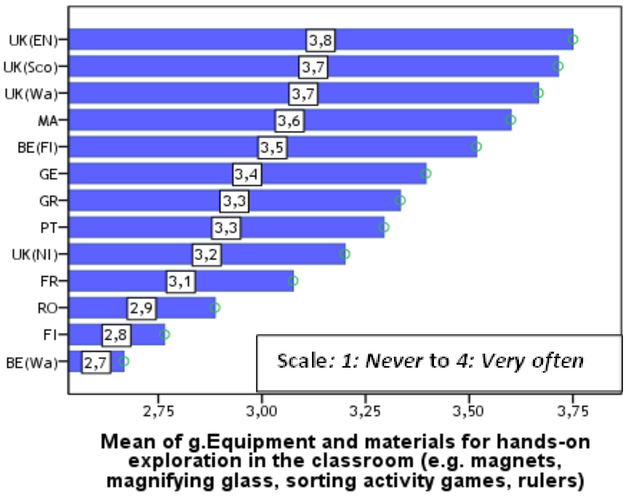
Availability of equipment and materials for Science hands-on exploration in the classroom



Availability of equipment and materials for Mathematics hands-on exploration in the classroom



Use of equipment and materials for Science and Mathematics hands-on exploration in the classroom



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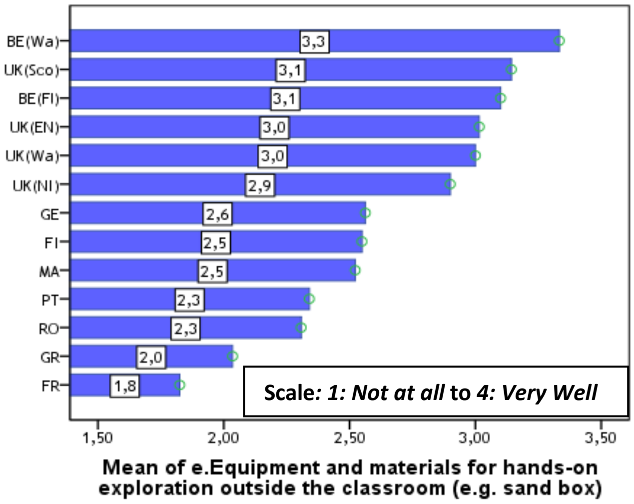
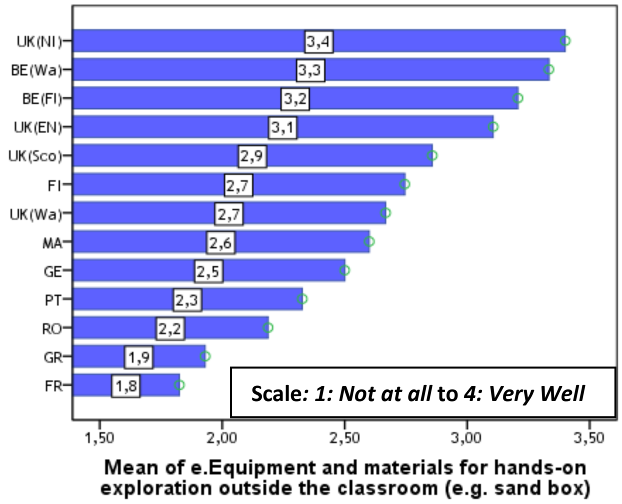
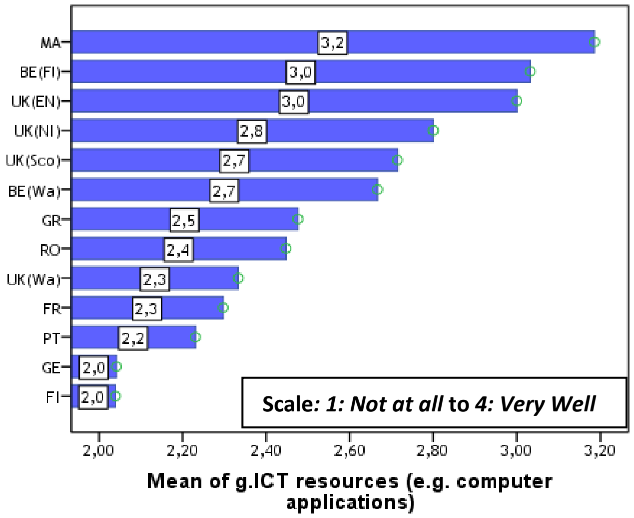
Availability of equipment and materials for Science hands-on exploration outside the classroom



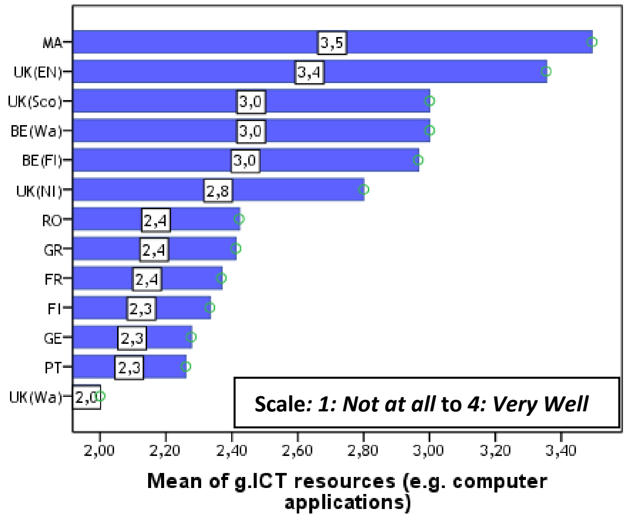
Availability of equipment and materials for Maths hands-on exploration outside the classroom



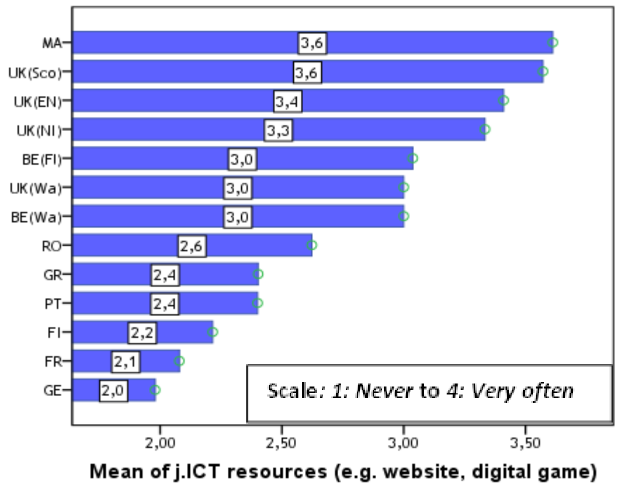
Availability of ICT resources for Science



Availability of ICT resources for Mathematics



Use of ICT resources for Science and Mathematics teaching



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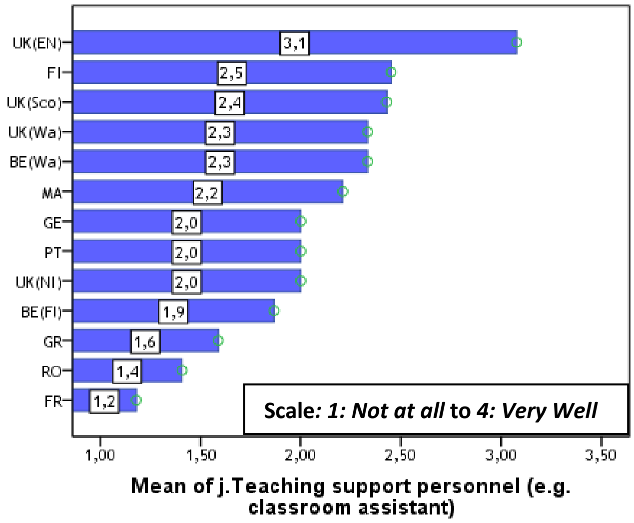

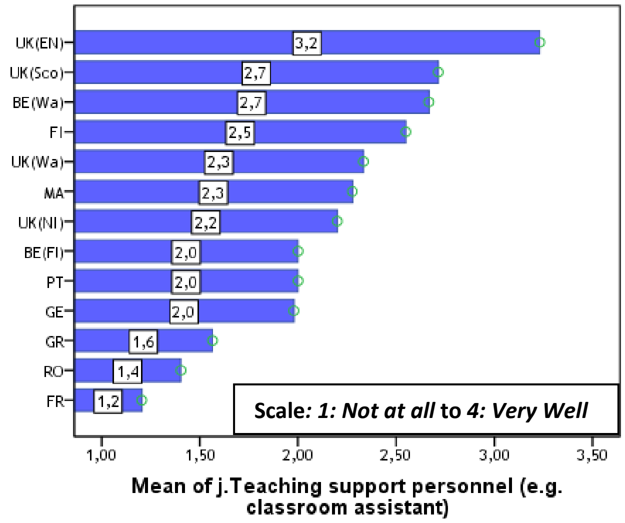

Figure 4.67. How well schools are resourced for science and mathematics: National samples' variations.

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4.3.2 Teacher-related factors

4.3.2.1 General Education and Training

The factors relating to sampled teachers' general education and training have been discussed in section 4.1.2.4 above.

4.3.2.2 Science and Mathematics Knowledge, Skills and Confidence

The factors relating to sampled teachers' knowledge and skills in science and mathematics have been discussed in section 4.1.2.5. Also sampled teachers' confidence in a variety of aspects related to the teaching of science and mathematics has been discussed in section 4.1.2.6.

4.3.2.3 Initial Teacher Education (ITE)

The extent to which a number of relevant to the CLS research disciplines and knowledge areas were studied as part of teachers' post-compulsory education and/or initial teacher training has been reported in section 4.1.2.5

4.3.2.4 Continuing Professional Development (CPD)

With a view to collect additional information about teachers' professional knowledge and skills, but also about the existing opportunities for professional development for preschool and early primary school teachers in the partner countries (to inform work in WP5), the survey included a question about professional development (CPD) activities teachers participated during the previous 18 months and their impact. A total of 16 CPD activities were included covering both individual and group, as well as formal and informal activities, which teachers may have had the opportunity to participate and could have had an impact on their teaching of science and mathematics.

Figure 4.68 shows all sampled teachers' participation in CPD activities. Engaging in informal dialogue with colleagues on how to improve their science and mathematics is predominantly what the large majority (over 80%) of teachers across all partner countries does. The individual informal activity of reading professional literature on science and mathematics is the second most common activity for 65.8% and 59.8% of the teachers respectively, and finally attending courses and workshops on science and mathematics subject matter and methods the third and last most common activity for the majority of respondents. Fewer than half of the sampled teachers (but over 40%) have recently participated in formal school-based CPD opportunities involving peer teaching observations and mentoring or coaching of science and/or mathematics teaching, and in science education research conferences or seminars. Finally, only about a third of them have participated in teacher networks formed specifically to promote the professional development of teachers in science and mathematics.

Figure 4.69 shows the perceived impact of the CPD activities teachers participated in. The findings there differ somewhat with the ones appearing in the previous figure. In other words the CPD activities that appear to have had larger impact on teachers' practices are not necessarily the

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ones attended by most teachers, with the exception of the professional development practice of engaging in informal dialogue with colleagues, which is both highly used and considered most effective. Interestingly, overall the majority of teachers report a moderate or high impact for all CPD activities, with over 70% acknowledging a moderate or high impact for 9 out of the 16 activities, including CPD courses and workshops on science/mathematics knowledge and methods, and school-based CPD activities. It is worth noting that participation in individual or collaborative research projects on science or mathematics topics of interest has had a moderate or high impact on teaching practice according to a large majority (about 70%) of teachers, but has been offered to and taken up as a professional development activity by fewer than half of the total sample (about 45%). Finally, participation in networks of teachers formed specifically for the professional development of teachers in science and mathematics is considered a less effective means of professional development, in line with the low proportion of teachers who state to have done so.

Differences in the perceived impact of CPD activities for science and mathematics

Comparing the perceived impact of equivalent CPD activities for science and mathematics we found no significant (t-test, $p<0.01$) differences.

Differences between partner countries

Due to the very small number of teachers from each participating country participating in formal CPD activities (based on their responses to this question), we did not proceed in the comparison of the impact results amongst the different partner countries. However, Table 4.4 shows the percentages of teachers in each national sample (excluding small samples) that participated in each of the CPD activities or declared the question as 'not appropriate'. For each CPD activity we have highlighted in green the country with the comparatively highest percentage of participating sampled teachers and with orange the country with the comparatively lowest percentage of participating sampled teachers. Some overall comments are:

- Romanian teachers are in the 'highest participating' green category for 10 out of the 16 CPD activities.
- The highest participation in mentoring and/or peer observation and coaching of science and mathematics teaching, as part of a formal school arrangement is reported by Finnish teachers and the lowest by French teachers. Finnish teachers however also report the lowest participation in courses/workshops, conferences and professional teacher networks on science.
- Relatively more Greek teachers (more than 90%) and fewest Maltese teachers (less than 50%) than all other partner country samples engage in informal dialogue with their colleagues on how to improve their science and mathematics teaching.
- More Portuguese teachers that all other partner country samples attend mathematics education conferences and participate in professional networks of teachers on mathematics.

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- German teachers hardly (less than 13%) participate in any individual or collaborative research project on science or mathematics.
- Finally, science and mathematics professional literature is least read by Maltese and English teachers.

Differences between preschool and primary education

Comparison the participation in CPD of preschool and early primary school teachers we notice that overall this is higher for primary than for preschool teachers for almost all activities (Table 4.5). In particular, the percentage difference between primary school and preschool teachers is highest and more than 10% for participation in courses/workshops as well as mentoring and/or peer observation and coaching of mathematics teaching. Exception is the participation in individual or collaborative research on science and mathematics topics of interest which appears to be higher for preschool teachers by up to 8.5% in the case of mathematics.

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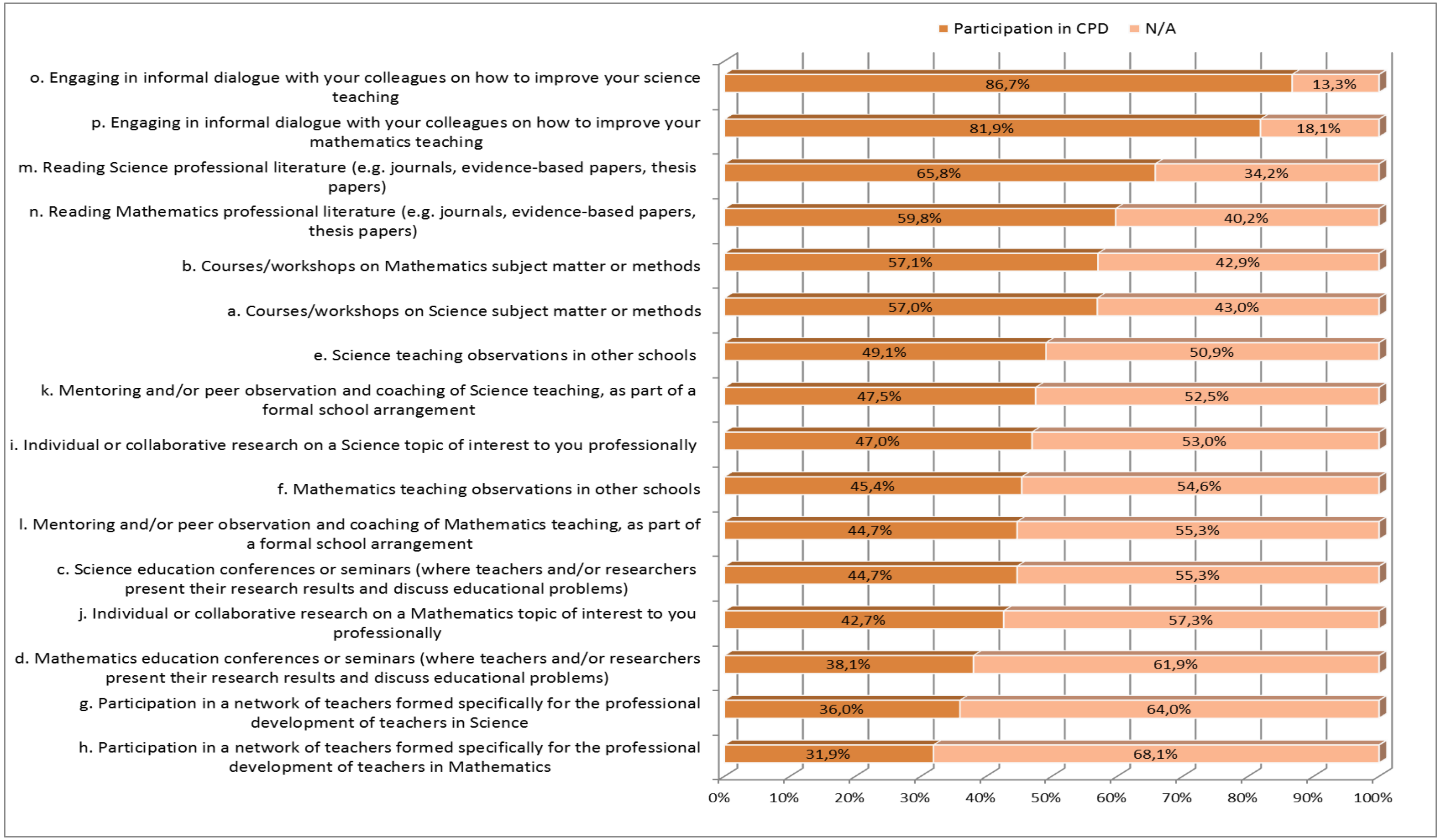

Figure 4.68. Teachers' participation in CPD activities.

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Figure 4.69. Impact of teachers' participation in CPD activities.

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	a. Courses/workshops on Science subject matter or methods		b. Courses/workshops on Mathematics subject matter or methods		c. Science education conferences or seminars		d. Mathematics education conferences or seminars		e. Science teaching observations in other schools		f. Mathematics teaching observations in other schools		g. Participation in a network of teachers formed specifically for the professional development of teachers in Science		h. Participation in a network of teachers formed specifically for the professional development of teachers in Mathematics	
	Participated	N/A	Participated	N/A	Participated	N/A	Participated	N/A	Participated	N/A	Participated	N/A	Participated	N/A	Participated	N/A
BE(Fl)	48,1%	51,9%	31,4%	68,6%	35,3%	64,7%	23,5%	76,5%	29,4%	70,6%	21,6%	78,4%	35,3%	64,7%	27,5%	72,5%
FI	28,1%	71,9%	52,3%	47,7%	19,0%	81,0%	22,2%	77,8%	14,8%	85,2%	18,0%	82,0%	11,5%	88,5%	21,0%	79,0%
FR	36,8%	63,2%	38,5%	61,5%	26,5%	73,5%	38,9%	61,1%	25,0%	75,0%	17,1%	82,9%	15,2%	84,8%	21,2%	78,8%
GE	66,0%	34,0%	55,1%	44,9%	38,3%	61,7%	28,6%	71,4%	27,7%	72,3%	31,9%	68,1%	42,6%	57,4%	12,8%	87,2%
GR	47,1%	52,9%	42,0%	58,0%	54,1%	45,9%	42,9%	57,1%	44,9%	55,1%	41,8%	58,2%	35,3%	64,7%	31,8%	68,2%
MA**	35,4%	64,6%	32,9%	67,1%	21,5%	78,5%	16,5%	83,5%	16,5%	83,5%	16,5%	83,5%	16,5%	83,5%	16,5%	83,5%
PT	52,6%	47,4%	65,0%	35,0%	49,1%	50,9%	52,8%	47,2%	51,9%	48,1%	36,5%	63,5%	34,7%	65,3%	43,4%	56,6%
RO	74,7%	25,3%	66,7%	33,3%	62,3%	37,7%	49,7%	50,3%	84,0%	16,0%	78,7%	21,3%	45,9%	54,1%	41,7%	58,3%
UK(EN)	47,3%	52,7%	60,3%	39,7%	29,2%	70,8%	21,4%	78,6%	19,7%	80,3%	23,6%	76,4%	35,2%	64,8%	25,0%	75,0%

	i. Individual or collaborative research on a Science topic of interest to you professionally		j. Individual or collaborative research on a Mathematics topic of interest to you professionally		k. Mentoring and/or peer observation and coaching of Science teaching, as part of a formal school arrangement		l. Mentoring and/or peer observation and coaching of Mathematics teaching, as part of a formal school arrangement		m. Reading Science professional literature		n. Reading Mathematics professional literature		o. Engaging in informal dialogue with your colleagues on how to improve your science teaching		p. Engaging in informal dialogue with your colleagues on how to improve your mathematics teaching	
	Participated	N/A	Participated	N/A	Participated	N/A	Participated	N/A	Participated	N/A	Participated	N/A	Participated	N/A	Participated	N/A
BE(Fl)	51,9%	48,1%	34,6%	65,4%	33,3%	66,7%	18,0%	82,0%	49,0%	51,0%	32,0%	68,0%	69,8%	30,2%	57,7%	42,3%
FI	19,7%	80,3%	16,4%	83,6%	69,4%	30,6%	76,6%	23,4%	54,0%	46,0%	55,6%	44,4%	79,4%	20,6%	87,3%	12,7%
FR	54,3%	45,7%	43,2%	56,8%	18,8%	81,3%	15,2%	84,8%	32,4%	67,6%	29,4%	70,6%	69,4%	30,6%	63,9%	36,1%
GE	12,8%	87,2%	6,4%	93,6%	30,4%	69,6%	18,2%	81,8%	65,2%	34,8%	48,9%	51,1%	79,2%	20,8%	58,3%	41,7%
GR	49,3%	50,7%	49,3%	50,7%	36,2%	63,8%	40,3%	59,7%	58,3%	41,7%	56,2%	43,8%	94,0%	6,0%	91,6%	8,4%
MA**	24,1%	75,9%	24,1%	75,9%	19,0%	81,0%	24,1%	75,9%	24,1%	75,9%	25,3%	74,7%	48,1%	51,9%	45,6%	54,4%
PT	61,5%	38,5%	60,7%	39,3%	42,0%	58,0%	36,5%	63,5%	64,2%	35,8%	61,8%	38,2%	88,1%	11,9%	84,1%	15,9%
RO	63,4%	36,6%	63,2%	36,8%	54,6%	45,4%	55,1%	44,9%	89,8%	10,2%	88,5%	11,5%	93,1%	6,9%	91,0%	9,0%
UK(EN)	29,2%	70,8%	19,4%	80,6%	54,8%	45,2%	41,7%	58,3%	50,0%	50,0%	24,3%	75,7%	86,5%	13,5%	72,6%	27,4%

Table 4.4. Teachers' participation in CPD activities: National variations.

The project CREATIVE LITTLE SCIENTISTS has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 289081.

		Participated in CPD		N/A		Primary-Preschool difference
a. Courses/workshops on Science subject matter or methods	preschool staff	139	53,9%	119	46,1%	5,2%
	primary school staff	224	59,1%	155	40,9%	
b. Courses/workshops on Mathematics subject matter or methods	preschool staff	123	48,6%	130	51,4%	14,0%
	primary school staff	240	62,7%	143	37,3%	
c. Science education conferences or seminars	preschool staff	107	44,6%	133	55,4%	0,2%
	primary school staff	160	44,8%	197	55,2%	
d. Mathematics education conferences or seminars	preschool staff	76	32,8%	156	67,2%	8,8%
	primary school staff	147	41,5%	207	58,5%	
e. Science teaching observations in other schools	preschool staff	127	48,8%	133	51,2%	0,5%
	primary school staff	187	49,3%	192	50,7%	
f. Mathematics teaching observations in other schools	preschool staff	108	42,0%	149	58,0%	5,7%
	primary school staff	181	47,8%	198	52,2%	
g. Participation in a network of teachers formed specifically for the professional development of teachers in Science	preschool staff	83	35,2%	153	64,8%	1,4%
	primary school staff	125	36,5%	217	63,5%	
h. Participation in a network of teachers formed specifically for the professional development of teachers in Mathematics	preschool staff	66	28,6%	165	71,4%	5,6%
	primary school staff	118	34,2%	227	65,8%	
i. Individual or collaborative research on a Science topic of interest to you professionally	preschool staff	120	49,8%	121	50,2%	-4,7%
	primary school staff	162	45,1%	197	54,9%	
j. Individual or collaborative research on a Mathematics topic of interest to you professionally	preschool staff	117	47,8%	128	52,2%	-8,5%
	primary school staff	142	39,2%	220	60,8%	
k. Mentoring and/or peer observation and coaching of Science teaching, as part of a formal school arrangement	preschool staff	112	44,6%	139	55,4%	5,1%
	primary school staff	169	49,7%	171	50,3%	
l. Mentoring and/or peer observation and coaching of Mathematics teaching, as part of a formal school arrangement	preschool staff	93	38,8%	147	61,3%	10,1%
	primary school staff	170	48,9%	178	51,1%	
m. Reading Science professional literature	preschool staff	171	64,8%	93	35,2%	1,8%
	primary school staff	253	66,6%	127	33,4%	
n. Reading Mathematics professional literature	preschool staff	156	59,5%	106	40,5%	0,4%
	primary school staff	226	59,9%	151	40,1%	
o. Engaging in informal dialogue with your colleagues on how to improve your science teaching	preschool staff	244	84,1%	46	15,9%	4,4%
	primary school staff	364	88,6%	47	11,4%	
p. Engaging in informal dialogue with your colleagues on how to improve your mathematics teaching	preschool staff	230	79,9%	58	20,1%	3,5%
	primary school staff	340	83,3%	68	16,7%	

Table 4.5. Differences in participation in CPD activities between preschool and primary school teachers.

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5. Conclusions, Limitations and Implications

5.1 Summary of findings

In the sections below the findings are summarised and presented under the three broad strands running across the project's research questions.

5.1.1 Aims, purpose, priorities

According to the analysis of the questionnaire responses given by teachers of early years and early primary education across the nine partner countries (and 13 related education systems):

- Children developing important attitudes and dispositions as a foundation for future learning, and becoming socially and environmentally aware and responsible citizens are the most important purposes for teaching science in compulsory education. The purpose which is seen as least important is to provide a foundational education for future scientists and engineers.
- Teachers very often plan their teaching of science in preschool and early primary education to pursue affective outcomes about science, science learning and learning in general. Social outcomes are also commonly pursued, whereas science cognitive outcomes are less so and more frequently by primary teachers.
- Out of the inquiry-related science learning outcomes teachers foster quite or very frequently the development of children's capabilities to carry out scientific inquiry, such as questioning, gathering and communicating findings, though to a lesser degree planning and conducting simple investigations.
- Learning outcomes related to the nature of science and thus understandings about scientific inquiry, that is about how scientists develop knowledge and understanding of the surrounding world, are the least frequently pursued by teachers overall, but more in early primary than in preschool education.
- The priorities set by teachers for the assessment of science are in agreement with the learning outcomes they pursue most frequently: affective priorities are considered comparatively as the most important, and cognitive outcomes as the least. Out of the latter the ones focusing on science processes and inquiry competences are thought of overall higher than the ones focusing on science ideas (facts, concepts, laws and theories) and on how science and scientists work.
- There is significant variation amongst partner countries in the importance their sampled teachers attribute to the assessment of science ideas and processes on the one hand, and the assessment of inquiry competences and understandings about the nature of science on the other.

5.1.2 Teaching, learning and assessment

According to the analysis of the questionnaire responses given by teachers of early years and early primary education across the nine partner countries (and 13 related education systems):

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- The inquiry-based science activities which are used most commonly by teachers - and even more by preschool teachers - are predominantly linked to observation, as well as to fostering children's questioning and eliciting their curiosity in natural phenomena. These activities are also strongly considered as enabling creativity development in children.
- Promoting understandings about scientific concepts and developing children's basic science procedural knowledge takes a less dominant place in the learning activities carried out in the classroom. In particular, learning activities that involve children planning and designing their investigations are the least common of all the learning activities tied to scientific inquiry, despite the fact that they are thought of by many teachers as amongst the three most likely to contribute to children's creativity. The low frequency of use of these activities is consistent with the findings about teachers' inquiry-related science learning priorities.
- Social activities such as communicating results and explanations based on evidence are also used quite frequently in the classroom. In these, teachers tend to allow children to choose freely and independently how to justify their explanations.
- Teachers however value a more 'guided' approach in respect of all other inquiry-related science activities (i.e. setting questions, identifying and analysing evidence, making connections to scientific knowledge and reflecting on the inquiry process). In these children decide from a pre-selected by the teacher number of choices.
- Teachers consistently and uniformly across the partner countries hold a great appreciation for all pedagogical contexts and approaches that promote dialogue and collaboration in science amongst children. They however fail to see the potential of these approaches for creativity development in children.
- Although also uniformly teachers endorse strongly affective learning outcomes in their teaching of science, the way they perceive the contexts and approaches identified in the research literature as enhancing motivation and affect in children varies significantly.
- There is a large consensus amongst teachers – reflected in their reported practice - that the teaching of science should be building on children's prior experiences and help relate science to everyday life. There is however less of a consensus as to whether these practices are enabling the development of creativity in children.
- Using drama and history to teach science are not practices very commonly used by teachers across the partner countries. Nor are they considered very 'creativity enabling' by them.
- Preschool teachers use more frequently than early primary school teachers open/unstructured and role/pretend play in their teaching of science. They also conceptualise them more as creative contexts.
- Similarly, preschool teachers plan more frequently outdoor learning activities for children than early primary school teachers, even though the latter consider them more as 'creativity enabling'.

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- The large majority of all teachers promote frequently the physical exploration of materials by children and consider this as a creative practice.
- All problem solving science contexts and approaches are thought of as amongst the most ‘creativity enabling’ by a large number of teachers, who also report to use them quite or very frequently.
- Teachers tend not to foster children’s autonomy in learning very frequently, nor to link this autonomy with creativity.
- There is correspondence between teachers’ frequent use of practices that encourage children to ask questions and foster their imagination and teachers’ strong view of these practices as ‘creativity enabling’. On the other hand, the use of questioning as a teaching tool, although very common, is not similarly appreciated by teachers as promoting creativity.
- Teachers quite or very frequently encourage children to record and express their ideas in different ways, as well as evaluate alternative ideas, but they also fail to see the potential contribution of these practices to the development of children’s creativity.
- A number of ‘creative’ dispositions identified in the research literature on creativity education are frequently praised and rewarded in the science classroom, according to teachers from the partner countries. The most frequently rewarded out of these are children’s ability to work together - a finding consistent with previous findings - and children’s sense of initiative.
- Interestingly, preschool teachers report to be assessing children’s curiosity a little more frequently (but significantly in statistical terms) than early primary school teachers.
- Overall, teachers report to be assessing children frequently during classroom interaction, attending to the pictures and other visual materials they produce as well as to their gestures or physical activity, and using questions in-context, authentic problem-based tasks and portfolios (collection of evidence of children’s work and progress). All these point to a formative emphasis of science assessment by teachers for the particular age range examined by *Creative Little Scientists*.
- Out of all formative approaches, these of self- and peer-assessment where the locus of the assessment judgment is on children rather than on teachers are the least used.
- Early primary teachers use more frequently than preschool teachers summative ways for the assessment of science, such as homework and tests but also tend more to ask children to reflect on their own learning and progress.
- On the other hand preschool teachers are more used to evaluate children’s visual representations of their scientific reasoning.
- The use of assessment by teachers is similarly predominantly for formative purposes, such as to identify ways to improve science learning and regularly monitor children’s progress towards a set of desirable science learning outcomes. The latter however

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seem to be defined by teachers themselves who only infrequently involve children in the decision process.

- Improving the science curriculum and grouping children for instruction are the least frequently identified purposes of assessment for the 3-8 age group of children.
- Primary teachers appear to be using assessment significantly more frequently for most of the functions that are traditionally associated with child-centered formative objectives.

5.1.3 Contextual factors

Curriculum-related factors

- In the national curricula for preschool and early primary education in the partner countries science, unlike mathematics is rarely presented as a separate area of learning; it is generally included within broader areas of learning, and thus integrated cross-curricular approaches to learning and teaching are advocated. Mathematics however is more commonly set out as a distinct area of learning.
- Group work is the preferred way of work for teachers in the early years science classroom, which on average has between 21 and 30 children.
- Teachers report spending 2 hours or less per week teaching science, whereas they spend more than 3 hours weekly on mathematics. As it could be expected more time is spent in primary than in preschool education on both subjects, but even more in mathematics compared to science.
- According to their teachers preschools and early primary schools are well resourced in computers and relevant library materials for science teaching, and in instructional materials, computers and equipment and materials for hands-on exploration in the classroom for mathematics teaching. Support personnel for teaching or for technical issues in both science and mathematics is overall the least available resource in schools.
- In their teaching of science and mathematics, overwhelmingly teachers use materials prepared by themselves or downloaded from the internet. On the other hand, materials prepared collaboratively by teachers in the school are the least commonly used resource by teachers after digital technologies.
- Teachers also frequently use equipment and materials for hands-on exploration *in* the classroom, but less frequently equipment and materials for hands-on exploration *outside* the classroom.
- The availability of computers and other digital technologies (such as interactive whiteboards) appears to match and exceed respectively their use in schools
- Schools seem to be better resourced in mathematics than in science, at least in terms of instructional materials, equipment for hands-on exploration in the classroom and ICT resources.

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- Primary schools are overall better resourced than preschools in computers and technical support personnel. Accordingly, primary teachers overall use more frequently than preschool teachers the corresponding resources.
- Preschool teachers on the other hand overall use more frequently than early primary teachers relevant library materials and resources for hands-on exploration in the classroom.

Teacher-related factors

The following sum up the teacher-related factors for the sampled teachers across the partner countries:

- Preschool and primary school teachers have a Bachelor's (or equivalent) level degree and are certified to teach.
- At least half of the teachers have not studied science and mathematics at a tertiary education level.
- More primary than preschool teachers have education higher than Bachelor's (or equivalent) and have studied science and mathematics at a higher level of formal education.
- The majority of all teachers appear to have had only an overview of, or introduction to Mathematics, Science, Environmental or Earth Sciences and ICT as part of their post-compulsory and initial teacher education, whereas areas of emphasis in their studies were the ones of Pedagogy, Developmental Psychology, Children's Development of Creativity, and Creative Teaching Approaches.
- Mathematics and Science have been studied at a deeper level at post-compulsory and initial teacher education level by more primary school than preschool teachers, whereas Developmental Psychology and Children's Development of Creativity have been study areas of emphasis by more preschool than primary school teachers.
- Engaging in informal dialogue with colleagues on how to improve their science and mathematics teaching is predominantly the professional development activity in which the large majority of teachers across all partner countries participates. This activity is also considered by teachers as having the maximum impact on their practice.
- Fewer than half of the teachers of the partner countries have recently participated in formal school-based CPD opportunities involving peer teaching observations and mentoring or coaching of science and/or mathematics teaching, or in science education research conferences or seminars, even though the large majority of teachers consider them as moderate and very effective.
- Participation in teacher networks formed specifically to promote the professional development of teachers in science and mathematics is low amongst teachers, who also appear to perceive it as having a low impact on their practice.

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- Participation in CPD activities is overall higher for primary than for preschool teachers. In particular, the difference is greatest for participation in courses/workshops as well as mentoring and/or peer observation and coaching of mathematics teaching.
- Finally, teachers overall feel most confident in their general pedagogic knowledge and least confident in both their knowledge/understanding of science (ideas, processes and nature) and their competencies to carry out scientific inquiry.
- More teachers feel confident in their mathematics teaching, assessment and pedagogic knowledge, than in their science teaching, assessment and pedagogic knowledge.
- More primary teachers are more confident than preschool teachers in both their science and mathematics teaching practice and their science and mathematics knowledge and competences.

5.2 Limitations

Most of the limitations of this study are linked to the sample of teachers that took part in the survey (see also section 3.2), which although as a total within the number pre-specified in the project's Description of Work (DoW), is still quite small for very robust and statistically significant quantitative conclusions. Also, although it was recognised from the outset (i.e. in the DoW) that the national samples are not going to be 'representative' in a formal statistical sense of either the number of schools or teacher population in the partner countries, some countries' or regions' samples were clearly under-represented in relation to the teacher population they correspond to, in particular Germany's, France's, Wallonia's, Wales' and Scotland's, whereas other countries' samples were overrepresented in the total sample, namely Finland's, Greece's and Romania's. Furthermore, the small number of sampled teachers in some partner countries or regions meant that it was not statistically realistic to compare their responses with others' in the rest of the partner countries. Finally, the non-representative character of the samples also means that there should be caution in the interpretation of the similarities and differences amongst countries, which can be only understood in depth in view of the unique characteristics of the different educational systems they refer to. The value of the *National Reports* for this purpose is paramount and this is why these are appended to this report.

Having identified these limitations, it also needs to be said that the findings in this report still have a unique value as they provide a rough but rich map of an unchartered but very important area, this of the intersection between science, mathematics and creativity in the preschool and early primary education in nine European countries and 13 educational systems, through the eyes of the key players in it, the teachers, and based on a very elaborate and cutting-edge theoretical framework.

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5.3 Implications

5.3.1 Implications for policy and teacher education

As suggested in the project's *Report on Mapping and Comparing Recorded Practices* (D3.2), policy needs to be developed and implemented within the particular local context of its application. As a result, implications and priorities for policy, building on this mapping and comparison of school practices, will vary across partner countries. However themes and issues discussed in this report offer some general areas for consideration in policy (including teacher education policy) to enhance opportunities for inquiry and creativity in early years science and mathematics. These are outlined below.

Aims and priorities for science education

The findings from this survey suggest that teachers perceive the teaching of science overall as contributing towards the development of children as socially and environmentally aware and responsible lifelong learning citizens, and see their role in the early years as mainly one of developing children's attitudes and dispositions for this. Learning outcomes related to science ideas and processes, but also to how science works and scientists develop knowledge are under-pursued. This could be due to teachers not recognising the latter outcomes as relevant to their overall rationale, which could further be linked to the fact that a significant number of them have had only an overview of, or introduction to science as part of their post-compulsory and initial teacher education.

Teaching, learning and assessment approaches

Concerning the use of inquiry-based science activities in the early years and early primary classroom, the findings suggest that this appears to be limited to observation, fostering children's questioning and eliciting their curiosity in natural phenomena. Teachers, who acknowledge their lack of confidence in both their knowledge/understanding of science and their competencies to carry out scientific inquiry, appear to avoid instigating and involving children in the design and conduct of investigations, even though they strongly consider these activities as contributing to the development of children's creativity.

This lack of confidence could be one of the reasons for which teachers also value more a 'guided' approach in respect to most inquiry activities, even though they see their role as facilitators of children's own inquiry, delaying instruction until the learner has had a chance to investigate on their own or with others.

Teachers' strong belief in the value of collaborative work for children was a recurring finding of the analysis of the various questions in the survey. Teachers' responses indicate that the practice of children working together is one they commonly use very often and guides the learning activities, pedagogy and assessment. Their commitment to social learning outcomes is also manifested in their more 'open' inquiry approach to children communicating their inquiry

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results, where teachers tend to allow children to choose freely and independently how to justify their explanations. Having said this, teachers need help to recognise better young children's capabilities to engage with processes associated with the evaluation as well as generation of ideas in science and mathematics.

Outdoor learning activities seem to be much more characteristic of preschool education than of primary education. Teachers could benefit from professional development opportunities which demonstrate the potential of these activities both for the teaching of science/mathematics and the development of children's creativity.

Teachers' knowledge about creative approaches appears to be stereotypical and not much refined, at least in relation to science pedagogical approaches and contexts. Whereas they easily identify creativity development with problem solving activities, children asking questions, imagination and the physical exploration of materials, they fail to do the same for most of the other synergies between IBSE and creative approaches identified in the project's *Conceptual Framework* based on the literature research. A striking example of this, is that teachers fail to appreciate the creativity potential of questioning as a teaching tool. Given how important it is that teachers model and foster positive attitudes toward curiosity and questioning, this points to an important gap that needs to be bridged by teacher education.

Teachers value science and mathematics assessment for formative purposes for the 3-8 age group of children studied by *Creative Little Scientists*, however they appear to be less experienced in the use of self- and peer- assessment, where the locus of the assessment judgment is on children, as well as in involving children in the identification of their own learning targets. Moreover, the potential contribution of the various modes of children's work (e.g. pictures, graphs, gestures, physical activities) for assessment purposes is not fully exploited by teachers, who would benefit from relevant training.

Contextual factors

Science and inquiry-related competences are given less important in the early primary curriculum than mathematics.

Early years and primary classroom would benefit from the existence of support teaching personnel who can attend to the individual children needs and facilitate science and mathematics inquiry.

Schools appear under-resourced in equipment and materials for hands-on exploration outside the classroom.

Digital technologies and ICT resources are under-exploited in preschools. Teachers would benefit from training on best practices of their use and potential for creativity development in science and mathematics.

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Systematic and institutionalised teacher collaboration is not widely common amongst the partner countries, nor are teacher networks specifically formed for the professional development of teachers in science and mathematics education. This contradicts teachers' acknowledgement that informal dialogue with colleagues on how to improve their science and mathematics teaching is the professional development activity that has the maximum impact on their practice.

Moreover, school-based professional development opportunities involving peer observations, mentoring and coaching appear not to be the norm, despite their recognized effectiveness in promoting change and innovation, and sustaining impact.

Courses and workshops in science and mathematics education are not as available to early years educators compared to primary teachers.

5.3.2 Implications for empirical work in this project

Due to the nature of the survey and its contained length, and/or based on its findings, the following themes of interest to the project have not been covered satisfactorily and thus need deeper examination in the next research phase of the project, the in-depth field study to be carried out as part of work in WP4:

- Differences between aims and practices in the teaching of science and mathematics.
- Teachers addressing learning outcomes associated to the nature of science and understandings of how science works.
- Teachers' fostering of positive attitudes in science.
- Teacher practices that promote children's reflection and reasoning in science/mathematics.
- The use of questioning by teachers.
- The role given to children's questions.
- Children's use of different ways of recording and expressing ideas and teachers' consideration of these and use for assessment purposes.
- Teachers fostering children's autonomy in learning.
- Teacher's role and children's agency in relation to inquiry-based activities.
- Teachers' use of IBSE activities that involve children in designing and carrying out simple investigations and/or projects.
- Teachers' use of the outside the classroom space and opportunities.
- Teachers' use of cross-disciplinary contexts for the teaching of science and mathematics.
- Differences between preschool and primary teachers' use of group and collaborative work in science.
- Teachers' preconceptions of science and mathematics in terms of creativity.
- Teachers' assessment of children's creative dispositions and children's related reactions.

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- Teachers' use of various forms of evidence for assessment purposes.
- The use of various materials and resources in the classroom for the teaching/learning of science/mathematics.
- Teachers' views about their own professional preparation and confidence in science and mathematics teaching.

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APPENDIX 1:
COMMENTS FROM PILOTING THE RESEARCH INSTRUMENT

IOE

1. Everyone so far has fed back that they felt they understood what the questionnaire was asking and found it interesting.

2. It has taken up to 45 minutes to complete - partly because of length but also in digesting and interpreting the information in the questions. Lots of information to take in.

3. People were not sure how to distinguish between 'having a positive attitude to science' and 'having a positive attitude to learning science' in the questions where these appear - Q24, Q33.
YES, BUT THERE IS A DIFFERENCE.

4. A couple of people asked about the boxes associated with Q30 and Q39 - whether there would be enough space to fill in reflections on differences in relation to mathematics - this may be due to the version they used - how far will these boxes expand? - expect UK teachers may wish to say quite a bit about that!
THE COMMENT/ESSAY BOX USED IN THE ELECTRONIC VERSION HAS NO CHARACTER LIMITATION.

5. Everyone suggested that it would be helpful if the features of inquiry learning associated with Q34 were on the same page as Q34. This was a question they found interesting but difficult. Might it be possible just to incorporate tick boxes somehow in the table itself?
IN THE ELECTRONIC VERSION THE TABLE IS ON THE SAME PAGE AS Q34. NOT POSSIBLE TO INCORPORATE TICK BOXES IN THE TABLE.

6. Will there be a space at the end to add any other comments - either about the issues or in response to the questionnaire? Might be useful to know if the questionnaire prompted thought about other issues or if there were particular questions they felt they could not answer and why?
CHANGES TO BE MADE.

AUC

It was piloted by 6 teachers.

In general they find the questions difficult, especially the questions about science education, goals of science, scientific aims, evaluation in science, …. Teachers of young children are not familiar with scientific and inquiry terminology although they stimulate an inquisitive attitude in their classrooms. It isn't easy to translate the questions concerning scientific education and scientific inquiry. The terminology is linked with secondary education. Teachers of young children use other terminology (also present in the national curriculum), we also have world orientation instead of science in elementary education. However they find the examples helpful and they are familiar with the contexts and learning activities mentioned in the survey.
BE FLEXIBLE IN THE TRANSLATION AND USE MORE EXAMPLES AS NECESSARY.

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Some of the questions were difficult for them to understand because of the link with earlier questions. We have rephrased these questions.
PLEASE LET US KNOW WHAT THESE WERE AND HOW YOU HAVE REPHRASED THEM. VERY IMPORTANT TO KEEP TRACK OF THESE CHANGES.

The term 'evaluation' needed sometimes explanation, because for some teachers it refers to testing, but by reading the examples the question becomes more clear to them.
OK

in question 10, we use the current terminology of our education system, but for some teacher the names were different in the past. This causes sometimes difficulties in choosing the right term. Also the ISCED seems to cause confusion.

→ Perhaps we have to add the old terminology as well?

THE ISCED LEVELS ARE USED BECAUSE THEY ARE INTERNATIONALLY AGREED LEVELS, WHICH CAN THEN BE DEFINED ACCORDINGLY IN EACH COUNTRY. I WOULD SUGGEST THAT YOU USE BOTH OLD AND NEW TERMS BUT YOU MAKE SURE THAT THEY ARE RELATED CORRECTLY TO THE ISCED LEVELS IN THE QUESTIONNAIRE. I AM CONSIDERING TAKING OUT THE TERM 'ISCED LEVEL' IF THIS CREATES A CONFUSION. HOWEVER THE OPTIONS OFFERED TO THE RESPONDENTS SHOULD CORRESPOND TO THE ISCED LEVELS MENTIONED.

In question 16: Some teacher teach in to different classrooms (once 3-4year olds) and once 4-5 year olds), but others teach 3-4-5year olds in one group and when they fill in the questionnaire it seems they are teaching in the same groups.
IS THE DIFFERENCE IMPORTANT, I.E. DOES THIS AFFECT THE RESULTS SOMEHOW? MULTIGRADE CLASSES ARE A FREQUENT REALITY IN GREECE? SHOULD WE CAPTURE THIS? IF YES, WE COULD ADD A QUESTION:

If you have selected more than one age group for any year in the question above (Q16), please specify if you taught /are likely to teach these age groups concurrently, or in separate classrooms.

In question 20: one of the teachers asked if the activity of 'riding a bike next to the Channe 'river' with my husband who is fascinated by the bird who live their' is this also a professional development activity?'
THERE ARE MANY CATEGORIES OF PROFESSIONAL DEVELOPMENT ACTIVITY. HOWEVER THESE CATEGORIES ARE WELL IDENTIFIED IN THE LITERATURE AND THEY ARE USED IN THE OECD TALIS QUESTIONNAIRE. IT UP TO YOU (WP5 LEADERS) TO SAY WHETHER YOU THINK THEY SHOULD BE REDUCED.

In question 42 National teacher curriculum guide, we don't know how to translate because we do not have it in Flanders.
TEACHERS DO NOT HAVE TO CHOOSE AN ANSWER. THIS IS WHY THERE EXISTS A 'NOT APPROPRIATE' COLUMN TO CHOOSE.

In question 24 and 33 'scientific processes' is mentioned: they want to know what we mean by scientific processes. Is it possible to provide an example?
OK

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Question 6/7 are very much the same with question 41/42; do we use the same issues and terminology. Now there is a difference.

QUESTIONS 6/7 ASK IF THE SCHOOL HAS THESE RESOURCES. QUESTIONS 41/42 ASK IF THE TEACHER IS MAKING USE OF THEM.

OU

Open University report on Northern Ireland (also England and Wales) 4 May 2012

Below is a summary of the feedback received by the OU on the questionnaire.

Unfortunately, we were unable to get too much feedback from NI schools, however we were able to get feedback from a number of other partners, including practitioners in England and Wales. From Northern Ireland, we had some feedback from our Staff Tutor in the OU's Regional Office in Belfast, who provided feedback. We aimed for discursive feedback, that is "this works, I think it would work better if you change this" type, deeming this as the most useful at this stage.

Feedback

Liz, OU EY Tutor, NI

By way of clarification, early years practitioners are not necessarily teachers. If this questionnaire is going only to those in statutory provision then it is fine to refer to them as teachers, but if it is to reach the range of settings where Early Years Practitioners (Sure Start, Playgroups, Child Minders, private Nurseries etc) work then it will alienate those people. The term classroom which is also used will not reflect other settings It might be useful therefore to agree a term or set of terms for the practitioner the q'aire has to speak to. In the same way it might be useful to have clarification of role and setting.

Q.22 works fine for those teaching Key Stage 1 but does not capture any of the work of early years practitioners at pre-school or teachers at foundation stage. Those respondents working with children at these points would , I imagine, respond Not Important. You are therefore omitting a significant amount of developmental work.

Just for general information Science sits within 'The World About Us' in pre-school, foundation and key stages 1 and 2 in Northern Ireland. So in sum if the questionnaire is being sent only to schools and to teachers it is fine (albeit attention needs to be given to capture Foundation learning), but if to the wider constituency then all the above need to be addressed.

Denise, KS2, Republic of Ireland

As I only have experience at a substitute level in an Irish-speaking primary school in ROI there is little point in me responding to the questionnaire. However Q41 and 42 interested me about resources - as all subjects are taught through the medium of Irish, resources e.g. websites, magazines, are in very limited supply and the teachers are often very creative! in their

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presentation of subjects like science and maths making their own resources or utilising simple and everyday objects.

THE 'OTHER' OPTION (WHICH IS 'OPEN') SHOULD BE CAPTURING THESE OTHER RESOURCES.

Kirsten, KS1/KS2 Art Teacher Wales

After a brief glance at doc: Is this a translated survey? Was it written in German originally? What do you make of the sentence structure? It certainly will take me some time to go through the whole doc.

UK PARTNERS ARE KINDLY ASKED TO CORRECT THE ENGLISH IN THE FINAL VERSION AS WELL. THE ENGLISH VERSION WILL BE USED ONLY IN THE UK.

PERHAPS KIRSTEN WOULD BE HAPPIER WITH THE WELSH VERSION WHICH IS BEING PREPARED?

Linda, EY PhD student

This survey is way too long and overly complicated. The difference between some of the points given is often so minute if not even overlapping that very soon you feel weary about moving on to the next question.

So I would fear that the accuracy of responses will decrease further down the questionnaire as exhaustion follows the hair splitting experience. However, it would be interesting to read their findings on regional differences etc. So, hopefully it will be a successful project.

Emma, Special Educational Needs Teacher, Wales

Introductory Section:

First sentence should be written as: "Thank you for agreeing to take part in the CLS online teacher survey. We hope…"

I've re written paragraphs 2 and 3:

"The aim of the work is to contribute to a better understanding across Europe of the common ground that science and mathematics education can share with the development of creativity in pre-school and early years settings (up to age 8)."

"More specifically with this survey we aim to explore existing practice in science and mathematics across nine European countries (Belgium etc…). We are seeking to identify opportunities and challenges for the development of creative skills within these areas of the curriculum."

Paragraph 5: Should be written as:

"The questionnaire addresses teachers practicing across a wide…"

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The introduction should include a statement justifying the length of the survey and the data being asked for, it lacks context in that at times I did not know why I was being asked about certain issues.
CHANGES TO BE MADE.

I would re-order some of the sections, i.e. start with

- Background info- about you (section 4)
- Background info- about your school (section 2)
- School science and maths resources (section 3)

At present the order of the sections does not make sense, for example getting into the detail of the resources then returning to background info about myself.
CHANGES TO BE MADE.

Also I would move section 6 your views about science education and assessment in education to after section 7 your approaches in teaching science. And possibly amalgamate it with section 8 your approaches in assessing science learning because this is a lengthy survey and I felt I had already visited the theme of section 8 in section 6.

In section 10, levels of formal education there is a gap- many UK teachers will have a first degree and PGCE, this is not as high as Masters.

Section 13: Are you certified to teach?

Is this survey for education staff other than teachers, if so this needs explaining?

Hala, EY Teacher, Bath

The survey was very long and this might put teachers off with a heavy workload. I wondered if it might be better to split the survey in half and send the second half at a later date?

In the Foundation Stage, Science is taught as part of 'Knowledge and Understanding of the World' and the term Science is not actually mentioned - just wondered if this might need to be considered in some of the wording.

On "What is the highest level of formal education that you have completed?", question I felt that my own education falls BETWEEN d and e. I did a Post Graduate Certificate (of Ed) but this can't be described as masters, doctorate level.

I felt that the rest of the survey was worded well and would help teachers to reflect on their practice.

Paul, Head Teacher (infant school), Bath

Thank you for an opportunity to comment.

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I thought it was clear and as a teacher I would not have found any questions inappropriate but possibly uncomfortable if I sensed that I was actually teaching in a manner that was not as creative as I would ideally want it to be. But, I think the questions need to be asked.

You may be tired of hearing that it is too long and feels as though it is repeating itself, but I know it isn't (repeating itself).

Can I suggest 2 things if it is not too late?

1. An over view of the sections at the start so that teachers can appreciate the whole picture and do not feel that it is over repetitive, e.g. P1: AUDIT OF RESOURCES; P2: ASSESSMENT METHODS

2. The options are 'clumped' a little to reduce the number of responses. 24 pages LOOKS a little long when the document is opened.

I found it thought provoking just to read and I am sending it to my Science Coord as a stimulus for making Science more creative (and I am thinking about our Maths Coord)

Please keep us in touch, I would like us to do the survey when it is ready, if we can.

Julia, EY teacher, London

1) Yes it's long, but unless you cut a huge chunk it's going to be long whatever. I think people will only do it of they're in a situation where they have to i.e. a staff meeting or something and they're given specific time for it. I would never do that if someone just handed it to me and said do it if you fancy, unless it was way shorter or I was v bored

2) My main concern is the wording. It's very wordy and I think if you want non-teachers to do it (which lots of EYFS practitioners are) it's a bit confusing. There are big chunks of text that just look unmanageable and unapproachable.

3) some of the science stuff doesn't seem very early years. Perhaps this is part of the point- that EY science should be more like "proper" science(?) but again it just seems a bit confusing.

Summary

The feedback was coherent and everyone who responded was grateful for the opportunity to be part of it. All were really interested in the project and were keen to see the final outcome, with many wishing to be part of the project in the future. This was really encouraging.

Overriding themes within the feedback seemed to be:

- **Length** of the questionnaire;
- **Structure** of the questionnaire and;
- **Wording** of the questionnaire

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- **Distinction** of practitioners, teachers etc. in EY as these mean different things for different schools.

In light of this, we would ask that:

- The changes suggested by Emma (SEN teacher from Wales) be actioned
- A final copy of the English version of the questionnaire be proof-read (OU [Jim] will volunteer to do that)
- Any efforts at all that can be made to consolidate similar questions to shorten the document.
- To be more clear about our target audience for the questionnaire and reflect this in the language – do we mean just teachers, or do we mean everyone involved in EY education?

UK PARTNERS WILL HAVE TO DECIDE ON THIS, KEEPING IN MIND WHAT WE ARE INTERESTED IN, I.E. PRACTICES OF SCIENCE AND MATHEMATICS TEACHING. WOULD YOU CONSIDER ALL EY SETTINGS AS PROVIDING THIS EDUCATION? FOR WP4 WE WILL BE CONCENTRATING ON 4-5/5-6 (DEPENDING) AND 7-8. THE SETTINGS THAT PROVIDE EDUCATION TO THESE AGE GROUPS SHOULD BE DEFINITELY INCLUDED.

UEF

General comments of survey from piloting.

Pilot groups: 4 Finnish primary school teachers from university school (teachers of 7-8 years old)

1 Kindergarten teacher (teacher of 4-5 years old)

Method: Teachers read the survey and focused on a) language, b) content of questions, c) relevancy of questions. Two hours discussion together.

Comments:

- Questionnaire focuses on school activities and thus it not so relevant for day care (4-5 years)
- Mathematics should be removed; survey does not focus relevantly on mathematics.
- Questionnaire is too long and complicated. It is very tiring. There are too many points.
- There are questions which are not relevant for Finnish school or Finnish kindergarten.
- Instruction or teaching is not relevant with 4-5 years old, it refers for school. Educate as a word is better.

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Specific comments:

1. Question 10: Master level and doctorate level should be separated. There is significant difference in master level and in PhD level. Most of teachers are in master level, but only few in doctoral level.

THIS IS WHY WE ASK TEACHERS TO SPECIFY WHAT.

2. Question 6: examples needed for every statement

3. Question 20: Does 18 months mean two academic year/school year?

IT MEANS 18 CONSECUTIVE MONTHS.

4. Question 42- we do not have national teacher curriculum guide –unrelevant

THIS IS WHY WE HAVE THE N/A OPTION

5. There are several questions in which translation follows too much the original questions and reveal the central European context of survey. Should be translated better to fit in Finnish culture.

PLEASE FEEL FREE TO ADAPT THE TRANSLATION ACCORDINGLY.

GUF

Concerning the ISCED-levels, for Germany we would have to include at least the level 3B which qualifies to work in Kindergarten.
Can we add more levels in the final version of the questionnaire?
ISCED LEVELS HAVE BEEN ADJUSTED ACCORGING TO 2011 LATEST UNESCO GUIDELINES (SEE IN DROPBOX). WE HAVE REMOVED THE TERM 'ISCED' AS THIS CREATED CONFUSION AND MANY TEACHERS DID NOT KNOW WHAT IT REFERED TO.

PLEASE FEEL FREE TO TRANSLATE IT SO THAT IT MAKES SENSE IN THE NATIONAL CONTEXT, BUT ALWAYS HAVING IN MIND THE ISCED RELEVANT LEVELS.

EA

Katerina, Kindergarten Teacher
Elli, Primary school Teacher

Needed about 45 minutes to complete the survey.

Question 7, Response d. → Instead of magnets , building blocks use sorting activities, rulers.

CHANGE TO BE MADE.

Question 10 → Relevant examples form Greek settings so teachers can understand the different ISCED levels

Question11 → Add "as written in your diploma" at the end of the question

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Question 25 → Difficult to answer, due to the integrated nature of pre-school teaching. Change the wording so it is obvious that we are looking for an estimate

OVERALL: While the survey took a long time to complete, it was very interesting and enjoyable. There is a feeling of repetition but mostly concerning the questions that are linked to each other. However, the teachers said they understood the difference between those questions.

UMINHO

Victor

Victor took more than 40 minutes to go all the way through.

Main point:

It is too long and therefore he suggested: to indicate an estimate of the time needed to complete the survey; to add a scroll bar in the top or bottom of the page to indicate the percentage of the test already done and what is still to go (otherwise he expects that several peoples will leave the survey incomplete.)

Specific points:

In question 16 it is possible to answer but also to choose NA...

NOT CLEAR.

In questions 17 and 18 there should be options including "others".

DONE

NILPRP

Following the interaction with some teachers and colleagues some suggestions and comments can be structured:

1. The questionnaire seems to be too long and it might be the case that teachers will miss the time or the patience to fill it.
2. For this reason, maybe some more technical questions involving some terminology to which teachers are not used, it will be better to keep this question for the interview phase of the project. During the interview, some clarifications can be made and some terms better explained. On the other side it seems that some of the questions are more appropriate for older children (secondary level) and not for early age teaching. At least in Romania, where teachers do not practice inquiry approach, it will be difficult for them to answer correctly to some questions, as for example:
    a. 'understanding of important scientific processes' – question 20 (in the revised version)

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b. ‘competencies necessary to carry out scientific inquiry’ – question 20 (in the revised version)
c. ‘understanding about scientific inquiry (e.g. how science and scientists work)’ – question 20 (in the revised version)
d. ‘assessing children in science’ (what type of assessment are you thinking about: formative, summative, as far as in Romania they are plasticizing only summative assessment) – question 20 (in the revised version)
e. ‘understand the important scientific ideas (facts, concepts, laws and theories)’ – question 24 (in the revised version)
f. ‘understand that scientists describe the investigations in ways that enable others to repeat the investigations’ – question 24 (in the revised version)
g. ‘to know and understand the important scientific processes’ – question 24 (in the revised version)
h. ‘to be able to communicate investigations and explanations’ – question 24 (in the revised version)
i. ‘to understand that scientific investigations involve asking and answering a question and comparing the answer with what scientists already know about the world’ – question 24 (in the revised version)

WE CANNOT MAKE THESE CHANGES YOU REQUESTED BECAUSE THE SITUATION VARIES TREMENDOUSLY IN THE DIFFERENT COUNTRIES. YOU NEED TO MAKE THIS NOTE IN YOUR COUNTRY REPORT AND PERHAPS RECONSIDER WHEN ANALYSING THESE ANSWERS. IF YOU BELIEVE STRONGLY THAT THE ANSWERS GIVEN TO THESE QUESTIONS ARE COMPLETELY AD-HOC AND YOU HAVE STRONG EVIDENCE ABOUT THIS, YOU MAY CONSIDER REMOVING THESE ANSWERS IN THE ANALYSIS PHASE. BUT WAIT AND SEE FIRST.

3. To slightly change question 38 in order to include also resources for mathematics (question 39), as in most of the cases they overlap (e.g. Instructional materials, Audio-visual resources, computers, ICT resources, other digital technologies, Other support personnel)

IN OUR FIRST ATTEMPT AT WRITING THE QUESTIONNARE WE HAD THESE TWO QUESTIONS AS ONE.

UoM

I have piloted it and since Malta is so similar to the U.K. the only little problems are related to the personal details such as the type of school. I thought of adding an explanation in brackets to help understanding.

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APPENDIX 2:
FINAL QUESTIONNAIRE

1. 'Creative Little Scientists' Teacher Survey

Thank you for agreeing to take part in the *Creative Little Scientists* online teacher survey. We hope that it will be an interesting experience for you. The aim of the work is to contribute to a better understanding across Europe of the common ground that science and mathematics education can share with the development of creativity in pre-school and first years of compulsory school (up to the age of eight).In this survey we aim to explore existing practices in pre-school and first years of compulsory school science and mathematics across nine European countries (Belgium, Finland, France, Germany, Greece, Malta, Portugal, Romania, and the UK). We are seeking to identify opportunities and challenges for the development of creative skills within these areas of the curriculum.

There are 44 questions organized in 7 sections:

- Background Information – About your School
- Background Information – About You
- Your Knowledge, and Skills and Confidence in Teaching Science and Mathematics
- Your Views about and Approaches in Teaching Science
- Your Views about and Approaches in Assessing Science Learning
- School Science and Mathematics Resources and Your Use of Them
- Thanking You and Further Communication

Almost all questions are multiple-choice questions and require you to select one or more answers as appropriate. Three questions will give you the opportunity to give your views on how creativity can be fostered as part of science teaching and another two questions will ask you to reflect about the differences between science and mathematics teaching in pre-school and first years of compulsory school. The questionnaire addresses teachers practicing across a wide age range, so you are kindly asked to interpret the wording of the questions according to the age phase you are teaching.

All your responses will be treated in the strictest confidence (according to the EC directive 95/46/EC) and will only be used for research purposes. All data gathered during the project will be stored in a secure location accessible only to the researchers.

Lexicon

Pre-school: Provision for young children prior to beginning in compulsory education. This can span education and care.

Early years: Birth to 8 years of age incorporating kindergarten, nursery, pre-school, elementary school, primary school.

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2. Background Information – About your School

1. *School Details

*School name:
Address 1:
Address 2:
*City/Town:
State/Province:
*ZIP/Postal Code:
*Country:

2. Which of the following best describes the community in which this school is located?

a. A <village, hamlet or rural area> (fewer than 3 000 people)
b. A <small town> (3 000 to about 15 000 people)
c. A <town> (15 000 to about 100 000 people)
d. A <city> (100 000 to about 1 000 000 people)
e. A large <city> with over 1 000 000 people

3. Approximately how many children are in your school?

a. < 50
b. 50-100
c. 101-150
d. 151-200
e. 201-500
f. 501-750
g. 750+

4. For which age range of children does your school provide education and/or care?

5. Would you characterize your school as? (Please select all that apply)

a. Fee paying
b. Non-fee paying
c. Public / State
d. Private
e. Run by Local Educational Authority
f. Other school characteristics. Please specify:

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3. Background Information – About You

6. Are you male or female?

a. Male
b. Female

7. Your Age range:

a. Under 25
b. 25-29
c. 30–39
d. 40-49
e. 50-59
f. 60+

8. What is the highest level of formal education that you have completed?

a. Finished Upper Secondary Education (Vocational)
b. Finished Upper Secondary Education (General)
c. Finished Post-Secondary Non-Tertiary Education (Vocational)
d. Finished Post-Secondary Non-Tertiary Education (General)
e. Finished Bachelor Level Education or Equivalent
f. Finished higher than Bachelor Level Education or Equivalent – e.g. Masters Level Education, Doctoral Level Education, or equivalent. Please specify

9. What is/are the main subject(s) of your highest educational qualification (if appropriate)?

10. Please list any other qualifications you have, including professional qualifications.

a.
b.
c.
d.
e.

11. Are you certified to teach?

a. Yes
b. No

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12. By the end of this school year, how long have you been working as a teacher?

a. Fewer than 5 years
b. 5-10 years
c. 11-20 years
d. More than 20 years

13. Please describe your current position in the school.

14. Which age groups have you taught in the last 3 school years and are LIKELY to teach next school year? (Select all that apply).

	2009-10	2010-11	2011-12	2012-13
a. Younger than 3 years				
b. 3-4 years				
c. 4-5 years				
d. 5-6 years				
e. 6-7 years				
f. 7-8 years				
g. Older than 8 years				
h. N/A				
i. If you have selected more than one age group for any school year, please specify if you taught /are likely to teach these age groups concurrently, or in separate classrooms:				

15. Approximately how many children are in your classroom?

a. Fewer than 10
b. 10-15
c. 16-20
d. 21-25
e. 26-30
f. More than 30

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4. Your Knowledge, Skills and Confidence in Teaching Science and Mathematics

16. What is the highest formal education level in which you studied SCIENCE?

a. Lower Secondary Education
b. Upper Secondary Education (Vocational)
c. Upper Secondary Education Secondary Education (General)
d. Post-Secondary Non-Tertiary Education (Vocational)
e. Post-Secondary Non-Tertiary Education (General)
f. Bachelor Level Education
g. Masters Level Education
h. Other (Please specify):

17. What is the highest formal education level in which you studied MATHEMATICS?

a. Lower Secondary Education
b. Upper Secondary Education (Vocational)
c. Upper Secondary Education Secondary Education (General)
d. Post-Secondary Non-Tertiary Education (Vocational)
e. Post-Secondary Non-Tertiary Education (General)
f. Bachelor Level Education
g. Masters Level Education
h. Other (Please specify):

18. As part of your post-compulsory education and/or initial teacher training, to what extent did you study the following areas?

	Not at all	Overview or introduction to topic	It was an area of emphasis
a. Mathematics			
b. Science			
c. Environmental or Earth Sciences			
d. ICT			
e. Pedagogy			
f. Developmental Psychology			
g. Children's Development of Creativity			
h. Creative Teaching Approaches			

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19. **During the last 18 months, did you have the opportunity to participate in any of the following kinds of professional development activities and if so, what was the impact of these activities on your teaching of SCIENCE or MATHEMATICS respectively?**

	No impact	**A small impact**	**A moderate impact**	**A large impact**	**N/A**
a. Courses/workshops on **Science** subject matter or methods					
b. Courses/workshops on **Mathematics** subject matter or methods					
c. **Science** education conferences or seminars (where teachers and/or researchers present their research results and discuss educational problems)					
d. **Mathematics** education conferences or seminars (where teachers and/or researchers present their research results and discuss educational problems)					
e. **Science** teaching observations in other schools					
f. **Mathematics** teaching observations in other schools					
g. Participation in a network of teachers formed specifically for the professional development of teachers in **Science**					
h. Participation in a network of teachers formed specifically for the professional development of teachers in **Mathematics**					
i. Individual or collaborative research on a **Science** topic of interest to you professionally					
j. Individual or collaborative research on a **Mathematics** topic of interest to you professionally					
k. Mentoring and/or peer observation and coaching of **Science** teaching, as part of a formal school arrangement					
l. Mentoring and/or peer observation and coaching of **Mathematics** teaching, as part of a formal school arrangement					
m. Reading **Science** professional literature (e.g. journals, evidence-based papers, thesis papers)					
n. Reading **Mathematics** professional literature (e.g. journals, evidence-based papers, thesis papers)					
o. Engaging in informal dialogue with your colleagues on how to improve your **science** teaching					
p. Engaging in informal dialogue with your colleagues on how to improve your **mathematics** teaching					
q. Other kind of professional development activity that had an impact on your teaching of Science or Mathematics (Please specify)					

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20. How would you rate your confidence in the following?

	1 (Very low)	2	3	4 (Very high)
a. Your knowledge and understanding of important scientific ideas.				
b. Your knowledge and understanding of important scientific processes.				
c. Your competencies necessary to carry out scientific inquiry.				
d. Your understanding about scientific inquiry (e.g. how science and scientists work).				
e. Your general pedagogic knowledge.				
f. Your knowledge of science pedagogy/didactics.				
g. Your knowledge of mathematics pedagogy/didactics.				
h. Your science teaching.				
i. Your mathematics teaching.				
j. Assessing children in science.				
k. Assessing children in mathematics.				
l. Your ICT skills.				

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5. Your Views about and Approaches in Teaching Science

21. Approximately how much time do you have planned for teaching SCIENCE and MATHEMATICS per week? (Please estimate).

	Science	Mathematics
a. Less than an hour		
b. 1-2 h		
c. 3-4 h		
d. More than 4 h		
e. N/A (Please explain)		

22. List up to five (5) SCIENCE topics/areas/themes that you have addressed in your teaching this school year.

a.
b.
c.
d.
e.

23. Please indicate your views on the importance of the following purposes of school SCIENCE in COMPULSORY EDUCATION (5 to 16-year-olds).

	1 (Not important)	2	3	4 (Very important)
a. To provide a foundational education for future scientists and engineers				
b. To develop socially and environmentally aware and responsible citizens				
c. To enrich the understanding and interaction with phenomena in nature and technology				
d. To develop more innovative thinkers				
e. To develop positive attitudes to science				
f. To develop important attitudes and dispositions as a foundation for future learning				

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24. Now focusing on the AGE GROUP(s) YOU TEACH, please indicate how often you foster the development of the following SCIENCE learning outcomes.

Please interpret the following in ways appropriate to the AGE PHASE YOU TEACH.

	Never - 1	Rarely - 2	Quite often - 3	Very often - 4	N/A
a. To know and understand the important scientific ideas (facts, concepts, laws and theories).					
b. To understand that scientists describe the investigations in ways that enable others to repeat the investigations.					
c. To be able to ask a question about objects, organisms, and events in the environment.					
d. To be able to employ simple equipment and tools, such as magnifiers, thermometers, and rulers, to gather data and extend to the senses.					
e. To know and understand important scientific processes.					
f. To be able to communicate investigations and explanations.					
g. To understand that scientific investigations involve asking and answering a question and comparing the answer with what scientists already know about the world.					
h. To have positive attitudes to science learning.					
i. To be interested in science.					
j. To be able to plan and conduct a simple investigation.					
k. To have positive attitudes to learning.					
l. To understand that scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge).					
m. To be able to collaborate with other children					

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25. How often do you use the following learning/teaching contexts and approaches in your SCIENCE teaching?

	Never - 1	Rarely - 2	Quite often - 3	Very often - 4
a. Open/unstructured play				
b. Role/Pretend play				
c. Drama				
d. Teaching science from stories				
e. Using history to teach science (e.g. transport, the work of scientists)				
f. Working in small groups				
g. Physical exploration of materials				
h. Using outdoor learning activities				
i. Taking children on field trips and/or visits to science museums and industry				
j. Integrating science with other curricular areas				
k. Building on children's prior experiences				
l. Fostering collaboration				
m. Encouraging different ways of recording and expressing ideas – oral, visual, digital, practical				
n. Encouraging problem finding – e.g. children asking questions				
o. Encouraging problem solving – e.g. children solving practical tasks				
p. Encouraging children to try out their own ideas in investigations				
q. Fostering classroom discussion and evaluation of alternative ideas				
r. Fostering imagination				
s. Relating science to everyday life				
t. Using questioning as a tool in science teaching				
u. Using digital technologies with children for science teaching and learning				
v. Fostering autonomous learning				

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26. Which of the contexts mentioned in question 25 do you consider as MOST LIKELY to contribute to the development of children's CREATIVITY?

	Choose up to 3 answers
a. Open/unstructured play	
b. Role/Pretend play	
c. Drama	
d. Teaching science from stories	
e. Using history to teach science (e.g. transport, the work of scientists)	
f. Working in small groups	
g. Physical exploration of materials	
h. Using outdoor learning activities	
i. Taking children on field trips and/or visits to science museums and industry	
j. Integrating science with other curricular areas	
k. Please mention any other context you think as contributing significantly to the development of children's creativity and justify your selection(s):	

27. Which of the teaching approaches mentioned in question 25 do you consider as MOST LIKELY to contribute to the development of children's CREATIVITY?

	Choose up to 3 answers
a. Building on children's prior experiences	
b. Fostering collaboration	
c. Encouraging different ways of recording and expressing ideas – oral, visual, digital, practical	
d. Encouraging problem finding – e.g. children asking questions	
e. Encouraging problem solving – e.g. children solving practical tasks	
f. Encouraging children to try out their own ideas in investigations	
g. Fostering classroom discussion and evaluation of alternative ideas	
h. Fostering imagination	
i. Relating science to everyday life	
j. Using questioning as a tool in science teaching	
k. Using digital technologies with children for science teaching and learning	
l. Fostering autonomous learning	
m. Please mention any other teaching approach you think as contributing significantly to the development of children's creativity and justify your selection(s):	

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28. **Question 25 referred to the contexts and approaches used by you in SCIENCE teaching. Please reflect and briefly describe in what ways, if any, these contexts and approaches might differ in the case of MATHEMATICS.**

29. **How often do you encourage children to undertake the following activities in SCIENCE?**

	Never - 1	Rarely - 2	Quite often - 3	Very often - 4
a. Observe natural phenomena such as the weather or a plant growing and describe what they see.				
b. Ask questions about objects, organisms, and events in the environment.				
c. Design or plan simple investigations or projects.				
d. Conduct simple investigations or projects				
e. Employ simple equipment and tools to gather data and extend to the senses.				
f. Use data to construct reasonable explanations.				
g. Communicate the results of their investigations and explanations.				

30. **Which of the SCIENCE activities mentioned in question 29 do you consider as MOST LIKELY to contribute to the development of children's CREATIVITY?**

	Choose up to 3 answers
a. Observe natural phenomena such as the weather or a plant growing and describe what they see.	
b. Ask questions about objects, organisms, and events in the environment.	
c. Design or plan simple investigations or projects.	
d. Conduct simple investigations or projects	
e. Employ simple equipment and tools to gather data and extend to the senses.	
f. Use data to construct reasonable explanations.	
g. Communicate the results of their investigations and explanations.	
h. Please mention any other activity you think as contributing significantly to the development of children's creativity and justify your selection(s):	

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The following table shows some essential features of INQUIRY learning in SCIENCE education and their possible variations in the classroom.

	A (Open)	B (Guided)	C (Structured)
a. **QUESTION:** Children investigate scientifically oriented question	Child poses a scientifically oriented question	Child selects from a range of, or refines, a scientifically oriented question provided by the teacher, materials or other source	Child is given a scientifically oriented question by the teacher, materials or other source
b. **EVIDENCE**: Children give priority to evidence	Child determines what constitutes evidence/data and collects it	Child selects from data/evidence provided by the teacher, materials or other source	Child is given evidence/data by the teacher, materials or other source
c. **ANALYSE**: Children analyse evidence	Child decides how to analyse evidence	Child selects from ways of analysing evidence provided by the teacher, materials or other source	Child is told how to analyse evidence provided by the teacher, materials or other source
d. **EXPLAIN**: Children formulate explanation based on evidence	Child decides how to formulate evidence based on evidence	Child selects from possible ways to formulate explanation given by the teacher, materials or other source	Child is given a way to formulate explanation based on evidence
e. **CONNECT**: Children connect explanations to scientific knowledge	Child independently finds and examines other resources and forms links to scientific knowledge	Child is directed to other resources and shown how to form links to scientific knowledge	Child is given other resources and shown the links with scientific knowledge
f. **COMMUNICATE**: Children communicate and justify explanation	Child chooses how to communicate and justify explanations	Child is given broad guidelines on how to justify and communicate explanations	Child is given all the steps to justify and communicate explanations by the teacher, materials or other source
g. **REFLECT**: Children reflect on the inquiry process and their learning	Child decides independently how to structure reflection on the inquiry process and his/her learning	Child is given broad guidelines to structure reflection on the inquiry process and his/her learning by the teacher, materials or other source	Child is given a structured framework for reflection by the teacher, materials or other source

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31. For each of the INQUIRY features please indicate the variation (A, B or C) from the table above that MOSTLY characterizes your approach in the SCIENCE classroom.

	A (Open)	B (Guided)	C (Structured)	N/A
a. QUESTION: Children investigate scientifically oriented question				
b. EVIDENCE: Children give priority to evidence				
c. ANALYSE: Children analyse evidence				
d. EXPLAIN: Children formulate explanations based on evidence				
e. CONNECT: Children connect explanations to scientific knowledge				
f. COMMUNICATE: Children communicate and justify explanation				
g. REFLECT: Children reflect on the inquiry process and their learning				

h. If you have selected N/A, please explain:

32. How strongly do you agree or disagree with each of the following statements about the role of teacher in fostering INQUIRY skills?

	1 (Strongly Disagree)	2	3	4 (Strongly Agree)
a. Teachers should demonstrate first the correct way to solve a problem				
b. Teachers should give children ample time to work out their own solutions to problems before showing them how they are solved				
c. Teachers should facilitate children's own inquiry				
d. Teachers should allow children to find solutions to problems on their own				

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6. Your Views about and Approaches in Assessing Science Learning

33. Focusing on the AGE GROUP YOU TEACH, please indicate your views about the importance of the following priorities of children's ASSESSMENT in SCIENCE education. To assess the development of children's:

	1 (Not important)	2	3	4 (Very important)
a. Knowledge and understanding of scientific ideas (facts, concepts, laws and theories)				
b. Knowledge and understanding of scientific processes				
c. Competencies necessary to carry out scientific inquiry				
d. Understandings about scientific inquiry (e.g. how science and scientists work)				
e. Positive attitudes and increase of interest in science				
f. Positive attitudes and increase of interest in learning science				

34. How often do you assess your pupils in SCIENCE in the following ways?

	Never - 1	Rarely - 2	Quite often - 3	Very often - 4
a. Using checklists to record observations of children				
b. During classroom interaction				
c. Evaluating children's pictures, graphs etc which show their scientific reasoning				
d. Evaluating children's relevant gestures or physical activity				
e. Marking their homework				
f. Using authentic problem-based tasks				
g. Asking each child to reflect on their own learning and progress				
h. Using closed question tests				
i. Using open question tests				
j. Using questions in context				
k. Using portfolios (collection of evidence of children's work and progress)				
l. Children correcting each other's work and giving each other feedback				

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35. How often do you reward/praise the following characteristics in your pupils in SCIENCE?

	Never - 1	Rarely - 2	Quite often - 3	Very often - 4
a. Sense of initiative				
b. Motivation				
c. Ability to come up with something new				
d. Ability to connect what they have learnt during your lessons with topics in other subjects				
e. Imagination				
f. Curiosity				
g. Ability to work together				
h. Thinking skills				

36. How often do you use ASSESSMENTS of children in SCIENCE for the following purposes?

	Never - 1	Rarely - 2	Quite often - 3	Very often - 4
a. To identify areas for improvement in your science teaching				
b. To identify aspects of the science curriculum that could be improved				
c. To identify ways to improve child science learning				
d. To monitor regularly individual children's or cohorts of children's progress towards a set of desirable science learning outcomes				
e. To inform parents of their child's progress in science				
f. To help group children for science instruction purposes				
g. To monitor year-to-year child progress in science				
h. To provide feedback to children about their progress in science				
i. To set targets with children for their own development in science				

37. Questions 34-36 referred to the approaches used by you in the assessment of SCIENCE learning. Please reflect and briefly describe in what ways, if any, these approaches might differ in the case of MATHEMATICS.

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7. School Science and Mathematics Resources and Your Use of Them

38. How well resourced do you feel your school is for the teaching of SCIENCE in terms of the following?

	1 (Not at all)	2	3	4 (Very Well)
a. Instructional materials (e.g. textbooks)				
b. Audio-visual resources				
c. Relevant library materials (e.g. story books)				
d. Equipment and materials for hands-on exploration in the classroom (e.g. magnets, building blocks)				
e. Equipment and materials for hands-on exploration outside the classroom (e.g. sand box)				
f. Computers				
g. ICT resources (e.g. computer applications)				
h. Other digital technologies (e.g. interactive whiteboard, camera)				
i. Budget for supplies (e.g. paper, drawing materials)				
j. Teaching support personnel (e.g. classroom assistant)				
k. Other support personnel (e.g. technical support)				

39. How well resourced do you feel your school is for the teaching of MATHEMATICS in terms of the following?

	1 (Not at all)	2	3	4 (Very Well)
a. Instructional materials (e.g. textbooks)				
b. Audio-visual resources				
c. Relevant library materials (e.g. story books)				
d. Equipment and materials for hands-on exploration in the classroom (e.g. sorting activity games, rulers)				
e. Equipment and materials for hands-on exploration outside the classroom (e.g. sand box)				
f. Computers				
g. ICT resources (e.g. computer applications)				
h. Other digital technologies (e.g. interactive whiteboard, camera)				
i. Budget for supplies (e.g. paper, drawing materials)				
j. Teaching support personnel (e.g. classroom assistant)				
k. Other support personnel (e.g. technical support)				

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40. How often do you use the following resources in your SCIENCE and MATHEMATICS teaching?

	Never - 1	Rarely - 2	Quite often - 3	Very often - 4	N/A
a. Student Textbooks					
b. Teaching materials prepared by you					
c. Teaching materials prepared by group of teachers in your school					
d. Resources downloaded from the Internet					
e. Audio-visual resources					
f. Relevant library materials (e.g. story books)					
g. Equipment and materials for hands-on exploration in the classroom (e.g. magnets, building blocks, sorting activity games, rulers)					
h. Computers					
i. Digital technologies (e.g. interactive whiteboard)					
j. ICT resources (e.g. website, digital game)					
k. Relevant media materials (e.g. newspapers, magazines)					

l. Other resources that you often use in your Science and Mathematics teaching:

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41. How often do you consult the following resources to inform your SCIENCE and MATHEMATICS teaching preparation?

	Never - 1	Rarely - 2	Quite often - 3	Very often - 4	N/A
a. Student textbook					
b. Teacher textbook guide					
c. Online textbook resources (incl. publishers' websites)					
d. School curriculum					
e. National curriculum					
f. National teacher curriculum guide					
g. National education agency website					
h. Teacher professional association documentation or website					
i. School assessment guidelines					
j. National assessment guidelines					

k. Other resources that you often use to inform your Science and Mathematics teaching preparation:

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8. Thanking You and Further Communication

We would like to thank you for spending time and effort to participate in the 'Creative Little Scientists' project survey.

Your contribution is greatly appreciated.

42. Any other comments you may have either about the issues or in response to the questionnaire are welcome feedback to our research.
e.g. Has the questionnaire prompted thought about issues you have not have had considered before? Were there particular questions you felt you could not answer and why?

43. Please indicate whether you wish to be contacted by the project for any of the following reasons:

		Yes	No
a.	Receive acknowledgment of your participation in the 'Creative Little Scientists' project survey		
b.	Clarify/Discuss further responses you gave in the survey		
c.	Participate in the second phase of the research, collaborating with researchers through classroom observations and interviews (January-April 2013).		
d.	Receive electronically the report that will be produced in English on early years science practices and their implications for children's creativity, which will include a set of exemplary case studies illustrating the variety of approaches observed throughout the nine European countries participating in the project.		
e.	Receive a publication (in English) containing exemplary teacher training materials, which will be selected on the basis of good practices identified in the case studies as well as being consistent with the guidelines and curricula for teacher training produced by the project.		

44. If you have indicated positively in any of the above aspects of the question above, please do provide us with your contact details.

First Name:

Surname:

Contact Email Address:

Contact Phone Number:

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APPENDIX 3:
CONNECTIONS BETWEEN CONCEPTUAL FRAMEWORK STRANDS, SPIDER-WEB DIMENSIONS, QUESTIONNAIRE ITEMS AND MAPPING AND COMPARISON FACTORS

Conceptual Framework Strands	Dimensions	Teacher Survey	Factors
Aims / purpose / priorities	Rationale or vision	23. Please indicate your views on the importance of the following purposes of school SCIENCE in COMPULSORY EDUCATION (5 to 16-year-olds).	◦ science economic imperative ◦ creativity economic imperative ◦ scientific literacy and numeracy for society and individual ◦ technological imperative ◦ science and mathematics education as context for development of general skills and dispositions for learning
	Aims and Objectives	24. Now focusing on the AGE GROUP(s) YOU TEACH, please indicate how often you foster the development of the following SCIENCE learning outcomes. Please interpret the following in ways appropriate to the AGE PHASE YOU TEACH.	◦ knowledge/understanding of science content ◦ understanding about scientific inquiry ◦ science process skills ◦ capabilities to carry out scientific inquiry or problem-based activities ◦ social factors of science learning ◦ affective factors of science learning ◦ creative dispositions
Teaching, learning and assessment	Learning Activities	29. How often do you encourage children to undertake the following activities in SCIENCE?	◦ focus on cognitive dimension ◦ focus on social dimension
		30. Which of the SCIENCE activities mentioned in question 29 do you consider as MOST LIKELY to contribute to the development of children's CREATIVITY?	

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<table>
<tr><th>Conceptual Framework Strands</th><th>Dimensions</th><th>Teacher Survey</th><th>Factors</th></tr>
<tr><td rowspan="9">Teaching, learning and assessment</td><td rowspan="5">Pedagogy</td><td>25. How often do you use the following learning/teaching contexts and approaches in your SCIENCE teaching?</td><td rowspan="5">◦ role of play and exploration
◦ role of motivation and affect
◦ role of dialogue and collaboration
◦ role of problem solving and agency
◦ fostering questioning and curiosity
◦ fostering reflection and reasoning
◦ teacher scaffolding and involvement</td></tr>
<tr><td>26/27. Which of the contexts mentioned in question 25 do you consider as MOST LIKELY to contribute to the development of children’s CREATIVITY?</td></tr>
<tr><td>28. Question 25 for MATHEMATICS.</td></tr>
<tr><td>31. For each of the INQUIRY features please indicate the variation (A, B or C) from the table above that MOSTLY characterizes your approach in the SCIENCE classroom.</td></tr>
<tr><td>32. How strongly do you agree or disagree with each of the following statements about the role of teacher in fostering INQUIRY skills?</td></tr>
<tr><td rowspan="4">Assessment</td><td>36. How often do you use ASSESSMENTS of children in SCIENCE for the following purposes?</td><td rowspan="4">◦ Assessment function/purpose
○ formative
○ summative
○ recipient of assessment results
◦ Assessment way/process
○ strategy
○ forms of evidence
○ locus of assessment judgment</td></tr>
<tr><td>34. How often do you assess your pupils in SCIENCE in the following ways?</td></tr>
<tr><td>35. How often do you reward/praise the following characteristics in your pupils in SCIENCE?</td></tr>
<tr><td>33. Focusing on the AGE GROUP YOU TEACH, please indicate your views about the importance of the following priorities of children’s ASSESSMENT in SCIENCE education.</td></tr>
</table>

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<table>
<tr><th>Conceptual Framework Strands</th><th>Dimensions</th><th>Teacher Survey</th><th>Factors</th></tr>
<tr><td rowspan="10">Contextual factors

(Curriculum-related)</td><td rowspan="2">Content</td><td>22. List five (5) SCIENCE topics/areas/themes that you addressed in your teaching this school year.</td><td rowspan="2">◦ science and mathematics as separate areas of knowledge or within a broader grouping
◦ level of detail of curriculum content
◦ links with other subject areas / cross-curriculum approach
◦ subject-specific requirements vs. broad core curriculum
◦ content across key areas of knowledge</td></tr>
<tr><td>25. How often do you use the following learning/teaching contexts and approaches in your SCIENCE teaching? (j)</td></tr>
<tr><td rowspan="8">Location</td><td>25. How often do you use the following learning/teaching contexts and approaches in your SCIENCE teaching? (h,i,f)</td><td rowspan="8">◦ Education system level
  ○ centralized/decentralized
◦ School level
  ○ state/public, private etc.
  ○ fee paying / non-fee paying
  ○ size of school
  ○ urban/rural location
  ○ student intake
◦ Classroom level
  ○ outdoors/indoors
  ○ formal/informal learning settings
  ○ small group settings</td></tr>
<tr><td>26. Which of the contexts mentioned in question 25 do you consider as MOST LIKELY to contribute to the development of children’s CREATIVITY? (h and i)</td></tr>
<tr><td>28. Question 25 for MATHEMATICS.</td></tr>
<tr><td>1. School details</td></tr>
<tr><td>2. Which of the following best describes the community in which this school is located?</td></tr>
<tr><td>3. Approximately how many children are in your school?</td></tr>
<tr><td>4. For which age range of children does your school provide education and/or care?</td></tr>
<tr><td>5. Would you characterise your school as?</td></tr>
</table>

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<table>
<tr><th>Conceptual Framework Strands</th><th>Dimensions</th><th>Teacher Survey</th><th>Factors</th></tr>
<tr><td rowspan="8">Contextual factors

(Curriculum-related)</td><td rowspan="4">Materials and Resources</td><td>38. How well resourced is your school in your opinion for the teaching of SCIENCE in terms of the following?</td><td rowspan="8">rich physical environment for exploration
sufficient space
outdoor resources
informal learning resources
ICT and digital technologies
variety of resources
sufficient human resources
policy documents
sufficient time for learning science and mathematics
multigrade teaching
ability grouping
small group settings
number of children in class</td></tr>
<tr><td>39. How well resourced is your school in your opinion for the teaching of MATHEMATICS in terms of the following?</td></tr>
<tr><td>40. How often do you use the following resources in your SCIENCE and MATHEMATICS teaching?</td></tr>
<tr><td>41. How often do you consult the following resources to inform your SCIENCE and MATHEMATICS teaching preparation?</td></tr>
<tr><td>Time</td><td>21. About how much time do you have planned for teaching SCIENCE and MATHEMATICS per week? (Please estimate).</td></tr>
<tr><td rowspan="3">Grouping</td><td>25. How often do you use the following learning/teaching contexts and approaches in your SCIENCE teaching? (f)</td></tr>
<tr><td>14. Which age groups have you taught in the last 3 school years and are LIKELY to teach next school year?</td></tr>
<tr><td>15. Approximately how many children are in your classroom?</td></tr>
</table>

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Conceptual Framework Strands	Dimensions	Teacher Survey	Factors
Contextual factors ***(Teacher-related)***	**Teacher Personal Characteristics**	6. Are you male or Female?	◦ Gender ◦ Age ◦ Qualifications ◦ level ◦ focus / content ◦ professional ◦ pedagogical competence ◦ scientific competence ◦ confidence ◦ ICT skills
		7. Your Age range	
	Teacher General Education and Training	8. What is the highest level of formal education that you have completed?	
		9. What is/are the main subject(s) of your highest educational qualification (if appropriate)?	
		10. Please list any other qualifications you have, including professional qualifications.	
		11. Are you certified to teach?	
	Teacher Science and Mathematics Knowledge, Skills and Confidence	16. What is the highest formal education level in which you studied SCIENCE?	
		17. What is the highest formal education level in which you studied SCIENCE?	
		18. As part of your post-compulsory education and/or initial teacher training, to what extent did you study the following areas?	
		19. During the last 18 months, did you have the opportunity to participate in any of the following kinds of professional development activities, and what was the impact of these activities on your teaching of SCIENCE or MATHEMATICS respectively?	
		20. How would you rate your confidence in the following?	

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Conceptual Framework Strands	Dimensions	Teacher Survey	Factors
Contextual factors ***(Teacher-related)***	**Initial Teacher Training**	18. As part of your post-compulsory education and/or initial teacher training, to what extent did you study the following areas?	◦ entry qualifications/requirements for prospective teachers ◦ ITE standards/competencies ◦ ITE curriculum ◦ level of education ◦ length of ITE ◦ location of ITE ◦ ITE providers ◦ profile/role of teacher educator ◦ profile/role of school mentor ◦ models of training ◦ assessment approaches used in teacher education
	Continuing Professional Development	19. During the last 18 months, did you have the opportunity to participate in any of the following kinds of professional development activities, and what was the impact of these activities on your teaching of SCIENCE or MATHEMATICS respectively?	◦ standards / competencies ◦ national priorities ◦ impact of CPD ◦ nature of CPD ◦ CPD providers

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APPENDIX 4:
AGREED MINIMUM NUMBER OF SCHOOLS FOR TEACHER SURVEY

	Preschool	Early Primary
Finland	40	40
Germany	40	40
Greece	50	50
France	20	20
Belgium	50	50
Portugal	30	30
Romania	30	30
UK (England)	30	30
UK (Wales)	10	10
UK (Northern Ireland)	10	10
UK (Scotland)	10	10
Malta	20	20
TOTAL	**340**	**340**

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APPENDIX 5: PARTICIPATION INVITATION LETTER

Science and mathematics education, creativity and innovation are areas equally recognized as important for Europe, and their strengthening as a vital priority. The *Creative Little Scientists* project constitutes a timely contribution to a better understanding, at the European level, of the potential available on the common ground that science and mathematics education in pre-school and early primary school (up to the age of eight) can share with creativity.

The *Creative Little Scientists* consortium, bringing together academics and researchers from 9 European countries (Belgium, Finland, France, Germany, Greece, Malta, Portugal, Romania, and the UK) and comprising 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 has set as overall aims for the project:

- To provide Europe with a clear picture of existing and possible practices, as well as their implications and the related opportunities and challenges, in the intersection of science and mathematics learning, and development of creative skills in pre-school and the early years of primary education (up to the pupil age of eight); and
- To transform the knowledge generated through this into policy guidelines, as well as guidelines, curricula and exemplary materials for relevant teacher training in the various European contexts.

In order for the project to achieve the above aims, teachers currently working in Pre-school and Primary Education are invited to participate:

- **in the first phase**, by completing the online questionnaire (available from mid-May 2012 until end of June 2012), and/or
- **in the second phase**, taking part in the in-depth research conducted by the project and collaborating with researchers through classroom observations and interviews. (January - April 2013).

All participating teachers will receive:

- A certificate of participation in the EC-funded research project *Creative Little Scientists.*
- A report on practices and their implications, which will include a set of exemplary case studies illustrating the variety of approaches observed throughout the nine European countries participating in the project.
- A publication containing exemplary teacher training materials, which will be selected on the basis of good practices identified in the case studies as well as being consistent with the guidelines and curricula for teacher training produced by the project.

All teachers interested in participating in the first and/or second research phase can contact (name, email address, tel. no), providing their name, telephone number, email address as well as their current school of employment and years of teaching experience. Alternatively,

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teachers can register by going to the project website, www.creative-little-scientists.eu, and filling in the web form provided after clicking on the button labeled 'Participate' (main menu at the top of the webpage).

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.

Contact Information:

Name, telephone number, email, institution

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APPENDIX 6:
ETHICAL APPROVAL FOR EACH COUNTRY

Country	Ethical approval required	Ethical approval received
Finland	No	N/A
France	Yes – by the Ministry of Education	Yes
Germany	No	N/A
Greece	Yes – by the Ministry of Education	Yes
Belgium	No	N/A
Portugal	Yes – by the Ministry of Education and/or school	Yes
Romania	Yes – by the National Supervisory Authority for Personal Data Processing	Yes
UK (England)	Yes – by Bishop Grosseteste University	Yes
UK (Wales)	Yes – by Bishop Grosseteste University	Yes
UK (Northern Ireland)	Yes – by the Open University	Yes
UK (Scotland)	Yes – by the Institute of Education	Yes
Malta	Yes – by the Directorate for Quality and Standards in Education	Yes

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APPENDIX 7:
DATA TABLES FOR THE PROJECT'S MAPPING AND COMPARISON CONCEPTUAL DIMENSIONS

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Rationale or Vision

Q23. Please indicate your views on the importance of the following purposes of school SCIENCE in COMPULSORY EDUCATION (5 to 16-year-olds).

	a. To provide a foundational education for future scientists and engineers.			b. To develop socially and environmentally aware and responsible citizens.			c. To enrich the understanding and interaction with phenomena in nature and technology.			d. To develop more innovative thinkers.			e. To develop positive attitudes to science.			f. To develop important attitudes and dispositions as a foundation for future learning.		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	35	2,5	0,9	35	3,6	0,5	35	3,4	0,6	35	3,2	0,7	34	3,4	0,7	35	3,5	0,7
BE(Wa)	3	2,7	1,5	3	4,0	0,0	3	3,7	0,6	3	3,7	0,6	3	3,3	0,6	3	3,7	0,6
FI	65	2,6	1,0	65	3,8	0,4	65	3,3	0,7	65	3,5	0,6	65	3,8	0,4	65	3,8	0,4
FR	43	2,7	1,0	46	3,7	0,5	46	3,1	0,7	46	3,3	0,7	46	3,5	0,7	45	3,6	0,5
GE	49	2,6	1,1	49	3,7	0,7	49	3,6	0,6	49	3,4	0,7	49	3,7	0,6	49	3,7	0,7
GR	88	2,8	1,0	90	3,8	0,5	89	3,5	0,6	89	3,7	0,6	89	3,6	0,6	88	3,7	0,5
MA	66	3,2	0,9	66	3,7	0,5	66	3,5	0,6	66	3,8	0,4	66	3,6	0,6	66	3,6	0,6
PT	54	3,1	0,9	55	3,8	0,4	55	3,6	0,6	55	3,7	0,6	55	3,8	0,4	55	3,8	0,4
RO	236	3,1	0,9	237	3,8	0,6	238	3,6	0,6	237	3,7	0,6	237	3,7	0,6	238	3,8	0,5
UK(EN)	69	3,6	0,6	69	3,7	0,5	69	3,7	0,5	69	3,9	0,4	69	3,8	0,5	69	3,8	0,4
UK(NI)	12	3,6	0,7	12	3,8	0,4	12	3,7	0,7	12	4,0	0,0	12	3,9	0,3	12	3,9	0,3
UK(Sco)	8	3,5	0,8	8	3,9	0,4	8	3,9	0,4	8	4,0	0,0	8	4,0	0,0	8	3,8	0,5
UK(Wa)	5	3,6	0,5	5	3,4	0,5	5	3,8	0,4	5	4,0	0,0	5	4,0	0,0	5	3,8	0,4
Total	733	3,0	1,0	740	3,7	0,5	740	3,5	0,6	739	3,6	0,6	738	3,7	0,6	738	3,7	0,5

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Aims and Objectives

Q24. Now focusing on the AGE GROUP(s) YOU TEACH, please indicate how often you foster the development of the following SCIENCE learning outcomes. Please interpret the following in ways appropriate to the AGE PHASE YOU TEACH.

	a. To know and understand the important scientific ideas (facts, concepts, laws and theories).			b. To understand that scientists describe the investigations in ways that enable others to repeat the investigations.			c. To be able to ask a question about objects, organisms, and events in the environment.			d. To be able to employ simple equipment and tools, such as magnifiers, thermometers, and rulers, to gather data and extend to the senses.			e. To know and understand important scientific processes.			f. To be able to communicate investigations and explanations.		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	28	2,2	1,0	26	1,6	0,7	34	3,5	0,7	34	3,5	0,7	31	3,2	0,9	31	3,2	0,8
BE(Wa)	3	3,3	0,6	3	2,7	1,2	3	4,0	0,0	3	3,3	0,6	3	3,0	1,0	3	2,7	0,6
FI	66	3,5	0,6	64	2,1	0,8	66	3,6	0,5	65	3,3	0,7	66	2,8	0,7	66	3,0	0,8
FR	44	2,6	0,8	45	2,0	0,8	45	3,4	0,5	46	3,2	0,7	46	2,6	0,7	45	3,0	0,7
GE	48	3,0	0,7	43	2,7	1,0	45	3,1	0,8	48	3,6	0,5	45	3,5	0,6	47	3,4	0,7
GR	82	2,8	1,0	78	2,4	1,1	85	3,6	0,6	82	3,4	0,7	78	2,7	1,0	79	2,6	1,1
MA	59	2,9	1,0	59	2,3	0,9	68	3,2	0,7	64	2,7	0,9	63	2,7	0,8	62	2,7	0,9
PT	53	3,1	0,7	53	2,6	0,7	54	3,3	0,6	53	3,3	0,7	55	3,1	0,7	54	3,1	0,7
RO	220	3,1	0,8	221	2,6	0,8	235	3,7	0,5	232	3,2	0,8	228	3,3	0,7	234	3,2	0,8
UK(EN)	65	3,2	0,8	65	2,6	1,0	66	3,7	0,6	65	3,5	0,6	65	3,2	0,8	65	3,5	0,6
UK(NI)	11	2,7	0,8	10	2,4	0,7	11	3,6	0,5	9	3,4	0,7	9	3,2	0,8	10	3,2	0,6
UK(Sco)	8	3,3	0,7	8	2,5	1,1	8	3,6	0,5	8	3,8	0,5	8	3,3	0,7	8	3,3	0,7
UK(Wa)	4	3,3	0,5	4	2,3	1,3	4	4,0	0,0	4	4,0	0,0	4	3,8	0,5	4	4,0	0,0
Total	691	3,0	0,8	679	2,4	0,9	724	3,5	0,6	713	3,3	0,8	701	3,1	0,8	708	3,1	0,8

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Q24 (cont). Now focusing on the AGE GROUP(s) YOU TEACH, please indicate how often you foster the development of the following SCIENCE learning outcomes. Please interpret the following in ways appropriate to the AGE PHASE YOU TEACH.

	g. To understand that scientific investigations involve asking and answering a question and comparing the answer with what scientists already know about the world.			h. To have positive attitudes to science learning.			i. To be interested in science.			j. To be able to plan and conduct a simple investigation.			k. To have positive attitudes to learning.			l. To understand that scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge).			m. To be able to collaborate with other children.		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	30	1,9	0,8	33	3,2	0,7	32	3,4	0,7	33	3,2	0,9	31	3,6	0,6	28	2,0	1,0	33	3,8	0,6
BE(Wa)	3	2,7	0,6	3	3,0	1,0	3	3,0	1,0	3	2,7	1,5	3	3,7	0,6	3	3,3	1,2	3	4,0	0,0
FI	66	2,3	0,8	65	3,6	0,6	63	3,7	0,5	64	2,8	0,7	61	3,8	0,4	65	2,4	0,8	59	3,8	0,4
FR	45	2,9	0,9	41	3,1	0,7	41	3,2	0,6	43	2,8	0,8	43	3,5	0,6	43	2,5	1,0	40	3,5	0,7
GE	44	2,6	0,9	47	3,6	0,5	46	3,6	0,5	45	3,4	0,6	44	3,8	0,5	45	2,9	0,9	44	3,9	0,3
GR	78	2,3	1,0	83	3,5	0,7	84	3,5	0,7	76	2,7	0,9	75	3,7	0,6	79	2,9	0,9	74	3,9	0,4
MA	60	2,6	0,9	69	3,4	0,7	70	3,5	0,6	65	3,0	0,7	66	3,6	0,6	64	2,9	0,9	70	3,5	0,6
PT	54	3,0	0,8	53	3,5	0,6	52	3,6	0,6	55	3,0	0,8	53	3,5	0,6	55	3,0	0,8	52	3,6	0,6
RO	229	2,9	0,8	233	3,5	0,6	235	3,6	0,6	221	3,0	0,8	223	3,7	0,5	223	3,0	0,8	227	4,1	2,9
UK(EN)	62	3,1	0,9	62	3,8	0,5	62	3,8	0,4	61	3,3	0,8	58	3,8	0,4	62	2,9	0,9	63	3,7	0,7
UK(NI)	10	3,2	0,6	9	3,7	0,7	10	3,7	0,5	10	3,2	0,9	9	3,7	0,5	10	2,8	0,4	8	3,6	0,5
UK(Sco)	8	2,5	0,8	8	3,6	0,5	8	3,8	0,5	8	3,4	0,7	8	3,9	0,4	8	3,0	1,1	8	3,8	0,5
UK(Wa)	4	3,3	1,0	5	3,8	0,4	4	3,8	0,5	4	4,0	0,0	4	4,0	0,0	4	3,3	1,0	5	4,0	0,0
Total	693	2,7	0,9	711	3,5	0,6	710	3,6	0,6	688	3,0	0,8	678	3,7	0,5	689	2,8	0,9	686	3,8	1,7

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Learning Activities

Q29. How often do you encourage children to undertake the following activities in SCIENCE?

	a.Observe natural phenomena such as the weather or a plant growing and describe what they see.			b.Ask questions about objects, organisms, and events in the environment.			c.Design or plan simple investigations or projects.			d.Conduct simple investigations or projects.			e.Employ simple equipment and tools to gather data and extend to the senses.			f.Use data to construct reasonable explanations.			g.Communicate the results of their investigations and explanations.		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	34	3,8	0,5	34	3,5	0,5	34	2,6	0,8	34	2,7	0,7	34	2,9	0,8	34	2,6	0,7	34	3,2	0,7
BE(Wa)	3	3,7	0,6	3	3,3	0,6	3	3,0	1,0	3	2,7	1,5	3	3,0	0,0	3	2,3	0,6	3	2,7	1,2
FI	58	3,4	0,5	58	3,1	0,6	58	2,3	0,5	58	2,5	0,5	58	2,8	0,6	57	2,9	0,6	57	3,2	0,6
FR	45	3,4	0,5	45	3,2	0,5	45	2,7	0,5	44	2,8	0,5	45	2,7	0,7	45	2,6	0,6	46	3,0	0,7
GE	49	3,3	0,7	48	3,1	0,8	48	2,7	0,8	49	2,9	0,7	49	2,9	0,8	47	2,3	0,7	47	3,0	0,7
GR	87	3,6	0,6	86	3,4	0,7	87	2,6	0,9	85	2,8	0,9	86	3,1	0,7	86	2,9	0,7	87	2,6	0,9
MA	73	3,5	0,6	73	3,2	0,7	72	2,4	0,7	70	2,5	0,7	69	2,4	0,8	70	2,3	0,7	70	2,6	0,8
PT	54	3,3	0,6	52	3,2	0,6	53	2,7	0,6	51	2,6	0,7	54	3,0	0,7	53	3,0	0,7	54	3,0	0,8
RO	238	3,7	0,5	240	3,7	2,0	237	2,9	0,7	236	2,9	0,7	235	2,9	0,7	236	3,4	3,5	236	3,1	0,7
UK(EN)	70	3,4	0,6	70	3,4	0,6	70	3,0	0,8	70	3,2	0,7	70	3,3	0,6	70	2,7	0,8	70	3,1	0,8
UK(NI)	10	3,3	0,7	10	2,9	0,7	10	2,8	0,6	10	2,8	0,6	10	2,9	0,6	10	2,6	0,5	10	3,0	0,5
UK(Sco)	8	3,8	0,5	8	3,5	0,5	8	2,9	0,4	8	3,1	0,6	8	3,4	0,5	8	2,5	0,8	8	3,1	0,6
UK(Wa)	4	3,8	0,5	4	3,5	0,6	4	3,5	0,6	4	3,5	0,6	4	3,5	0,6	4	3,0	0,8	4	3,5	0,6
Total	733	3,5	0,6	731	3,4	1,3	729	2,7	0,7	722	2,8	0,7	725	2,9	0,7	723	2,9	2,1	726	3,0	0,8

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Pedagogy

Q25. How often do you use the following learning/teaching contexts and approaches in your SCIENCE teaching?

	a.Open/unstructured play			b.Role/Pretend play			c.Drama			d.Teaching science from stories			e.Using history to teach science (e.g. transport, the work of scientists)			f.Working in small groups			g.Physical exploration of materials		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	34,0	3,3	0,7	34,0	2,6	0,9	34,0	2,3	0,8	34,0	3,3	0,7	33,0	2,0	0,9	34,0	3,6	0,5	35,0	3,8	0,4
BE(Wa)	3,0	3,0	1,0	3,0	2,3	1,5	3,0	2,7	1,2	3,0	2,7	1,5	3,0	2,3	1,5	3,0	3,3	0,6	3,0	3,0	1,0
FI	58,0	2,5	0,9	58,0	2,6	0,7	58,0	2,3	0,7	58,0	2,8	0,7	58,0	2,3	0,7	58,0	3,0	0,7	58,0	3,0	0,7
FR	45,0	2,3	0,9	44,0	1,6	0,7	43,0	1,3	0,5	45,0	2,3	0,8	45,0	2,0	0,9	46,0	3,4	0,6	46,0	3,2	0,6
GE	49,0	3,0	0,9	49,0	2,3	0,9	49,0	1,9	0,8	48,0	2,8	0,7	48,0	2,1	0,8	49,0	3,4	0,7	49,0	3,4	0,6
GR	85,0	3,1	0,8	86,0	3,1	0,8	86,0	3,0	0,8	86,0	3,1	0,8	86,0	2,7	0,9	86,0	3,4	0,6	85,0	3,3	0,7
MA	73,0	3,0	0,9	73,0	3,0	0,9	72,0	2,8	0,9	71,0	3,2	0,8	71,0	2,6	0,9	72,0	3,3	0,7	71,0	3,1	0,7
PT	54,0	2,6	0,8	54,0	2,8	0,8	54,0	2,4	0,8	53,0	2,8	0,7	53,0	2,9	0,7	55,0	3,1	0,6	54,0	3,1	0,7
RO	236,0	3,2	0,7	239,0	3,3	0,7	235,0	2,4	0,8	239,0	3,1	0,7	237,0	2,7	0,7	238,0	3,5	0,5	238,0	3,2	0,7
UK(EN)	69,0	2,9	1,0	68,0	2,9	1,0	69,0	2,5	0,8	69,0	2,8	0,8	69,0	2,5	0,8	69,0	3,7	0,5	69,0	3,6	0,6
UK(NI)	11,0	2,7	1,2	11,0	3,0	0,9	11,0	2,5	1,1	11,0	2,4	0,8	11,0	2,5	0,7	11,0	3,5	0,7	11,0	3,3	0,8
UK(Sco)	8,0	3,6	0,5	8,0	3,3	0,9	8,0	2,4	0,9	8,0	2,8	0,7	8,0	2,5	0,5	8,0	3,5	0,5	8,0	3,6	0,5
UK(Wa)	5,0	3,2	1,1	4,0	3,0	1,2	4,0	2,5	1,0	4,0	2,8	1,0	4,0	2,3	0,5	4,0	3,8	0,5	4,0	3,5	0,6
Total	730,0	3,0	0,9	731,0	2,9	0,9	726,0	2,4	0,9	729,0	2,9	0,8	726,0	2,5	0,8	733,0	3,4	0,6	731,0	3,3	0,7

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Q25 (cont). How often do you use the following learning/teaching contexts and approaches in your SCIENCE teaching?

	h.Using outdoor learning activities			i.Taking children on field trips and/or visits to science museums and industry			j.Integrating science with other curricular areas			k.Building on children's prior experiences			l.Fostering collaboration			m.Encouraging different ways of recording and expressing ideas – oral, visual, digital, practical			n.Encouraging problem finding – e.g. children asking questions			o.Encouraging problem solving – e.g. children solving practical tasks		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	35,0	3,1	0,7	35,0	3,0	0,7	35,0	3,3	0,7	35,0	3,3	0,6	35,0	3,4	0,7	35,0	2,9	1,0	35,0	3,3	0,7	35,0	3,4	0,6
BE(Wa)	3,0	3,3	0,6	3,0	3,0	1,0	3,0	3,7	0,6	3,0	3,3	1,2	3,0	3,3	0,6	3,0	3,3	0,6	3,0	3,0	1,0	3,0	3,3	0,6
FI	58,0	3,1	0,7	57,0	2,8	0,7	58,0	3,1	0,6	58,0	3,4	0,5	58,0	3,1	0,7	58,0	2,8	0,7	58,0	3,4	0,6	58,0	3,2	0,7
FR	46,0	2,8	0,8	42,0	2,1	0,8	43,0	2,4	0,7	46,0	3,1	0,6	43,0	3,3	0,7	45,0	2,8	0,8	46,0	3,3	0,6	46,0	3,3	0,5
GE	49,0	3,1	0,8	49,0	2,7	0,8	47,0	3,0	1,0	49,0	3,4	0,6	49,0	3,5	0,5	49,0	3,0	0,9	49,0	3,6	0,6	48,0	3,6	0,5
GR	85,0	2,8	0,8	85,0	2,6	0,9	85,0	3,0	0,8	86,0	3,5	0,6	86,0	3,6	0,6	83,0	3,4	0,8	85,0	3,5	0,6	84,0	3,4	0,7
MA	72,0	3,1	0,8	71,0	2,4	0,7	71,0	3,0	0,8	72,0	3,2	0,8	73,0	3,1	0,8	71,0	3,1	0,9	72,0	3,3	0,6	71,0	3,3	0,7
PT	55,0	2,7	0,8	54,0	2,7	0,8	55,0	3,3	0,6	55,0	3,3	0,7	0,0			0,0			0,0			0,0		
RO	239,0	3,2	2,7	235,0	2,7	0,8	239,0	3,5	2,1	238,0	3,7	0,5	239,0	3,8	2,0	234,0	3,2	1,5	239,0	3,5	0,6	234,0	3,7	2,1
UK(EN)	69,0	3,3	0,7	69,0	2,7	0,8	69,0	3,5	0,7	69,0	3,7	0,5	69,0	3,5	0,7	68,0	3,2	0,8	69,0	3,6	0,6	69,0	3,4	0,6
UK(NI)	11,0	3,1	0,8	11,0	2,3	0,9	11,0	3,4	0,7	11,0	3,7	0,6	11,0	3,4	0,5	11,0	3,4	1,0	11,0	3,7	0,5	11,0	3,6	0,5
UK(Sco)	8,0	3,4	0,5	8,0	2,9	0,6	8,0	3,5	0,5	8,0	3,6	0,5	8,0	3,6	0,5	8,0	3,4	0,7	8,0	3,6	0,5	8,0	3,6	0,5
UK(Wa)	4,0	3,5	0,6	4,0	2,8	1,0	4,0	3,5	0,6	4,0	4,0	0,0	4,0	4,0	0,0	4,0	3,8	0,5	4,0	3,8	0,5	4,0	3,8	0,5
Total	734,0	3,1	1,7	723,0	2,6	0,8	728,0	3,2	1,4	734,0	3,5	0,6	678,0	3,5	1,3	669,0	3,1	1,1	679,0	3,5	0,6	671,0	3,5	1,3

	p.Encouraging pupils to try out their own ideas in investigations			q.Fostering classroom discussion and evaluation of alternative ideas			r.Fostering imagination			s.Relating science to everyday life			t.Using questioning as a tool in science teaching			u.Using digital technologies with children for science teaching and learning			v.Fostering autonomous learning		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	35,0	3,2	0,7	35,0	2,7	0,9	35,0	3,2	0,6	35,0	3,1	0,7	35,0	3,4	0,6	34,0	2,7	1,0	35,0	3,3	0,7
BE(Wa)	3,0	3,7	0,6	3,0	3,7	0,6	3,0	3,3	1,2	3,0	4,0	0,0	3,0	3,3	0,6	3,0	2,3	0,6	3,0	3,7	0,6
FI	58,0	3,0	0,7	58,0	3,3	0,6	58,0	3,3	0,6	58,0	3,5	0,5	58,0	2,9	0,8	57,0	2,3	0,7	57,0	2,8	0,6
FR	46,0	3,2	0,7	46,0	3,3	0,6	40,0	3,0	0,8	44,0	2,9	0,7	43,0	3,2	0,7	43,0	2,4	0,9	45,0	2,5	0,8
GE	49,0	3,4	0,6	48,0	2,9	0,8	49,0	3,3	0,6	49,0	3,5	0,6	48,0	3,0	0,9	49,0	2,3	0,9	49,0	3,6	0,7
GR	83,0	3,2	0,7	84,0	3,3	0,7	84,0	3,5	0,6	84,0	3,4	0,7	84,0	3,3	0,8	84,0	2,9	0,9	85,0	3,0	0,7
MA	71,0	3,0	0,7	70,0	3,2	0,7	72,0	3,3	0,6	72,0	3,5	0,5	71,0	3,3	0,7	69,0	3,2	0,8	70,0	2,9	0,8
PT	0,0			0,0			0,0			0,0			0,0			0,0			0,0		
RO	234,0	3,3	2,1	236,0	3,4	0,6	240,0	3,9	2,8	238,0	3,5	0,6	237,0	3,4	0,6	240,0	2,9	0,7	235,0	3,0	0,7
UK(EN)	69,0	3,3	0,7	69,0	3,4	0,6	69,0	3,4	0,6	69,0	3,7	0,4	69,0	3,6	0,6	69,0	3,0	0,8	69,0	3,1	0,7
UK(NI)	10,0	3,4	0,7	11,0	3,6	0,7	11,0	3,7	0,5	11,0	3,4	0,7	11,0	3,4	0,7	11,0	2,9	0,8	11,0	3,0	0,6
UK(Sco)	8,0	3,6	0,5	8,0	3,5	0,8	8,0	3,6	0,5	8,0	3,6	0,5	8,0	3,6	0,5	8,0	3,1	0,6	8,0	3,3	0,7
UK(Wa)	4,0	4,0	0,0	4,0	3,8	0,5	4,0	3,8	0,5	4,0	4,0	0,0	4,0	4,0	0,0	4,0	3,3	1,0	4,0	3,8	0,5
Total	670,0	3,2	1,4	672,0	3,3	0,7	673,0	3,5	1,8	675,0	3,5	0,6	671,0	3,3	0,7	671,0	2,8	0,8	671,0	3,0	0,7

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Q32. How strongly do you agree or disagree with each of the following statements about the role of teacher in fostering INQUIRY skills?

	a. Teachers should demonstrate first the correct way to solve a problem.			b. Teachers should give children ample time to work out their own solutions to problems before showing them how they are solved.			c. Teachers should facilitate children's own inquiry.			d. Teachers should allow children to find solutions to problems on their own.		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	33	1,4	0,7	33	3,8	0,4	33	3,6	0,6	33	3,8	0,4
BE(Wa)	2	1,5	0,7	2	3,0	1,4	2	4,0	0,0	2	3,5	0,7
FI	53	2,2	0,8	53	3,2	0,8	53	3,5	0,5	53	3,1	0,7
FR	40	1,7	0,9	42	3,5	0,7	42	3,6	0,5	42	3,5	0,6
GE	48	1,3	0,4	49	3,6	0,8	49	3,8	0,7	49	3,7	0,7
GR	84	1,5	0,8	85	3,5	0,7	85	3,4	0,8	85	2,8	0,8
MA	65	2,5	1,1	65	3,5	0,8	66	3,2	0,9	64	3,3	0,8
PT	51	1,8	1,0	53	3,1	0,8	53	3,3	0,8	52	3,2	0,8
RO	230	2,6	1,1	232	3,6	0,7	232	3,7	0,5	234	3,6	0,6
UK(EN)	69	1,7	0,7	69	3,5	0,7	69	3,6	0,8	69	3,3	0,8
UK(NI)	10	2,0	1,2	10	3,3	0,8	10	3,5	0,7	10	3,3	0,8
UK(Sco)	7	1,3	0,8	7	3,6	0,8	7	3,7	0,5	7	3,4	0,5
UK(Wa)	3	2,0	1,0	3	2,7	0,6	3	3,3	0,6	3	3,0	1,0
Total	695	2,0	1,1	703	3,5	0,7	704	3,6	0,7	703	3,4	0,7

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Assessment

Q33. Focusing on the AGE GROUP YOU TEACH, please indicate your views about the importance of the following priorities of children's ASSESSMENT in SCIENCE education.
To assess the development of children's

	a.Knowledge and understanding of important scientific ideas (facts, concepts, laws and theories)			b.Knowledge and understanding of important scientific processes			c.Competencies necessary to carry out scientific inquiry			d.Understandings about scientific inquiry (e.g. how science and scientists work)			e.Positive attitudes and increase of interest in science			f.Positive attitudes and increase of interest in learning science		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	30	2,2	0,9	30	2,6	0,8	30	3,0	0,7	29	2,0	0,7	31	3,2	0,7	30	3,2	0,8
BE(Wa)	3	2,7	1,5	3	2,3	1,5	3	2,3	1,5	3	2,7	1,5	3	3,0	1,7	3	3,0	1,7
FI	52	3,1	0,7	52	2,8	0,6	52	2,4	0,6	52	2,1	0,6	52	3,7	0,5	52	3,3	0,6
FR	35	2,4	0,9	36	2,6	0,9	35	2,8	0,8	33	2,3	0,8	37	3,3	0,7	35	3,2	0,7
GE	49	2,6	0,8	49	3,0	0,8	49	3,1	0,8	49	2,4	0,9	48	3,6	0,5	48	3,6	0,6
GR	82	2,5	1,0	83	2,6	0,9	81	2,6	0,9	82	2,6	0,9	84	3,4	0,7	84	3,4	0,7
MA	64	2,6	0,9	63	2,8	0,8	62	2,5	0,8	60	2,3	0,8	65	3,1	0,9	65	3,3	0,8
PT	52	2,9	0,9	53	3,0	0,8	51	2,9	0,8	51	2,7	0,8	52	3,6	0,5	51	3,5	0,5
RO	230	3,3	0,9	232	3,4	0,7	232	3,3	0,8	230	3,1	2,1	231	3,9	2,0	230	3,8	0,4
UK(EN)	66	2,8	1,0	67	3,1	0,9	66	3,1	0,9	67	2,9	0,9	67	3,7	0,6	66	3,7	0,6
UK(NI)	10	2,4	1,1	10	2,8	0,9	9	3,1	0,8	10	2,9	0,6	10	3,7	0,5	10	3,7	0,5
UK(Sco)	7	2,4	1,1	7	2,7	1,1	7	2,9	1,2	7	2,7	0,8	7	3,7	0,5	7	3,7	0,5
UK(Wa)	3	2,7	1,2	3	3,7	0,6	3	3,7	0,6	3	3,3	0,6	3	3,7	0,6	3	3,7	0,6
Total	683	2,8	1,0	688	3,0	0,8	680	3,0	0,9	676	2,7	1,5	690	3,6	1,3	684	3,5	0,6

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Q34. How often do you assess your pupils in SCIENCE in the following ways?

	a.Using checklists to record observations of children			b.During classroom interaction			c.Evaluating children's pictures, graphs etc which show their scientific reasoning			d.Evaluating children's relevant gestures or physical activity			e.Marking their homework			f.Using authentic problem-based tasks		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	29	2,1	1,0	30	3,0	0,9	29	2,3	1,0	30	2,6	1,0	29	1,1	0,4	29	1,7	0,9
BE(Wa)	3	2,0	1,0	3	3,0	1,0	3	2,3	0,6	3	2,3	1,2	3	1,0	0,0	3	2,0	1,0
FI	52	2,3	0,8	52	3,4	0,6	52	2,2	0,7	52	3,0	0,7	51	2,4	0,9	52	2,6	0,7
FR	36	1,9	0,8	39	2,9	0,6	39	2,9	0,6	38	2,6	0,6	36	2,1	1,2	38	2,8	0,7
GE	49	2,3	1,0	49	2,6	0,9	49	2,3	1,0	49	2,3	1,0	49	1,6	0,8	48	2,5	1,0
GR	80	2,0	0,9	82	3,3	0,7	83	3,4	0,7	81	3,0	0,8	82	1,9	0,9	81	2,8	0,9
MA	63	1,8	0,8	64	3,2	0,8	64	2,6	1,0	63	3,0	0,8	61	2,2	1,2	59	2,2	0,9
PT	51	2,3	0,8	51	3,3	0,5	49	2,7	0,9	51	2,8	0,8	50	2,2	0,9	49	3,0	0,7
RO	228	2,8	0,7	232	3,4	0,6	232	3,2	0,7	226	2,8	0,9	223	2,5	1,0	228	3,0	0,8
UK(EN)	67	2,3	1,0	68	3,5	0,6	68	3,0	0,9	66	2,9	0,9	66	1,6	0,8	68	2,6	1,0
UK(NI)	10	1,8	0,8	10	3,0	0,7	10	2,5	1,0	10	2,1	0,9	10	2,6	1,3	9	2,2	0,7
UK(Sco)	7	2,0	0,6	7	3,9	0,4	7	2,9	1,1	7	3,3	0,8	7	1,3	0,5	7	2,7	1,0
UK(Wa)	3	1,7	0,6	3	3,7	0,6	3	3,3	0,6	3	3,7	0,6	3	1,7	0,6	3	3,0	1,0
Total	678	2,3	0,9	690	3,3	0,7	688	2,9	0,9	679	2,8	0,9	670	2,1	1,0	674	2,7	0,9

	g.Asking each child to reflect on their own learning and progress			h.Using closed question tests			i.Using open question tests			j.Using questions in context			k.Using portfolios (collection of evidence of children's work and progress)			l.Children correcting each other's work and giving each other feedback		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	29	2,1	1,0	29	1,3	0,6	30	1,7	1,0	27	1,3	0,7	29	1,6	1,0	29	1,8	1,0
BE(Wa)	3	2,7	1,5	3	1,7	0,6	3	2,7	1,5	3	3,3	0,6	3	3,7	0,6	3	3,7	0,6
FI	52	2,4	0,7	52	1,7	0,6	52	2,2	0,8	50	2,1	0,6	52	2,1	0,7	52	1,8	0,7
FR	37	2,4	0,8	36	2,1	0,9	36	2,4	0,9	37	2,7	0,7	36	2,1	0,8	37	2,4	0,8
GE	49	2,7	0,8	49	1,6	0,9	49	1,7	0,9	49	2,3	0,9	49	3,0	0,8	49	2,2	1,0
GR	81	2,5	1,0	82	1,8	0,9	82	2,3	1,0	79	2,2	0,8	82	2,9	0,9	82	2,5	0,9
MA	58	2,5	1,0	59	1,9	1,0	61	2,1	1,1	62	2,7	1,0	64	2,4	1,1	59	1,6	0,8
PT	50	2,8	0,8	49	2,0	0,9	49	2,1	1,0	48	3,0	0,7	50	2,5	0,9	49	2,4	0,9
RO	225	2,6	0,8	224	2,2	0,9	226	2,9	0,8	228	3,0	0,7	229	3,4	0,7	228	3,1	0,8
UK(EN)	68	3,1	0,9	66	1,8	0,9	67	2,3	1,2	67	3,2	0,7	67	2,6	1,1	67	2,3	0,9
UK(NI)	10	2,9	1,0	10	2,0	0,8	10	2,4	1,2	10	3,4	0,5	10	2,7	1,1	10	2,2	1,0
UK(Sco)	7	3,4	0,5	7	1,9	0,7	7	2,9	1,3	7	3,4	0,5	7	2,9	0,9	7	2,6	1,1
UK(Wa)	3	2,7	0,6	3	1,7	1,2	3	1,7	1,2	3	3,3	0,6	3	3,7	0,6	3	2,3	1,2
Total	672	2,6	0,9	669	1,9	0,9	675	2,4	1,0	670	2,7	0,9	681	2,8	1,0	675	2,5	1,0

The project CREATIVE LITTLE SCIENTISTS has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 289081.

Q35. How often do you reward/praise the following characteristics in your pupils in SCIENCE?

	a.Sense of initiative			b.Motivation			c.Ability to come up with something new			d.Ability to connect what they have learnt during your lessons with topics in other subjects		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	29	3,3	0,8	29	3,5	0,6	29	3,2	0,8	30	3,3	0,7
BE(Wa)	3	3,3	0,6	3	4,0	0,0	3	3,7	0,6	3	3,7	0,6
FI	52	3,3	0,5	52	3,5	0,5	52	3,5	0,5	52	3,3	0,6
FR	36	3,1	0,7	35	3,1	0,9	34	2,9	0,8	36	3,0	0,9
GE	48	3,3	0,7	49	3,4	0,6	49	3,4	0,6	48	3,0	0,8
GR	82	3,6	0,5	80	3,4	0,6	83	3,6	0,6	83	3,5	0,7
MA	68	3,4	0,6	67	3,6	0,5	67	3,7	0,5	68	3,5	0,7
PT	53	3,4	0,5	53	3,5	0,5	53	3,4	0,5	52	3,3	0,6
RO	232	3,7	0,5	231	3,5	0,6	231	3,7	0,5	232	3,6	0,6
UK(EN)	68	3,3	0,7	68	3,4	0,7	68	3,4	0,7	68	3,4	0,7
UK(NI)	10	3,2	0,6	10	3,2	0,6	10	3,4	0,5	10	3,2	0,6
UK(Sco)	7	3,7	0,5	7	3,6	0,5	7	3,7	0,5	7	3,6	0,5
UK(Wa)	3	3,7	0,6	3	4,0	0,0	3	3,7	0,6	3	3,7	0,6
Total	691	3,5	0,6	687	3,5	0,6	689	3,5	0,6	692	3,4	0,7

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Q35 (cont). How often do you reward/praise the following characteristics in your pupils in SCIENCE?

	e.Imagination			f.Curiosity			g.Ability to work together			h.Thinking skills		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	29	3,3	0,8	30	3,5	0,7	30	3,5	0,5	29	2,9	0,6
BE(Wa)	3	3,7	0,6	3	3,7	0,6	3	4,0	0,0	3	3,3	0,6
FI	52	3,3	0,7	52	3,5	0,5	52	3,5	0,5	50	3,5	0,6
FR	36	2,8	0,7	36	3,1	0,7	36	3,2	0,7	36	3,3	0,8
GE	48	3,5	0,6	49	3,5	0,6	49	3,6	0,6	48	3,4	0,6
GR	83	3,7	0,5	83	3,5	0,6	83	3,7	0,4	80	3,6	0,5
MA	68	3,6	0,6	67	3,6	0,6	68	3,6	0,6	68	3,6	0,5
PT	53	3,4	0,6	53	3,5	0,5	53	3,4	0,6	53	3,3	0,6
RO	232	3,7	0,5	231	3,7	0,5	232	3,7	0,5	230	3,7	0,5
UK(EN)	68	3,3	0,8	67	3,4	0,8	68	3,5	0,7	68	3,5	0,6
UK(NI)	10	3,6	0,5	10	3,4	0,5	9	3,6	0,5	10	3,7	0,5
UK(Sco)	7	3,6	0,8	7	3,7	0,5	7	3,7	0,5	7	3,7	0,5
UK(Wa)	3	3,7	0,6	3	3,7	0,6	3	4,0	0,0	3	4,0	0,0
Total	692	3,5	0,6	691	3,5	0,6	693	3,6	0,6	685	3,6	0,6

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Q36. How often do you use ASSESSMENTS of children in SCIENCE for the following purposes?

	a.To identify areas for improvement in your science teaching			b.To identify aspects of the science curriculum that could be improved			c.To identify ways to improve child science learning			d.To monitor regularly individual children's or cohorts of children's progress towards a set of desirable science learning outcomes			e.To inform parents of their child's progress in science		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	28	1,6	0,7	29	2,0	0,8	29	2,1	0,9	29	2,4	0,8	29	2,1	0,7
BE(Wa)	3	1,7	0,6	3	2,0	1,0	3	2,7	0,6	3	2,7	0,6	3	2,0	1,0
FI	52	3,1	0,8	52	2,3	0,8	51	3,2	0,7	52	3,0	0,7	52	2,7	0,8
FR	38	2,4	0,9	37	2,4	0,9	37	2,8	0,8	39	3,1	0,6	38	2,9	0,7
GE	49	1,8	0,9	48	1,8	0,8	49	2,7	1,0	49	2,4	1,0	49	2,1	0,8
GR	80	3,1	0,7	80	2,5	0,8	81	2,9	0,7	80	3,0	0,8	81	2,5	0,9
MA	62	2,3	0,8	62	2,4	0,8	62	2,6	0,8	61	2,5	0,8	61	2,1	0,8
PT	51	2,8	0,7	50	2,5	0,7	52	3,0	0,6	52	3,0	0,6	52	2,6	0,7
RO	231	3,0	0,7	229	2,7	0,8	229	3,1	0,6	229	3,2	0,6	232	3,3	0,6
UK(EN)	69	3,1	0,7	69	2,9	0,8	69	3,1	0,8	69	2,9	0,9	69	2,8	0,8
UK(NI)	10	2,5	0,8	10	2,5	0,7	10	2,8	0,8	10	2,3	0,8	10	2,1	0,7
UK(Sco)	7	2,9	0,9	7	2,3	0,8	7	2,6	0,8	7	2,9	0,9	7	2,9	1,1
UK(Wa)	3	3,3	0,6	3	3,3	0,6	3	3,3	0,6	3	3,7	0,6	3	3,3	0,6
Total	683	2,7	0,9	679	2,5	0,8	682	2,9	0,8	683	2,9	0,8	686	2,8	0,9

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Q36(cont.). How often do you use ASSESSMENTS of children in SCIENCE for the following purposes?

	f. To help group children for science instruction purposes			g. To monitor year-to-year child progress in science			h. To provide feedback to children about their progress in science			i. To set targets with children for their own development in science		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	26	1,7	0,7	27	2,2	1,0	27	2,0	0,9	27	2,1	1,0
BE(Wa)	3	3,0	0,0	3	2,0	1,0	3	3,0	0,0	3	2,7	0,6
FI	51	2,0	0,8	51	2,8	0,8	52	3,4	0,6	51	2,8	0,8
FR	37	2,8	0,8	38	2,8	0,9	37	2,8	0,8	38	2,4	0,8
GE	49	1,6	0,8	48	1,9	0,7	49	2,6	0,9	49	2,2	1,0
GR	80	2,4	1,0	79	2,4	0,9	80	2,3	1,0	81	2,4	0,9
MA	61	2,2	0,8	61	2,1	0,9	61	2,3	0,9	59	2,3	0,9
PT	50	2,6	0,7	49	2,5	0,8	51	2,8	0,7	50	2,5	0,7
RO	228	3,0	0,7	230	3,1	0,7	229	3,1	0,7	230	2,9	0,8
UK(EN)	69	2,1	1,0	69	2,8	1,0	69	2,8	0,9	69	2,4	1,0
UK(NI)	10	2,1	0,9	10	1,9	1,0	10	2,2	0,9	10	1,7	0,8
UK(Sco)	7	1,3	0,8	7	2,4	1,0	7	2,9	1,1	7	2,6	1,0
UK(Wa)	3	2,3	0,6	3	3,7	0,6	3	2,7	0,6	3	2,7	0,6
Total	674	2,5	0,9	675	2,6	0,9	678	2,8	0,9	677	2,6	0,9

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Materials and Resources

Q38. How well resourced do you feel your school is for the teaching of SCIENCE in terms of the following?

	a.Instructional materials (e.g. textbooks)			b.Audio-visual resources			c.Relevant library materials (e.g. story books)			d.Equipment and materials for hands-on exploration in the classroom (e.g. magnets, building blocks)			e.Equipment and materials for hands-on exploration outside the classroom (e.g. sand box)		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	30	2,8	0,8	31	2,9	0,9	31	2,9	0,9	31	3,0	0,9	30	3,1	0,8
BE(Wa)	3	3,0	1,0	3	2,7	1,2	3	2,3	1,2	3	3,0	1,0	3	3,3	0,6
FI	51	2,9	1,0	51	3,2	0,9	51	3,3	0,6	51	2,9	0,7	51	2,5	0,8
FR	39	2,0	1,1	40	2,0	0,9	39	2,5	0,8	39	2,2	0,8	40	1,8	0,9
GE	47	2,7	0,8	48	2,0	0,8	46	2,8	0,7	47	3,0	0,8	48	2,6	1,1
GR	86	2,8	1,1	85	2,6	1,0	86	2,7	1,0	85	2,8	1,0	86	2,0	1,1
MA	66	2,4	1,2	68	2,6	1,0	69	2,6	0,9	68	2,8	0,9	67	2,5	1,1
PT	52	2,5	0,9	52	2,5	0,9	50	2,8	0,8	52	2,5	0,8	50	2,3	0,9
RO	231	2,8	0,8	232	2,6	0,9	233	3,0	0,8	231	2,4	0,9	234	2,3	1,0
UK(EN)	66	2,2	0,9	66	2,6	1,0	66	2,4	0,8	66	3,2	0,8	66	3,0	0,9
UK(NI)	10	1,7	1,1	10	1,9	1,1	10	2,7	0,7	10	2,6	1,3	10	2,9	1,1
UK(Sco)	6	2,0	1,1	7	2,1	0,9	7	2,7	1,0	7	3,0	0,8	7	3,1	0,7
UK(Wa)	3	2,0	0,0	3	2,0	0,0	3	1,7	0,6	3	2,7	0,6	3	3,0	0,0
Total	690	2,6	1,0	696	2,6	1,0	694	2,8	0,9	693	2,7	0,9	695	2,4	1,0

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Q38(cont.). How well resourced do you feel your school is for the teaching of SCIENCE in terms of the following?

	f.Computers			g.ICT resources (e.g. computer applications)			h.Other digital technologies (e.g. interactive whiteboard, camera)			i.Budget for supplies (e.g. paper, drawing materials)			j.Teaching support personnel (e.g. classroom assistant)			k.Other support personnel (e.g. technical support)		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	31	3,2	0,8	31	3,0	0,9	31	2,7	1,1	31	3,2	0,9	30	1,9	0,9	30	2,1	1,0
BE(Wa)	3	3,7	0,6	3	2,7	0,6	3	1,7	0,6	3	3,0	1,7	3	2,3	1,2	3	1,7	0,6
FI	51	2,8	0,9	51	2,0	0,9	51	2,3	1,0	51	2,8	0,8	51	2,5	0,9	51	1,6	0,7
FR	40	2,8	1,0	37	2,3	1,1	40	2,2	1,0	40	2,9	1,0	39	1,2	0,6	40	1,1	0,5
GE	48	2,5	1,0	48	2,0	1,0	48	2,1	0,9	48	2,4	0,9	48	2,0	1,1	47	1,3	0,7
GR	85	2,8	1,0	84	2,5	1,2	85	2,1	1,3	86	3,0	1,0	85	1,6	1,1	85	1,8	1,2
MA	70	3,5	0,7	70	3,2	0,9	68	3,6	0,6	68	2,7	1,0	67	2,2	1,1	65	2,3	1,0
PT	51	2,7	0,9	52	2,2	0,9	52	2,5	0,9	52	2,3	1,0	52	2,0	1,1	50	1,6	0,8
RO	232	2,8	0,9	228	2,4	1,0	229	2,3	1,0	230	1,9	1,0	231	1,4	0,9	231	1,3	0,7
UK(EN)	66	3,4	0,7	66	3,0	0,8	66	3,3	0,8	66	3,1	0,9	65	3,1	0,9	66	2,2	1,1
UK(NI)	10	3,0	1,1	10	2,8	1,2	10	3,1	0,9	10	2,8	1,3	10	2,0	0,8	10	1,2	0,4
UK(Sco)	7	3,3	0,8	7	2,7	0,8	7	3,6	0,5	7	2,7	0,8	7	2,4	0,8	7	1,1	0,4
UK(Wa)	3	3,0	1,0	3	2,3	0,6	3	3,0	1,0	3	2,3	1,2	3	2,3	1,5	3	1,0	0,0
Total	697	2,9	0,9	690	2,5	1,0	693	2,6	1,1	695	2,5	1,1	691	1,9	1,1	688	1,6	0,9

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Q39. How well resourced do you feel your school is for the teaching of MATHEMATICS in terms of the following?

	a.Instructional materials (e.g. textbooks)			b.Audio-visual resources			c.Relevant library materials (e.g. story books)			d.Equipment and materials for hands-on exploration in the classroom (e.g. sorting activity games, rulers)			e.Equipment and materials for hands-on exploration outside the classroom (e.g. sand box)		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	30	3,0	0,9	29	2,7	0,9	29	2,8	1,0	30	3,2	0,7	29	3,2	0,8
BE(Wa)	3	3,0	1,0	3	2,3	0,6	3	2,3	1,2	3	3,0	1,7	3	3,3	0,6
FI	51	3,4	0,9	51	3,2	0,9	51	2,9	0,9	51	3,3	0,7	51	2,7	0,8
FR	40	2,6	1,1	40	1,8	1,1	40	1,9	0,9	40	2,6	0,9	40	1,8	1,0
GE	47	2,8	0,9	47	2,1	1,0	47	2,4	0,9	48	3,0	0,8	48	2,5	1,0
GR	86	3,1	1,0	85	2,5	1,1	85	2,7	1,0	86	2,9	1,0	86	1,9	1,1
MA	61	3,5	0,8	64	3,1	0,8	67	2,9	1,0	66	3,0	0,8	65	2,6	1,1
PT	50	2,7	1,0	50	2,6	0,8	50	2,7	0,9	48	2,9	0,8	49	2,3	1,0
RO	232	2,8	0,9	232	2,6	0,9	230	2,9	0,9	231	2,4	0,9	230	2,2	1,0
UK(EN)	66	2,7	1,0	66	2,7	0,9	65	2,4	0,9	66	3,3	0,8	66	3,1	0,9
UK(NI)	10	2,9	1,2	10	2,7	1,2	10	3,0	1,1	10	3,5	0,7	10	3,4	1,0
UK(Sco)	7	3,1	1,1	7	2,7	1,0	7	2,3	1,0	7	2,9	0,7	7	2,9	0,7
UK(Wa)	3	3,0	0,0	3	2,0	0,0	3	1,7	0,6	3	3,3	0,6	3	2,7	1,2
Total	686	2,9	1,0	687	2,6	1,0	687	2,7	0,9	689	2,8	0,9	687	2,4	1,1

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Q39(cont.). How well resourced do you feel your school is for the teaching of MATHEMATICS in terms of the following?

	f.Computers			g.ICT resources (e.g. computer applications)			h.Other digital technologies (e.g. interactive whiteboard, camera)			i.Budget for supplies (e.g. paper, drawing materials)			j.Teaching support personnel (e.g. classroom assistant)			k.Other support personnel (e.g. technical support)		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	29	3,2	0,8	29	3,0	1,0	29	2,8	1,1	28	3,3	0,8	29	2,0	1,1	29	2,0	1,1
BE(Wa)	3	3,7	0,6	3	3,0	0,0	3	2,0	1,0	3	3,0	1,7	3	2,7	1,5	3	2,0	1,0
FI	51	2,6	0,9	51	2,3	0,9	51	2,3	0,9	51	2,8	0,9	51	2,5	0,9	51	1,6	0,8
FR	39	2,7	1,1	38	2,4	1,2	40	2,1	1,0	40	2,9	1,0	39	1,2	0,7	38	1,1	0,5
GE	48	2,5	1,0	47	2,3	1,0	48	2,0	1,0	48	2,5	0,9	48	2,0	1,1	48	1,4	0,7
GR	86	2,8	1,0	85	2,4	1,1	85	2,1	1,3	84	3,0	1,0	85	1,6	1,1	86	1,7	1,2
MA	70	3,6	0,6	67	3,5	0,7	70	3,6	0,7	69	2,9	0,9	65	2,3	1,1	61	2,2	1,1
PT	50	2,6	0,9	50	2,3	0,9	48	2,4	1,0	50	2,3	1,0	50	2,0	1,1	49	1,6	0,9
RO	230	2,8	0,9	232	2,4	1,0	228	2,1	1,1	229	1,8	1,0	228	1,4	0,9	228	1,3	0,7
UK(EN)	66	3,5	0,7	65	3,4	0,8	65	3,4	0,8	66	3,2	0,8	65	3,2	0,8	65	2,5	1,1
UK(NI)	10	2,9	1,0	10	2,8	1,0	9	3,3	0,7	10	3,0	1,1	10	2,2	1,1	10	1,8	1,1
UK(Sco)	7	3,1	0,9	6	3,0	0,6	7	3,6	0,5	7	3,0	0,8	7	2,7	0,8	7	1,4	0,8
UK(Wa)	2	3,0	1,4	3	2,0	1,0	3	3,0	1,0	3	2,3	1,2	3	2,3	1,5	3	1,0	0,0
Total	691	2,9	1,0	686	2,6	1,0	686	2,5	1,2	688	2,5	1,1	683	1,9	1,1	678	1,6	1,0

The project CREATIVE LITTLE SCIENTISTS has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 289081.

Q40. How often do you use the following resources in your SCIENCE and MATHEMATICS teaching?

	a.Student Textbooks			b.Teaching materials prepared by you			c.Teaching materials prepared by group of teachers in your school			d.Resources downloaded from the Internet			e.Audio-visual resources			f.Relevant library materials (e.g. story books)		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	23	2,1	0,9	29	3,9	0,3	24	2,0	0,9	29	3,3	0,6	28	2,8	0,8	29	3,5	0,6
BE(Wa)	3	2,3	1,5	3	4,0	0,0	3	3,0	1,7	3	3,3	1,2	3	3,0	1,0	3	2,7	1,2
FI	51	3,3	1,2	51	2,9	0,7	50	2,5	0,8	51	2,6	0,9	51	2,7	0,8	47	3,0	0,8
FR	40	2,5	1,2	40	3,7	0,5	39	1,9	0,9	39	2,8	0,9	40	2,3	1,0	40	2,2	0,8
GE	49	2,9	1,0	49	3,3	0,8	47	2,7	1,0	48	3,0	0,7	48	2,3	0,8	46	3,0	0,9
GR	82	3,2	0,9	86	3,7	0,6	85	2,6	1,0	84	3,6	0,6	85	2,9	0,9	82	3,2	0,9
MA	59	3,4	1,1	66	3,8	0,5	60	2,9	0,9	67	3,7	0,5	67	3,6	0,7	68	3,1	0,9
PT	49	3,0	1,2	51	3,4	0,6	47	2,2	1,0	50	3,4	0,6	51	2,9	0,7	50	2,9	0,7
RO	211	3,1	1,0	229	3,7	0,5	224	2,6	1,0	229	3,6	0,6	228	3,1	0,8	231	3,2	0,8
UK(EN)	63	1,7	0,8	67	3,6	0,7	66	2,4	1,1	67	3,2	0,7	66	3,1	0,8	66	2,7	0,8
UK(NI)	10	2,3	1,2	10	3,4	0,8	9	2,2	1,0	10	3,1	1,0	10	2,8	1,0	10	3,4	1,0
UK(Sco)	7	2,0	1,2	7	3,6	0,8	6	2,0	0,9	7	3,4	0,8	7	2,7	0,5	7	3,0	0,8
UK(Wa)	3	1,7	1,2	3	3,7	0,6	3	2,0	0,0	3	3,0	0,0	3	2,3	0,6	3	1,7	0,6
Total	650	2,9	1,1	691	3,6	0,6	663	2,5	1,0	687	3,4	0,7	687	3,0	0,9	682	3,0	0,9

The project CREATIVE LITTLE SCIENTISTS has received funding from the European Union
Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 289081.

Q40(cont.). How often do you use the following resources in your SCIENCE and MATHEMATICS teaching?

	g.Equipment and materials for hands-on exploration in the classroom (e.g. magnets, magnifying glass, sorting activity games, rulers)			h.Computers			i.Digital technologies (e.g. interactive whiteboard)			j.ICT resources (e.g. website, digital game)			k.Relevant media materials (e.g. newspapers, magazines)		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	29	3,5	0,7	27	3,0	0,9	26	1,9	0,9	27	3,0	0,8	26	2,3	0,9
BE(Wa)	3	2,7	1,5	2	3,5	0,7	3	2,0	1,7	3	3,0	1,7	3	3,0	1,7
FI	51	2,8	0,7	51	2,3	0,7	50	1,7	1,0	51	2,2	0,9	49	2,3	0,7
FR	40	3,1	0,7	39	2,4	0,9	38	1,6	1,0	38	2,1	1,1	40	2,0	0,7
GE	43	3,4	0,7	49	2,4	1,1	48	1,9	1,1	49	2,0	1,0	48	2,1	0,8
GR	81	3,3	0,8	85	3,0	1,0	82	2,0	1,3	82	2,4	1,1	81	2,9	1,0
MA	70	3,6	0,6	68	3,6	0,6	65	3,7	0,8	67	3,6	0,7	65	2,8	0,9
PT	51	3,3	0,6	51	2,7	0,9	50	2,1	1,0	50	2,4	1,0	49	2,7	0,8
RO	229	2,9	0,8	227	2,9	0,9	220	1,9	1,1	228	2,6	1,0	222	2,9	0,9
UK(EN)	64	3,8	0,6	63	3,3	0,8	63	3,4	1,0	61	3,4	0,8	63	2,3	0,7
UK(NI)	10	3,2	0,9	9	3,2	1,1	8	3,4	0,9	9	3,3	1,1	10	2,2	1,0
UK(Sco)	7	3,7	0,5	7	3,4	0,5	7	3,6	0,8	7	3,6	0,5	7	2,3	0,8
UK(Wa)	3	3,7	0,6	3	2,7	0,6	3	3,7	0,6	3	3,0	1,0	3	2,0	0,0
Total	681	3,2	0,8	681	2,9	1,0	663	2,2	1,2	675	2,7	1,1	666	2,6	0,9

The project CREATIVE LITTLE SCIENTISTS has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 289081.

Q41. How often do you consult the following resources to inform your SCIENCE and MATHEMATICS teaching preparation?

	a.Student textbook			b.Teacher textbook guide			c.Online textbook resources (incl. publishers' websites)			d.School curriculum			e.National curriculum		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	20	1,9	1,0	23	2,7	1,1	24	2,7	1,2	27	3,1	0,9	29	3,6	0,6
BE(Wa)	3	2,3	1,5	3	2,7	1,5	3	3,0	1,7	3	3,3	1,2	3	3,0	1,0
FI	51	3,3	0,9	51	3,6	0,8	51	3,0	0,8	51	3,1	0,8	51	2,7	0,9
FR	38	2,8	1,2	39	2,8	1,0	40	2,7	1,0	40	3,6	0,6	40	3,5	0,7
GE	48	3,2	0,8	48	2,9	1,0	49	2,3	0,9	45	2,5	1,0	46	2,3	1,1
GR	82	3,2	1,0	85	3,4	0,7	84	3,2	0,9	79	3,2	0,9	82	2,9	1,0
MA	61	3,2	1,0	66	3,2	1,0	63	3,0	1,0	64	3,4	0,7	64	3,3	0,8
PT	49	3,2	1,0	49	3,0	0,9	51	2,7	0,9	48	3,1	0,7	49	3,0	0,7
RO	221	3,3	0,9	231	3,4	0,7	0			0			0		
UK(EN)	60	1,9	0,9	64	2,3	0,9	63	2,5	1,0	64	3,4	0,8	65	3,3	0,8
UK(NI)	10	2,6	1,3	10	2,7	1,3	10	2,2	1,1	10	3,6	1,0	10	3,8	0,4
UK(Sco)	6	2,3	1,2	7	2,3	1,0	7	2,4	1,1	7	3,7	0,5	7	3,7	0,5
UK(Wa)	3	2,0	1,0	3	2,3	1,2	3	2,0	1,0	3	3,3	1,2	3	3,3	0,6
Total	652	3,0	1,0	679	3,2	0,9	448	2,8	1,0	441	3,2	0,9	449	3,1	0,9

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Q41(cont.). How often do you consult the following resources to inform your SCIENCE and MATHEMATICS teaching preparation?

	f.National teacher curriculum guide			g.National education agency website			h.Teacher professional association documentation or website			i.School assessment guidelines			j.National assessment guidelines		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	24	1,4	0,9	27	1,8	1,1	28	3,1	0,9	23	2,3	0,9	24	2,0	1,0
BE(Wa)	3	2,3	1,5	3	2,3	1,5	3	3,7	0,6	3	3,0	1,0	3	3,0	1,7
FI	48	2,3	1,0	51	1,7	0,7	51	1,6	0,7	50	2,4	1,0	48	2,1	0,8
FR	34	2,6	1,2	40	2,5	1,0	40	2,8	1,0	39	2,6	1,0	39	2,8	0,8
GE	46	2,1	1,0	47	1,7	0,8	48	2,1	0,9	43	2,1	1,0	45	1,6	0,8
GR	83	3,2	0,9	82	2,3	1,1	80	2,2	1,1	78	2,5	1,1	78	2,2	0,9
MA	63	2,9	0,9	61	2,6	1,0	62	2,4	1,1	61	3,0	0,8	63	2,7	1,0
PT	45	2,6	0,9	50	2,4	0,8	47	2,3	0,8	49	2,7	0,9	47	2,4	0,9
RO	0			0			0			0			0		
UK(EN)	63	2,4	1,0	64	2,1	0,9	65	2,4	1,0	64	3,1	0,9	64	2,9	0,8
UK(NI)	10	2,8	1,2	10	2,0	1,2	9	2,0	1,1	9	2,8	1,2	9	2,3	1,1
UK(Sco)	5	3,4	0,9	6	2,8	1,3	6	2,5	1,4	6	3,2	0,8	5	3,4	0,5
UK(Wa)	3	2,0	1,0	3	2,0	1,0	3	2,0	1,0	3	3,3	0,6	3	2,7	0,6
Total	427	2,6	1,1	444	2,2	1,0	442	2,3	1,0	428	2,7	1,0	428	2,4	1,0

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Teacher Science and Mathematics Knowledge, Skills and Confidence

Q19. During the last 18 months, did you have the opportunity to participate in any of the following kinds of professional development activities and if so, what was the impact of these activities on your teaching of SCIENCE or MATHEMATICS respectively?

	a.Courses/workshops on Science subject matter or methods			b.Courses/workshops on Mathematics subject matter or methods			c.Science education conferences or seminars (where teachers and/or researchers present their research results and discuss educational problems)			d.Mathematics education conferences or seminars (where teachers and/or researchers present their research results and discuss educational problems)			e.Science teaching observations in other schools			f.Mathematics teaching observations in other schools		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	25	2,4	1,1	16	2,3	1,2	18	2,2	1,1	12	1,8	1,1	15	2,1	1,0	11	1,6	0,9
BE(Wa)	4	2,8	1,0	4	3,5	0,6	3	2,7	0,6	3	3,0	1,0	2	2,0	1,4	1	2,0	
FI	18	2,9	0,9	34	2,9	0,9	12	2,3	0,9	14	2,7	1,3	9	2,1	0,9	11	2,2	1,0
FR	14	2,4	0,9	15	2,4	0,7	9	2,0	0,7	14	2,1	0,9	9	1,6	0,7	6	1,5	0,5
GE	31	3,5	0,7	27	3,1	0,9	18	3,4	0,8	14	2,8	1,1	13	2,7	0,9	15	2,6	1,0
GR	33	3,0	1,1	29	2,8	1,1	40	2,8	1,1	30	2,7	1,1	31	2,8	1,2	28	2,5	1,2
MA	28	2,5	1,0	26	2,6	1,0	17	1,9	1,0	13	1,9	1,0	13	1,5	0,8	13	1,7	0,9
PT	30	2,8	1,2	39	3,2	1,0	26	2,3	1,1	28	2,6	1,0	27	2,3	1,0	19	2,0	1,1
RO	133	3,5	0,7	116	3,4	0,7	99	3,3	0,8	76	3,0	0,8	178	3,5	0,6	166	3,5	0,6
UK(EN)	35	3,2	0,8	44	3,0	0,6	21	3,3	1,0	15	3,1	1,0	14	3,0	1,0	17	3,2	1,1
UK(NI)	6	3,7	0,5	5	3,6	0,5	2	3,0	0,0	1	3,0		2	2,5	0,7	1	2,0	
UK(Sco)	3	2,3	1,2	4	3,8	0,5	2	2,5	2,1	3	3,3	1,2	1	1,0		1	1,0	
UK(Wa)	3	3,7	0,6	4	3,3	1,0	0			0			0			0		
Total	363	3,1	0,9	363	3,1	0,9	267	2,9	1,0	223	2,7	1,0	314	3,0	1,0	289	2,9	1,1

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Q19(cont.). During the last 18 months, did you have the opportunity to participate in any of the following kinds of professional development activities and if so, what was the impact of these activities on your teaching of SCIENCE or MATHEMATICS respectively?

	g.Participation in a network of teachers formed specifically for the professional development of teachers in Science			h.Participation in a network of teachers formed specifically for the professional development of teachers in Mathematics			i.Individual or collaborative research on a Science topic of interest to you professionally			j.Individual or collaborative research on a Mathematics topic of interest to you professionally			k.Mentoring and/or peer observation and coaching of Science teaching, as part of a formal school arrangement			l.Mentoring and/or peer observation and coaching of Mathematics teaching, as part of a formal school arrangement		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	18	2,4	1,3	14	1,8	0,9	27	2,9	1,2	18	2,3	1,0	17	2,4	1,1	9	1,6	0,9
BE(Wa)	1	2,0		2	3,0	1,4	3	3,3	1,2	3	3,0	0,0	4	3,0	0,8	3	3,3	0,6
FI	7	1,9	1,2	13	2,5	1,3	12	2,2	1,1	10	2,0	1,2	43	2,7	0,9	49	2,8	0,9
FR	5	1,0	0,0	7	1,7	1,0	19	2,9	1,0	16	2,7	1,0	6	2,0	1,3	5	1,6	1,3
GE	20	3,6	0,8	6	2,3	1,2	6	3,0	1,5	3	2,0	1,7	14	3,1	1,1	8	2,4	1,3
GR	24	2,4	1,2	21	2,2	1,2	34	2,9	1,2	35	2,9	1,2	25	2,6	1,3	27	2,5	1,3
MA	13	1,6	0,8	13	1,8	0,9	19	2,2	1,0	19	2,2	1,0	15	1,9	1,1	19	2,1	1,0
PT	17	1,9	1,0	23	2,6	1,2	32	2,7	1,0	34	2,8	1,0	21	2,1	1,2	19	1,9	1,1
RO	72	3,3	0,8	63	3,1	0,9	104	3,4	0,7	103	3,3	0,8	89	3,5	0,7	87	3,4	0,8
UK(EN)	25	3,2	0,9	18	3,1	1,0	21	3,0	0,9	14	3,2	1,1	40	3,1	0,9	30	3,0	1,0
UK(NI)	1	2,0		0			2	2,5	0,7	1	2,0		3	3,0	1,0	2	3,0	0,0
UK(Sco)	3	2,7	1,5	3	2,3	1,5	3	3,0	1,7	2	3,0	1,4	3	1,3	0,6	3	2,0	1,0
UK(Wa)	2	3,0	0,0	1	3,0		0			1	2,0		1	3,0		2	3,0	0,0
Total	208	2,8	1,2	184	2,6	1,1	282	3,0	1,0	259	2,9	1,1	281	2,9	1,1	263	2,8	1,1

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Q19(cont.). During the last 18 months, did you have the opportunity to participate in any of the following kinds of professional development activities and if so, what was the impact of these activities on your teaching of SCIENCE or MATHEMATICS respectively?

	m.Reading Science professional literature (e.g. journals, evidence-based papers, thesis papers)			n.Reading Mathematics professional literature (e.g. journals, evidence-based papers, thesis papers)			o.Engaging in informal dialogue with your colleagues on how to improve your Science teaching			p.Engaging in informal dialogue with your colleagues on how to improve your Mathematics teaching		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	25	2,6	0,9	16	2,4	1,0	37	2,9	0,9	30	2,7	1,0
BE(Wa)	3	2,7	1,5	2	2,0	0,0	3	3,3	0,6	4	3,5	0,6
FI	34	2,9	0,8	35	2,8	0,9	50	2,9	1,0	55	3,1	0,9
FR	11	2,5	1,2	10	2,2	1,4	25	2,8	0,7	23	2,9	0,7
GE	30	3,1	0,9	23	2,8	1,0	38	3,0	0,9	28	2,9	1,0
GR	42	2,9	1,0	41	2,8	1,0	78	3,1	0,9	76	3,2	0,9
MA	19	2,3	1,1	20	2,2	1,1	38	2,8	1,0	36	2,9	1,1
PT	34	2,8	0,9	34	2,7	0,9	52	3,2	0,7	53	3,2	0,7
RO	185	3,4	0,7	177	3,4	0,7	203	3,5	0,7	193	3,5	0,7
UK(EN)	36	2,6	0,9	17	2,6	1,1	64	3,1	0,8	53	3,3	0,7
UK(NI)	1	3,0		3	2,7	0,6	7	3,1	0,7	6	2,8	0,8
UK(Sco)	4	2,8	1,3	4	3,5	0,6	7	2,9	1,2	7	3,3	1,3
UK(Wa)	0			0			6	3,0	0,9	6	3,7	0,5
Total	424	3,1	0,9	382	3,0	1,0	608	3,2	0,8	570	3,2	0,8

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Q20. How would you rate your confidence in the following?

	a. Your knowledge and understanding of important scientific ideas.			b. Your knowledge and understanding of important scientific processes.			c. Your competencies necessary to carry out scientific inquiry.			d. Your understanding about scientific inquiry (e.g. how science and scientists work).			e. Your general pedagogic knowledge.			f. Your knowledge of Science pedagogy/didactics.		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	54	2,2	0,8	54	2,2	0,7	54	2,5	0,6	53	2,0	0,7	54	3,2	0,7	54	2,3	0,7
BE(Wa)	5	3,2	0,8	5	2,6	0,5	5	2,8	0,8	5	2,4	0,9	5	3,2	0,4	5	2,8	0,8
FI	69	2,6	0,6	69	2,1	0,7	69	2,7	0,6	69	2,0	0,7	69	3,1	0,6	68	2,5	0,6
FR	45	2,5	0,8	45	2,4	0,8	45	2,2	0,7	45	2,2	0,8	45	2,8	0,6	45	2,6	0,5
GE	49	2,7	0,8	49	2,8	0,8	48	2,6	0,9	49	2,6	0,9	49	3,4	0,6	49	2,6	0,8
GR	96	2,6	0,7	95	2,5	0,7	94	2,4	0,9	95	2,6	0,9	96	3,4	0,5	96	2,7	0,8
MA	69	2,6	0,7	69	2,2	0,8	67	2,1	0,8	68	2,1	0,9	66	2,8	0,8	68	2,3	0,9
PT	71	2,5	0,6	70	2,5	0,7	71	2,4	0,7	71	2,5	0,7	72	3,0	0,6	71	2,8	0,6
RO	235	3,2	0,8	236	3,2	0,8	237	3,0	0,8	233	3,0	0,8	239	3,7	0,6	239	3,5	0,6
UK(EN)	76	2,9	0,8	76	2,9	0,8	76	3,0	0,7	75	2,9	0,9	76	3,2	0,7	76	2,8	0,8
UK(NI)	12	2,9	0,7	12	2,8	0,8	12	2,5	0,9	12	2,6	0,8	12	2,4	0,9	12	2,0	0,9
UK(Sco)	8	2,6	0,7	8	2,6	0,7	8	2,9	0,6	8	2,8	0,7	8	2,9	0,8	8	2,6	0,9
UK(Wa)	6	2,8	0,4	6	2,8	0,4	6	2,8	0,4	6	2,7	0,5	6	2,8	0,8	6	2,5	0,8
Total	795	2,8	0,8	794	2,7	0,8	792	2,7	0,8	789	2,6	0,9	797	3,3	0,7	797	2,8	0,8

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Q20(cont.). How would you rate your confidence in the following?

	g.Your knowledge of Mathematics pedagogy/didactics.			h.Your Science teaching.			i.Your Mathematics teaching.			j.Assessing children in science.			k.Assessing children in mathematics.			l.Your ICT skills.		
	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation	Valid N	Mean	Standard Deviation
BE(Fl)	54	2,5	0,7	54	2,7	0,8	54	2,7	0,8	52	2,4	0,9	52	2,6	0,8	53	2,9	0,9
BE(Wa)	5	2,8	0,4	5	2,6	0,9	5	3,0	0,7	5	3,0	0,7	5	3,0	0,7	5	2,6	0,9
FI	69	2,8	0,7	68	2,9	0,7	68	3,0	0,7	69	2,5	0,7	68	2,8	0,7	69	2,4	0,8
FR	20	2,1	0,4	45	2,6	0,6	44	2,7	0,5	44	2,3	0,5	44	2,7	0,6	44	2,3	0,9
GE	48	2,5	0,9	49	2,8	0,8	49	2,6	0,8	48	2,7	0,7	49	2,7	0,8	49	2,9	0,7
GR	96	2,8	0,7	95	2,7	0,8	96	2,8	0,7	96	2,6	0,8	96	2,8	0,7	95	3,0	0,8
MA	68	2,7	0,8	71	2,8	0,8	71	3,1	0,8	67	2,5	0,9	70	3,1	0,9	71	2,9	0,8
PT	70	2,9	0,5	72	2,8	0,6	71	3,0	0,6	69	2,7	0,6	69	2,9	0,6	72	2,7	0,8
RO	238	3,6	0,6	240	3,6	0,6	239	3,6	0,6	238	3,5	0,6	236	3,6	0,5	235	3,2	0,8
UK(EN)	76	2,7	0,9	76	3,0	0,6	76	3,0	0,7	76	2,9	0,6	75	3,0	0,6	76	3,2	0,6
UK(NI)	12	2,5	1,2	12	2,8	0,6	12	3,3	0,5	12	2,6	0,8	12	3,4	0,7	12	3,4	0,7
UK(Sco)	8	2,4	0,7	8	3,0	0,8	8	2,8	0,5	8	2,9	0,6	8	3,1	0,4	8	2,9	0,6
UK(Wa)	6	2,7	1,0	6	2,8	0,4	6	3,0	0,6	6	2,8	0,8	6	3,2	1,0	6	3,3	0,5
Total	770	3,0	0,8	801	3,0	0,8	799	3,1	0,8	790	2,9	0,8	790	3,1	0,8	795	2,9	0,8

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