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

D3.2 Report on Mapping and Comparing Recorded Practices

ADDENDUM 6 of 13:
National Report on Approaches in Greek Policy

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Executive Summary

This National report examines the way in which teaching, learning and assessment is conceptualised in Greek policy for early years science and mathematics, and the role for creativity. This report is one of the European national policy reports that contribute to the *Creative Little Scientists* project deliverable (D3.2 *Report on Mapping and Comparing Recorded Practices*) mapping and comparing policy approaches across Europe.

In order to map the key messages in Greek policy, as well as allow comparisons with other nations, this report draws upon a survey instrument used to rate the extent to which certain approaches and the role of creativity are emphasised across relevant policy documents in this area. The survey tool was designed drawing on two key sources. Firstly, approaches were distinguished according to nine curriculum themes: Rationale, Aims, Content, Learning Activities, Teacher Role / Location, Materials and Resources, Groupings, Time, and Assessment. Secondly, specific approaches within these dimensions were identified from prior work in this project (the D2.2 *Conceptual Framework* and D3.1 *List of Mapping and Comparison Factors*). The ratings given in the survey were then discussed in sections within this report that drew upon other sources and commentaries to interpret approaches within the particular context of Greek education and policy.

Education policy in Greece is controlled by the Ministry of Education and Religious Affairs, Culture and Sports and regulated through official state legislation. The Greek Pedagogical Institute (GPI) (now replaced by the Institute of Educational Policy (IEP)), played a pivotal role in all reform efforts in Greece since its formation in 1964. The current curriculum (Cross-Thematic Curriculum Framework for Primary and Secondary Education) was written in 2003, but was only put into widespread practice in 2006. The curriculum reform of 2003, aimed to follow the new trends in education as these occur in other EU countries, mainly by promoting the interdisciplinary concept ("cross-thematic approach") as the main pillar of the proposed approach.

The role of creativity is not mentioned explicitly among the current curriculum. However, by taking a closer look at the curriculum, there is potential for children to foster creative dispositions identified, such as curiosity and imagination. The report highlights how many of the approaches identified as being support of creativity in early years science and mathematics are emphasised across policy documents.

This report discusses in greater detail the findings from this national policy, and importantly the implications, not only for the fieldwork planned in the next project phases, but also for the development of policy recommendations.

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1. Introduction

1.1 Aims of national report

This main aim of this National Report is to map existing approaches, as recorded in public policy documents and official statements of policy, to the teaching, learning, and assessment of science and mathematics in the early years and to teacher education in early years mathematics and science, in Greece. This report has been prepared as part of Work Package 3.2 of the *Creative Little Scientists* project (D3.2 *Report on Mapping and Comparing Recorded Practices*) which aims to map and compare policy within and between European partner countries. The main research questions for this phase of the project were: *How is teaching, learning and assessment of science and mathematics conceptualised? What role does creativity play in these?*

In order to analyse Greek policy documents, this report draws upon previous reports delivered in the *Creative Little Scientists* project, the D2.2 *Conceptual Framework* and D3.1 *List of Mapping and Comparison Factors*, which identified key dimensions pertinent to the role of creativity in early science and mathematics. As well as providing a structure for this report and facilitating comparison with other European policies, these frameworks help identify inconsistencies and tensions in the key policy messages within Greek policy.

1.2 Defining terms

Three terms often used in this report that would benefit from defining are: 'policy', 'curriculum', and 'creativity'.

1.2.1 Policy

The term 'policy' is used in this report to refer to policy texts, which Ozga (2000, p.33) defines as any *"vehicle or medium for carrying and transmitting a policy message"*. However, in accordance with the aims of this report, policy will be examined in relation to messages in formal written documentation. These may include either statutory requirements or guidance.

1.2.2 Curriculum

The term 'curriculum' is often used to refer to different aspects of educational policy. In a narrower sense it refers to the content and activities prescribed. In contrast, the term can be used to capture the wider aspects of educational policy. For example, Alexander (2010, p.250) refers to the curriculum as 'what is intended to be taught and learned overall (the planned curriculum); what is taught (the curriculum as enacted); what is learned (the curriculum as experienced)'. In a similar way, Van den Akker (2007) describes three levels of curriculum policy: what is intended (the ideal and formally written), what is implemented (perceived and enacted by practitioners) and what is attained (experiences and outcomes of learners). In this light, policy texts are an element of the intended or planned curriculum: what is formally written.

1.2.3 Creativity

As reported in the *Conceptual Framework* (D2.2), the *Creative Little Scientists* project indicates a focus on little c, or personal, or everyday, creativity, i.e. 'purposive imaginative activity generating outcomes that are original and valuable in relation to the learner'. In the *Literature Review of Science and Mathematics Education* (Addendum 1 of 4 of D2.2

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Conceptual Framework) in pre-school and early years of primary school, the following definition is used in relation to being creative in science and mathematics: 'to generate alternative ideas and strategies as an individual or community, and reason critically between these'.

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2. Overview of National Early Years Education Provision and Policy

Education policy in Greece is controlled by the Ministry of Education and Religious Affairs, Culture and Sports (mentioned hereforth as MinEdu) and regulated through official state legislation. In order for the policy to be implemented into practice responsibilities are divided among several governmental bodies which report back to the Ministry. These are divided into administrative agencies such as Regional Education Directorates, Directorates of Education (Prefecture) and independent agencies with a specific purpose such as the Institute of Educational Policy and the General Secretariat for Research and Technology. At the administrative level, responsible for each primary and secondary school are the principal, the assistant-principal and the teachers' association.

Compulsory education is divided into four (4) levels. Nipiagogeio (Pre-Primary school); Dimotiko Scholeio (Primary Education); Secondary Education which comprises of Gymnasio (Lower Secondary) and the Geniko (General Upper Secondary) or Epaggelmatiko Lykeio (Vocational Upper Secondary), as well as Epaggelmatikes Scholes (Vocational Education Training Schools /EPAS); and Higher Education which includes Panepistimia (Universities), Polytechnic Universities, Technologika Ekpaideftika Idrymata (Higher Technological Institutes), and the School of Fine Arts (ASKT).

The structure of the Greek educational system is presented in the figure below.

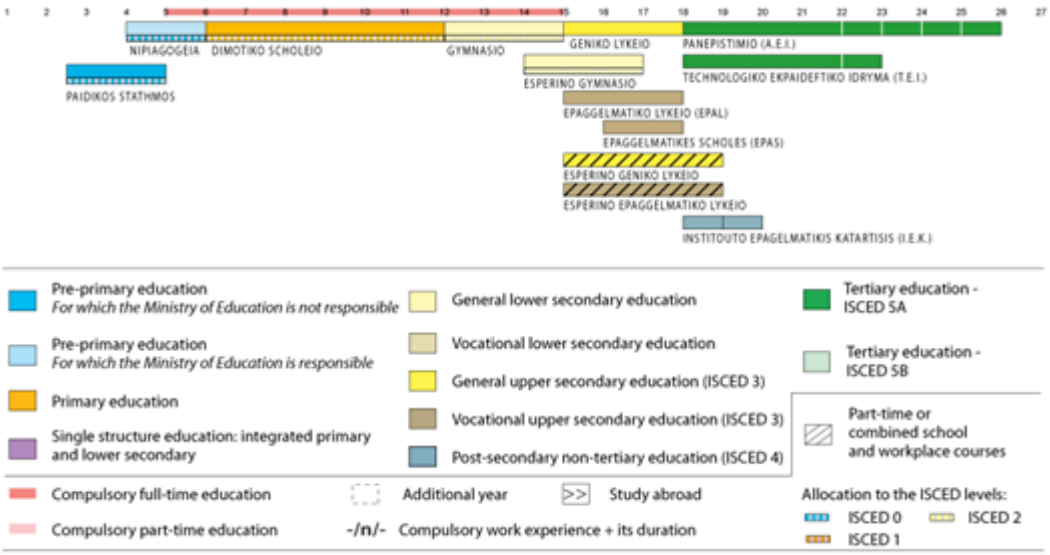

Figure 1: Structure of the Greek national education system (Source: Eurydice)

2.1 Pre-school education

Pre-school education in Greece is provided in public Pre-Primary schools, which operate under the auspices of MinEdu; public Child and Infant Centres, which are run by the Local Authorities and operate under MinEdu; and private Child and Infant Centres which function under the auspices of the Ministry of Health and Social Welfare. The majority of pre-primary schools as well as Child and Infant Centres are under state control. Nevertheless, there are also private ones. In public pre-primary schools attendance is free of charge. In

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public Child and Infant Centres as a rule there are monthly fees, which vary according to parental income. All private institutions charge monthly fees for children to attend.

Child and Infant Centres enrol children from 6 months to 4 years old. In particular, Child Centres enrol children from 2.5 year of age up to 4 years of age, whereas Infant Centres from 6 months to 2.5 years. Infant classes are attended by a maximum of 12 infants with 2 teachers and one assistant. Every class of the Child Centre serves up to 25 children with one teacher and one assistant. Teachers in Child and Infant Centres have received general pedagogical training and have attended (at least) a semester's course on science education during their Initial Teacher Training, and cannot be considered as subject specialists. Children who attend public/municipal Child and Infant Centres have to reside in the area close to the centre, whereas priority is given to children of working parents, families in financial distress and other special need cases. There are no such restrictions for private Child and Infant Centres.

Children may attend pre-primary school for up to two years. Attendance is optional for 4 year old children and compulsory for children of 5 years of age. Attendance in pre-primary education has been made compulsory since 2007. In order for a child to enrol for pre-primary education it is required to:

- have completed the fourth year of age;
- have received the required vaccinations and dental examination

Pre-primary schools have a limit of 25 children per teacher. The Pre-Primary School programme is divided into two age groups, juniors (5-year old children) and pre-juniors (4-year old children), but without a separate curriculum for each age group. It is common, especially in rural or remote areas where there is only one teacher in the school, for both groups of children to be taught together. Concerning subject specialism in science, the situation is similar to Child and Infant Centres' teachers MinEdu is responsible for allocation of time and the daily schedule for pre-primary schools at a central level by issuing directives to schools. At school level, school advisors and school staff cooperate to make the necessary adjustments in order to satisfy the individual needs of schools.

2.1.1 Curriculum

The Greek Pedagogical Institute (GPI) was an independent state organisation operating under the supervision of MinEdu. Its duties were to formulate guidelines, draft timetables and curricula, approve and order textbooks among its main responsibilities. As the only agency that has the authority to develop and publish curricula all the policy documents analysed in this report are authored by GPI. In May 2011, a new organisation, the Institute of Educational Policy (IEP), was created to replace the GPI and incorporate other governmental agencies (e.g. the School Book Publishing Organisation) into one larger organisation.

A curriculum for pre-primary schools was developed for the first time in 2003 as a part of the cross-thematic curriculum framework for primary and secondary education. This reform was implemented in 2006, when the new textbooks were published to replace the ones previously used. The main goal of pre-primary education is to offer a rich environment that will assist children to develop physically, emotionally, cognitively and socially. The programmes presented in the curriculum are not considered distinct teaching material (lesson plans, list of teaching activities), but rather state common aims and skills, as well as

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provide general guidelines for implementing activities that are suitable and appropriate for the development of all Pre-Primary School children.

Child and Infant Centres aim to promote children's socialization and bonding, support children's development and provide an environment of freedom and security. The day includes time for individualized growth and development programmes, for free play and creative activities supportive of the aforementioned goals, as well as meals and rest periods. The aim of the teacher is to contribute to the children's ability to concentrate, act independently and have confidence in themselves and their personal abilities. There is no national curriculum for Child and Infant Centres and both public and private Centres can choose the materials used in teaching at their discretion.

2.2 Primary education

Primary education in Greece is compulsory for all children; it is regulated by MinEdu and provided in primary schools for children aged from 6 up to 12 years old. All public primary schools operate under Regional Education Directorates which specify the limits of school districts. Children whose residence is within the limits of a school district are automatically enrolled in the primary school designated for that district. Public primary schools are free of charge while primary schools in the private provision have monthly fees. Schools are divided into "one-post", "two-post" up to "twelve-post" according to the number of teachers who are regular employees. Schools of fewer than six teachers are multigrade schools, in which a teacher may teach more than one year group concurrently. Primary schools that have less than 15 students enrolled are merged with other schools in neighbouring areas where students are transported free of charge. Classes can have up to 25 pupils and similarly to pre-primary education, while teachers have attended courses in all subjects as part of their Initial Teacher Training they cannot be considered specialists in science.

For children to be admitted in primary education they must:

- have completed their 6th year of age by December 31st of the year of admission;
- present a pre-primary school attendance certificate;
- present a birth certificate;
- present all required health examination and vaccinations certificates.

Private primary schools may ask for additional certificates or request that children are interviewed before admission.

2.2.1 Curriculum

All subjects in primary education are considered to have equal value and are compulsory. The following subjects are taught across all grades of primary school: Modern Greek Language, Mathematics, Arts Education, Physical Education and Information and Communication Technology (ICT). ICT is incorporated and taught through other subjects in all primary schools, but few (961), which pilot an adjusted version of the cross-thematic curriculum with ICT as a separate subject. The subject 'Study of the Environment' is taught in the first 4 grades of the primary school, replaced by the subject 'Sciences' in the last 2 grades.

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2.2.2 Quality assurance

A provision regarding evaluation of schools, including teaching and learning was included in a law passed in May 2010 (3848/201) and its implementation is in progress. According to this, quality of teaching and learning is monitored by Principals and School Advisors. The responsibility of educational operation falls under the School Advisors. Principals are responsible to uphold the standards set by MinEdu and its various agencies in both organisational and educational levels in their school. Principals also have the duty to conduct a yearly report on the educational work of their school and submit it to the Regional Education Directorate of their district and the School Advisor. School Advisors evaluate schools and submit a report of their own for all schools under their jurisdiction once a year. Principals have the authority to request a visit from the School Advisor for educational purposes whenever they deem it necessary. In their reports, School Advisors evaluate the degree of sufficiency of scientific and pedagogical skills of the teachers working in these schools including the Principal. The heads of the Regional Education Directorates have the duty to assess school principals as well as compile an overall evaluation of all the schools in their region, assessing issues like punctuality on time of arrival at the school, participation in school activities, relations between teachers and parents, teachers' level of cooperation with their colleagues within and outside the school unit.

Some of the bodies evaluating institutions in primary and secondary education are the following: Ministry of Education and Religious Affairs, Culture and Sports, Institute of Educational Policy, Regional Centres of Educational Planning Support, Regional Education Directors and Heads of Directorates. Evaluation of institutions takes place at the school, at a regional, as well as at a national level.

2.2.3 Curriculum documents

The curriculum documents for Greece are presented in the table below:

Year of publication	Document title	Author / Organisation
2003	A cross-thematic curriculum framework for compulsory education - Diathematikon programma – Curriculum for Study of the environment	Greek Pedagogical Institute (GPI)
2003	A cross-thematic curriculum framework for compulsory education - Diathematikon programma – Curriculum for Mathematics	Greek Pedagogical Institute (GPI)
2003	A cross-thematic curriculum framework for compulsory education - Diathematikon programma – Curriculum for Kindergarten	Greek Pedagogical Institute (GPI)
2006	Guide for the kindergartener	Dafermou, Ch., Koulouri, P., Mpasagianni, E.
2011	New school (School for the 21st Century) - Kindergarten/Pre-school curriculum.	Greek Pedagogical Institute (GPI)

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2011	New school (School for the 21st Century) - Kindergarten/Pre-school guide for the teacher.	Greek Pedagogical Institute (GPI)
2011	New school (School for the 21st Century) - Curriculum for Study of the environment	Greek Pedagogical Institute (GPI)
2011	New School (School for the 21st Century) - Curriculum for mathematics in primary Education	Greek Pedagogical Institute (GPI)
2011	New School (School for the 21st Century) - Teacher guide for Mathematics in Primary Education "Tools for Didactic Approaches"	Greek Pedagogical Institute (GPI)
2011	New School (School for the 21st Century) - Teacher guide for Study of the Environment in Primary Education "Tools for Didactic Approaches"	Greek Pedagogical Institute (GPI)

2.2.4 Directions of policy

The curriculum reform of 2003, aimed to adapt the decisions of the European Union in order for the Greek educational system to follow the new trends in education as these occur in other EU countries, especially after the poor performance of Greek pupils in the PISA 2000 test (Alahiotis & Karatzia, 2006). This is evident by the introduction of various elements into the educational process, such as ICT and the promotion of the interdisciplinary concept ("cross-thematic approach"), which serves as the main pillar of the proposed approach. To evidence the interrelation and cohesion among school subjects as well as among the different levels of education the curriculum was published as a single 700-page document. It is the first curriculum to utilise new mathematical knowledge within the context of other disciplines and courses in the first grade of primary school. However, the increase in quantity and quality of knowledge that students in the first year of primary school have to conquer and the strong pacing of this knowledge led to the readjustment of the curriculum for kindergarten (to prepare and to support the transition of students to primary school). To tackle the increased pupil work load and responding to international reports about the importance of early years education, MinEdu introduced compulsory attendance at pre-primary schools (for 5-year-olds) in December 2006.

Particular emphasis has been laid so far in the modernisation and expansion of lifelong learning (LLL) platforms and the modernisation of tertiary education, always in accordance with EU trends and mutually agreed priorities. Cornerstones in this on-going effort have been the coordination and enhancement of LLL providers, the upgrading of vocational training with the establishment of special vocationally oriented secondary education units and the facilitation of inter-level mobility (easier access to post-secondary non-tertiary and tertiary education for graduates), the substantial regulatory and institutional reform of higher education, and the expansion of mandatory education by one year (pre-school education).

In 2011, a new curriculum was released by GPI and it was piloted during the 2011-12 school year in 188 schools (21 pre-primary, 99 primary and 68 secondary schools). The main message the emerging curriculum embodies is that an urgent and substantial change is needed and that the priority of education should be to restore traditional values and cultivate unity and cooperation for society. The "New School" curriculum, as it is entitled,

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supports the view that in order to tackle the problems in education but also in society, a complete overhaul is necessary. Some of the new elements included in the curriculum are:

- early years is viewed as the first step towards developing EU-defined key competences;
- the objective to develop skills in the context of science and technology and transform them into competences for the modern citizen (in primary education);
- explicit mention of "scientific literacy" as one of the aims of early years science education;
- a teaching methodology for science which utilises elements of scientific methodology to construct teaching strategies;
- attempt to link science with society and culture, and foster elements of the nature of science;
- inquiry-based teaching methodology.

Due to financial insecurity during 2012, MinEdu made a decision to extend the piloting phase of the "New School" curriculum for another school year (2012-13) in the same schools as the previous school year.

The main points of the emerging curriculum will be pointed out throughout the document to evidence the direction of policy in Greece.

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3. Research Questions and Methodology

3.1 Research Questions

The main research question for this Work Package, adapted for this National Report is:

How is teaching, learning and assessment of science and mathematics in the early years conceptualised in policy in Greece?

The sub questions identified within this overarching research question are:

- *What is the role of creativity in the way teaching, learning and assessment of science and mathematics in the early years are conceptualised in policy in Greece?*
- *What are the main similarities and differences between mathematics and science in the way teaching, learning and assessment of these areas in the early years are conceptualised in policy in Greece?*
- *What are the main similarities and differences between pre-school and school phases in the way teaching, learning and assessment of science and mathematics in the early years are conceptualised in policy in Greece?*

In order to examine how teaching, learning and assessment are conceptualised across Greek policy, this report drew upon the framework of curriculum components 'the vulnerable spider web' (see van den Akker, 2007) that identifies the following key questions related to student learning:

- Rationale or vision: Why are children learning?
- Aims and objectives: Toward which goals are children learning?
- Content: What are children learning?
- Location: Where are children learning?
- Learning activities: How are children learning?
- Teacher role: How is the teacher facilitating learning?
- Materials and resources: With what are children learning?
- Grouping: With whom are children learning?
- Time: When are children learning?
- Assessment: How to measure how far children's learning has progressed?

As well as factors relating to the curriculum, the *Conceptual Framework* (D2.2) identified teacher factors as significant in teaching, learning and assessment approaches in the classroom. This is further indicated in the D3.1 *List of Mapping and Comparison Factors* derived from the *Conceptual Framework*. Consequently, this report set out to examine Teacher factors addressed in policy, in particular approaches documented in relation to both:

- Initial Teacher Education: What are the requirements for initial teacher education?
- Continuing Professional Development: What are the opportunities for Continuing Professional Development?

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3.2 Method

3.2.1 Data selection

Policy documents were chosen that captured the different aspects of curriculum according to the nine dimensions identified by Van den Akker (listed in the previous section) in relation to early science and mathematics. The documents embodying the curriculum in Greece present the rationale behind the reform effort, aims and purposes, learning outcomes and activities, topics, competences and skills promoted, role of the teacher, assessment criteria and methods, as well as suggested teaching materials.

Additional materials reviewed include Eurydice reports, policy review from an EU Comenius project and a number of research articles focusing on curriculum reform in Greece. All documents apart from those that form the National Curriculum have been reviewed to provide the necessary context to the analysis of the main curriculum documents and have not been used to complete the policy survey (see next section).

3.2.2 Survey tool

A survey tool was developed in order to quantify judgments about the extent to which particular approaches were emphasised in Greek policy documents. Whilst quantifying approaches is problematic, this was considered important in order to support comparisons between European partners, as well as provide an informative representation of approaches within Greek documents.

The survey tool comprised of two main sections: one relating to Teaching, Learning, and Assessment approaches. This was subdivided according to the dimensions of curriculum described previously, namely: *Rationale; Aims; Content; Learning activities; Teacher role/Location; Materials and resources; Grouping; Time*. The other section focused on Teacher Education, subdivided into *Initial Teacher Education* and *Continuing Professional Development*.

The sections were comprised of a series of questions about approaches advocated in national policy. In each section researchers in partner countries were asked to provide background information or evaluate the extent to which particular approaches were, or were not emphasised across policy documents, and also the extent to which the role of creativity is emphasised in these approaches. These approaches listed were carefully drawn from prior work in the *Creative Little Scientists* project, namely the D2.2 *Conceptual Framework* and the D3.1 *List of Mapping and Comparison Factors*, which drew attention to significant approaches characteristic of creativity in early years science and mathematics. A summary of the emphasis ratings given for Greek policy is presented in Appendix A; information on the background sections of the questionnaire are integrated into the main text of this report.

3.2.3 Completion of the survey tool

The author of this report, one of the *Creative Little Scientists* project team in Greece, completed the Survey tool. Inter-rater reliability was not possible due to project limitations and the importance of the local expertise of researchers completing the survey tool for their national documents. Therefore, it was required that each project member completing the survey provided justifications for their responses alongside specific references to the policy documents to support judgements made. These justifications were assessed and discussed with a second project team member and later reviewed by two external

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reviewers, a practising teacher and Director of the 'Primary Science Laboratory' in the 9th Primary School of Rethymno, Crete and a Lecturer of Science Education in the Department of Preschool Education of the University of Crete.

3.2.4 Context of policy messages

A significant challenge of analysing and quantifying policy messages is that they need to be interpreted in relation to the particular national context: taking into account economic, political, geographic, historical factors for example. Consequently, the results of the survey analysis are interpreted within the broader background to current policy, drawing upon wider sources.

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4. Approaches to Teaching, Learning and Assessment

This section summarises and reflects upon the findings from the policy survey. The overarching aim is to draw out key messages and highlight any issue, tensions or criticisms that may exist for different aspects. Reflecting the questionnaire, the findings are reported under headings taken from van den Akker's framework of components (van den Akker, 2007) as follows:

- Rationale or Vision
- Aims and Objectives
- Content
- Learning Activities
- Teacher Role / Location
- Materials and Resources
- Groupings
- Time
- Assessment

4.1 Rationale or Vision

4.1.1 Key summary points

The curriculum for pre-primary and primary education in Greece does not state specific purposes for science education. This is due to the fact that science is not a separate teaching area for either educational level, but more importantly for keeping in line with the cross-thematic vision of the entire curriculum. The general principles of the curriculum are focused on providing a well-rounded education; developing children mentally, physically and socially; allowing them to find their own interests and develop competencies; be sensitive towards the environment and prepare them for developing their ICT skills.

The curriculum for "Study of the Environment", the thematic area that includes science in primary school, states that its main purpose is for children "to acquire knowledge and develop competencies which allow the student to observe, describe, interpret and predict up to a certain point the functions and interactions of the natural as well as human environment" (GPI, 2003, p.306).

The emerging "New School" curriculum separates science as a distinct area for pre-primary education and presents specific purposes for science education. Scientific literacy is viewed as very important so that children can systematically inquire, solve problems, form a critical stance and actively take decisions that support the close relationship of science and technology with society. Children developing positive attitudes towards science is also one of the purposes of science education in pre-primary school along with fostering curiosity and motivation of young children for inquiring about the world around them. The emerging "New School" curriculum for primary school adds a few additional purposes for science education such as conquering the fundamental and essential conceptual foundation in all the different fields of science and acquiring a valuable body of information.

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4.1.2 Role of creativity

Creativity is not mentioned as a purpose of neither the "Study of the Environment" curriculum or in the general guidelines. However, it is defined as one of the main competences that the curriculum aims to foster and develop. In pre-primary curriculum creativity is presented as an outcome of education; "children should gradually conquer the necessary knowledge, skills, values and attitudes so that they can spend the rest of their lives happily and creatively" (GPI, 2003 p. 586).

In the emerging "New School" curriculum, creativity takes on a more prominent role, in the form of creative thinking, as one of the main skills that the new curriculum develops. The main area where creativity can be fostered along with reflection and self-assessment is problem solving.

4.1.3 Main differences between preschool and primary school

The main difference between the two levels is that in primary school acquiring knowledge is emphasised while in pre-primary the focus is more on increasing interest in learning and promoting understanding. This is more evident in the emerging "New School" curriculum where curiosity, scientific literacy and increase of interest in science are the points of emphasis for pre-primary, while for primary education building a conceptual framework is the main purpose for science education.

4.1.4 What are the differences, if any, between science and mathematics?

There are specific purposes in the pre-primary curriculum presented for mathematics as opposed to science. The purpose of including mathematics is to assist children to expand their initial knowledge of mathematics and be able to apply familiar mathematical structures in unfamiliar settings. The purpose for mathematics in pre-primary is similar to the one for science in primary school, particularly when it comes to children being able to observe, describe, interpret and predict.

For primary education, the purposes of mathematics are focused on developing thinking skills (analysis, deduction, methodical thinking and concentration). There are also a set of values and attributes emphasised which have been identified in D2.2 as creative attributes, such as persistence, sense of initiative, creative imagination and critical thinking.

4.2 Aims and Objectives

4.2.1 Key summary points

The current National Curriculum for pre-primary education offers a variety of aims and relevant learning outcomes. Fostering collaboration is one of the focal aims, either with other children by "understanding the value of collaborative work and joint discovery" (GPI, 2003 p. 600) or to develop collaborative skills. Increased interest in learning and in science is also emphasised among desired learning outcomes along with some realisation of the significance of observation, experiments and description for the study of materials and phenomena, and of familiarisation with basic research procedures.

The situation is somewhat different for primary school. Knowing and understanding concepts has a dominant role among the various intended learning outcomes. Verbs like learn, recognize and know (all used extensively in the cognitive domain of Bloom's taxonomy) are used very often when presenting the learning outcomes. Communication of investigations is also emphasized by "enriching children's vocabulary and expanding their

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communicative" (GPI, 2003, p. 311) skills as well as "being able to describe procedures like mixing and cooling" (GPI, 2003, p. 320).

Inquiry is emphasized in the emerging "New School" curriculum and inquiry-based science teaching methodology has influenced the learning outcomes in both the pre-primary and primary science curriculum. The focus has been shifted to asking questions, being able to handle simple equipment, familiarize themselves with scientific processes and communicating their explanations. The same aims for science education are even more highlighted in the primary curriculum with learning outcomes such as "children will be able to ask questions and plan the necessary steps to study a phenomenon, build a technological construction and tackle problems in general", "plan, choose, build and use tools and materials to observe and collect data" and "children will be capable of using a simple scientific vocabulary, read, write and converse in order to produce multimodal texts of scientific and technological content". Collaboration is featured prominently among learning outcomes as it is characterized as one of the pillars of the curriculum.

4.2.2 Role of creativity

Creativity is not mentioned explicitly among the aims and objectives of science education in the current curriculum. The learning outcomes described in the curriculum for both pre-primary and primary education, place an emphasis on children learning to use simple equipment and realising the significance of scientific processes for gathering data. By getting immersed into scientific inquiry and finding their own path towards answering their questions, children can foster creative dispositions identified, such as curiosity and imagination. Curiosity, a creativity attribute already identified in the previous stages of the *Creative Little Scientists* project (D2.2 – *Conceptual Framework*), is described as one of the driving forces of science in pre-primary school.

The emerging "New School" curriculum explicitly refers to using equipment to gather data and communicate the explanations children develop. The curriculum states that through improving their skills in using means of representation and communication "they acquire new thinking skills that assist them to develop critical and creative thinking" (GPI 2011, p. 20). Creativity is also emphasised in children asking questions as they "activate creative thinking and imagination" (GPI 2011, p. 34).

4.2.3 What are the main differences between preschool and school?

In the current primary curriculum, learning outcomes do not include only expanding children's prior knowledge, recognizing, identifying and discovering the natural and human environment that surrounds them, but also correlating, comparing, suggesting, distinguishing and sorting. This added range of learning outcomes for primary school (compared to preschool) points to the increased importance of developing conceptual understanding and skills rather than expanding their prior experience, getting children interested and assisting them to begin to realize the significance of scientific processes and inquiry.

4.2.4 What are the differences, if any, between science and mathematics?

In mathematics, there are a number of learning outcomes which, due to the nature of numeracy, have a rather close-ended approach. For example, children have to spend a large portion of their time in the classroom reciting - "to recite the sequence of numbers from 1 to 10" (GPI, 2003, p. 255).

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Another difference in aims and objectives between science and mathematics is that children, as part of the problem solving section of the mathematics curriculum, take part in activities which aim to allow them the freedom to control their investigations. This particular part of the mathematics curriculum is closer to IBSE methodology than the more guided approach described in the science curriculum.

4.3 Content

4.3.1 Key summary points

Science is included in a thematic area called "Child and the Environment" in pre-primary education, which is divided into two axes: a) human environment and interaction and b) natural environment and interaction. In primary education, science is part of the thematic area called "Study of the Environment", which is also divided into human and natural environment content. Keeping in line with the cross-thematic vision of the curriculum, elements from science education are taught in other thematic areas like language or physical education.

The main topics are presented in the table that follows.

Pre-primary	Primary
5 senses	Objects (solids, liquids, gases)
Plants and animals	Energy in our lives
Sources of energy (the sun, fire, electricity)	The journey of sound
Simple machines and inventions	Plants and animals
Air and water	Animate and inanimate objects
	The cycle of water
	The Sun - day and night

The emerging "New School" curriculum for pre-primary education places Science as a distinct learning area, one of eight in total. The other areas are:

- Personal and social development
- ICT
- Mathematics
- Environment and sustainable development
- Language
- Physical education
- Art

The topics taught are very similar to the current curriculum with the addition of a section devoted to Earth and Space. Topics are taught starting from the familiar and concrete (living things) to the abstract and wide (planet Earth and space).

For primary education, science remains a part of "Study of the Environment", along with social sciences, religious studies, finance, citizenship education and road traffic education. The themes explored by children as part of science within the "Study of the Environment" framework are identical to the current curriculum.

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4.3.2 Role of creativity

Creativity is emphasised in content for science in a very similar implicit sense as in the 'Aims and Objectives' section above.

4.3.3 What are the main differences between preschool and school?

There are not that many differences between the two stages as most of the content in pre-primary is continued, on a more detailed level, in primary school. This is largely due to the fact that one of the important developments in this particular curriculum was the sense of continuity and smooth transition between different grades and stages.

4.3.4 What are the differences, if any, between science and mathematics?

Mathematics, as opposed to science, is a separate thematic area in both pre-primary and primary education. The learning topics for both pre-primary and primary school for mathematics are focused on numeracy and children getting familiarised with simple mathematical processes. An important difference between science and mathematics is that problem solving is explicitly stated as a learning topic in mathematics and not implicitly as in science.

4.4 Learning Activities

4.4.1 Key summary points

Learning activities play a prominent role in the current curriculum. The format of the curriculum is common for all stages of compulsory education. The main section of all curriculum documents that were analysed is a table with three columns that present the intended outcomes, indicative cross-thematic learning activities and fundamental cross-thematic concepts.

In both pre-primary and primary education considerable emphasis is given to the process of inquiry. Teachers plan learning activities that encourage children to observe and describe natural phenomena, use simple tools to gather data and communicate their results or explanations at the end of the activity.

The majority of learning activities presented in the pre-primary curriculum use forms of structured play to encourage children to carry out the elements of scientific inquiry described above. Usually, children do not have the freedom to choose their own topics to research, given the time required to pose their own questions or plan their own research path. Teachers are instructed to use questioning to facilitate the process.

The emerging "New School" curriculum clearly follows the Inquiry-Based Science Education (IBSE) methodology and as such learning activities require children explicitly to:

- systematically observe phenomena
- form hypotheses and/or predictions
- organise experimental procedures to test their hypothesis
- record data gather through observation
- analyse and interpret the data collected

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4.4.2 Role of creativity

The only mention of creativity in the learning activities suggested states that, "these activities originate from the needs and knowledge of children, they activate creativity, exchange ideas and lead to new knowledge" (GPI, 2003, p. 587-8).

Even though the current curriculum does not explicitly follow IBSE methodology, by focusing on children's investigations it provides plenty of room for fostering creativity. The approach for children's investigations/inquiries can be characterised as guided, where the teacher plays a significant role in guiding the children through their learning path, but without controlling their decisions and actions.

4.4.3 What are the main differences between preschool and school?

In both pre-primary and primary curricula learning activities which are suggested are focused on promoting children's explorations. There are no significant differences in the approach followed.

4.4.4 What are the differences, if any, between science and mathematics?

Experimentation is limited in mathematics in comparison to science. Most learning activities in mathematics are designed to lead to an expected/"correct" result.

4.5 Teacher Role / Location

4.5.1 Key summary points

The role of the teacher is presented in the teaching methodology section of the pre-primary curriculum. There is a short paragraph entitled 'Role of the Teacher' which states that the teacher has to create the necessary conditions so that in an environment which is attractive, safe, friendly and rich in stimulation, all children can be motivated to learn. The teacher has to organise appealing, meaningful and interesting teaching experiences in the spirit of collaboration, encouragement, acceptance, love and sharing. The teacher also seeks the "effortless participation" of every child in the daily activities at their own pace and takes advantage of children's previous knowledge and experiences as a starting point (GPI, 2003).

Open play is emphasised because it "allows children to develop, discover, creatively use equipment and tools, experiment, communicate, collaborate and socialize" (GPI, 2003, p. 591). Activities which include events that stimulate children's interest are considered ideal for learning and have to be capitalised using appropriate teaching interventions (e.g. children decide to make a card to send to their classmate who is ill). Open play is mentioned continuously in the section of the pre-primary curriculum which describes appropriate learning activities, further solidifying its role in pre-primary education. On the other hand, role play is not used as often.

"Projects" are defined as investigations of topics chosen by the children. These "Projects" could either have individual or group goals. The teacher assists children in planning, uses discussions and collaborates with children to allow them to decide on the development of their "Project". "Projects" have an integral role in the current curriculum. They are the main teaching approach for teaching science and have a number of elements common to the IBSE methodology in essence, although the "Project" methodology does not get into the level of detail that IBSE gets. "Projects" as they are presented in the curriculum offer the chance for teachers to allow children to take control over their learning and conduct open

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investigations based on their interests. However, the freedom for children actually to choose the topic of their "Projects" is limited since the curriculum offers a number of suggested topics suitable for every thematic area. The teacher has the opportunity and space to let children choose the specific area (within the suggested topics) they want to explore and can play an important role in allowing children to have the freedom to truly control their explorations.

A very important approach advocated in the curriculum is integrating science with other curricular areas. Teachers should be able to plan and choose activities that engulf elements from the different thematic areas. The importance of cross curricular work is evident throughout the curriculum and more so from the title of the entire curriculum 'A cross-thematic curriculum framework for compulsory education'. There is constant mention of the attention a teacher must pay in connecting different thematic areas and allowing children to see for themselves the links and connections. The section of the curriculum which presents the suggested learning activities mentions the different thematic areas involved in all the activities. Similarly, building on children's prior experiences and knowledge is another element which is present throughout the curriculum. This is an obvious influence of the constructivist approach (although the actual term is not mentioned anywhere) and teachers have to be able to identify children's prior knowledge before being able to plan their teaching. As already mentioned above, fostering collaboration and encouraging different ways of recording and expressing ideas are also very important approaches for teachers to use as part of their teaching according to the guidelines and philosophy of the current curriculum in both primary and pre-primary education.

In the emerging "New School" curriculum for pre-primary education, the teacher is asked to organise appropriate learning experiences according to the following five frameworks:

- Play (open, structured)
- Routines (recurring everyday actions)
- Everyday situations
- Inquiries ("Projects", small scale investigations, problem solving)
- Organised activities

Teachers share control of the learning path with students, allowing them to shift between completely open-ended and guided approaches.

Play is still considered as the dominant activity suitable for children development but the emerging curriculum does a much better job of illuminating the reader (practitioner, researcher or casual reader) on the appropriateness and actual benefits of play for pre-school children. The same observation can be made for all additional frameworks. They are adequately explained while offering easy-to-use examples for practicing teachers.

An important feature of the emerging curriculum is the introduction of "inquiries" as a separate framework for pre-primary school. "Inquiries" are described as group efforts to answer questions that either come from the children or the teacher. "Inquiries" follow IBSE methodology and include all the elements that have been highlighted by the previous project work (D2.2 – *Conceptual Framework*) which are relevant to the distinct stages of IBSE. The role of the teacher is presented in detail and the main points asked from teachers are:

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- to study the curriculum in depth;
- to identify children's ideas in regard to the concepts investigated and use them in planning the appropriate learning activities;
- to organise meaningful activities that stimulate curiosity, creativity, imagination;
- to mainly carry out "inquiries", investigations, problem solving.

4.5.2 Role of creativity

Creativity is emphasised, although again not explicitly, through the open-ended nature of the teaching methodology described and presented. The significance of both open and role play, collaborative work, experimenting with various ways of recording or collecting data and questioning are evidence of the role that creativity plays in the teaching methodology promoted.

4.5.3 What are the main differences between preschool and school?

The difference between pre-primary and primary education is that for teachers in primary schools there are some additional contexts and approaches suggested. Role play and drama are emphasized as they are the preferred choice for a number of activities suggested. Learning outdoors, both through visits or just outside of the classroom, is also emphasised and along with conscious efforts to relate science to everyday life demonstrate a trend in the primary curriculum towards taking advantage of less controlled teaching settings.

4.5.4 What are the differences, if any, between science and mathematics?

There is less group work in mathematics. Limited discussion in the classroom in relation to science. There are also more teacher-led activities, where the teacher has to present something to the students using lecture style teaching. Children are called to repeat what the teacher has presented and learn by repetition. The teaching approaches presented in the mathematics curriculum are not in line with what is presented in the section entitled teaching methodology (foster autonomous learning, not one correct answer, children choose their own path).

Problem solving is emphasized as a separate theme in mathematics. It has to be noted that problems in this context are refer more to numeracy problems that in the wider sense. There are also a number of activities in mathematics that are asking children to reflect, which is not explicitly mentioned in science.

4.6 Materials and Resources

4.6.1 Key summary points

The current curriculum offers suggestions for materials to be used, but in the form of general guidelines without limiting the teacher to follow a set path. It is mentioned that the teacher has the freedom to choose the materials he/she wants to use in the classroom activities. It is very common for the curriculum to use the phrase "through appropriate activities and appropriate materials for the children…".

There are a number of cases where specific materials are suggested due to the nature of the activity -"use a camera to collect pictures of the changes happening in the school garden as seasons pass by" (GPI, 2003, p. 604). These activities are the only source a teacher can use to know about appropriate materials to use in pre-primary school. Equipment and materials for hands-on exploration in the classroom are emphasised for

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pre-primary children with activities suggested involving the use of magnifying lenses, magnets, thermometers, tape measures, model cars, compasses and binoculars among others. Audio-visual resources are also featured prominently among the activities by using photographs, maps, slides and posters. Children in pre-primary schools also get familiarised with digital technologies whenever possible, but this is carried out by learning to take photographs and use audio recorders as there are no specific reference to using computers.

The primary curriculum presents a list of materials consistent with the materials mentioned previously (when describing the learning activities). These materials are:

- computer software
- maps
- globes
- magnets
- students bring their favourite storybooks
- slides
- video and audio recordings
- material from mass media outlets
- works of art
- posters
- textbooks
- models
- pedagogical material from the internet

The emphasis regarding the materials used in the suggested learning activities is placed, similarly to the pre-primary curriculum, on audio-visual resources and equipment for exploration in the classroom. The primary curriculum also emphasises the significance of textbooks by stating that, "Textbooks, but also other teaching materials promote investigation, raising awareness and acquiring a holistic perspective for the natural as well as for the social environment of children" (GPI, 2003, p. 335).

In the emerging "New School" curriculum for primary school, materials and resources have a more prominent role compared to the current curriculum. Each of the topics presented are accompanied by suggested activities as well as materials and resources. Pedagogical material downloaded from the internet play a significant part, as do software programs that can contribute to the education process (e.g. Google Earth). Most of the audio-visual resources suggested are now also online. This kind of detail in presentation and the large number of additional resources offered to teachers other than the official textbook have not been present in any of the previous curricula.

4.6.2 Role of creativity

The resources mentioned are not particularly related to creativity and no specific mention can be found anywhere. As already mentioned above, the materials suggested in the curriculum are used in learning activities which implicitly attempt to increase the role that creativity plays.

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4.6.3 What are the main differences between preschool and school?

The main difference between pre-primary and primary education when it comes to appropriate materials is the increased emphasis on the value of textbooks in primary school. Other than this, materials suggested are similar for both stages.

4.6.4 What are the differences, if any, between science and mathematics?

Materials suggested for mathematics education are focused on developing children's numeracy skills through hands-on exploration in the classroom. The use of digital technologies, although mentioned as appropriate in the section entitled "Required teaching materials", is not mentioned anywhere in the activities suggested.

4.7 Groupings

4.7.1 Key summary points

Group work is emphasised in both pre-primary and primary curricula for both science and mathematics. Small group work is mentioned a number of times across all documents analysed and is the only guideline for grouping children provided in the curriculum. In the pre-primary curriculum it is specifically mentioned to teachers that they should emphasise small group work (GPI, 2003, p. 591).

4.8 Time

4.8.1 Key summary points

The general guidelines offered in the curriculum state that the time spent on each thematic area should "correspond to the volume of cognitive elements taught, the significance of topics and their degree of difficulty for children to comprehend them" (GPI, 2003, p. 15).

In pre-primary education there is no guidance for the time spent by teachers on either specific thematic areas or activities. Suggested topics do not have any time accompanying them and teachers can choose how much time to spend on each of the activities they use as part of their teaching.

In primary education, a set time is mentioned for every suggested topic mentioned in the curriculum. In total, there are 55 hours allocated in the first grade of primary school for "Study of the Environment" and 48 in the second grade. There are also cross-thematic "Projects" which can be "alternatively used to complement the activities suggested in the curriculum and they have to take up 10% of the total time allocated" (GPI, 2003, p. 317). This is part of the "flexible zone" methodology and it is the same for both science and mathematics in primary education.

The suggested time stated in the curriculum for mathematics adds up to 120 hours for each of the first two grades of primary school.

In the emerging "New School" pre-primary curriculum, time is not allocated for the different thematic areas and similarly to the current curriculum it is up to the teacher to divide the time as he/she chooses. For the emerging "New School" primary curriculum, all topics, activities and thematic areas have suggested teaching hours allocated for each of them. For the first grade of primary school 82 hours are allocated for "Study of the Environment" which are divided into two different areas: social sciences (40 hours) and science and technology (42 hours). For the second grade there 81 hours in total: 38 hours

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for social sciences and 43 for science. There are also 110 hours suggested for mathematics in each of the first two grades of primary school.

4.9 Assessment

4.9.1 Key summary points

General guidance

Assessment is viewed as an integral part of the teaching and learning process regardless of level of education or subject in the current curriculum. In the general guidelines of the curriculum which offer guidance for all stages of education the main purpose of assessment is to "provide feedback to the educational process and identify difficulties and gaps in learning" (GPI, 2003, p. 17). There are several aims for assessment that follow and which include:

- determining if children reach the learning goals set;
- planning the next steps for teaching;
- recording the individual and cohorts' learning path, skills and interests;
- improving the quality of the educational process, which aims towards reinforcing and encouraging children as well as motivating them to learn;
- identifying learning difficulties to improve planning the necessary interventions and improving teaching;
- cultivating the spirit of exploration among children, problem solving and acquiring knowledge and competencies through cross-thematic approach;
- fostering children's accountability by utilising collaborative work and self-assessment;
- improving children's confidence and self-respect;
- acquiring metacognitive skills by allowing them to manage their learning.

Assessment is divided into diagnostic, formative and summative. The curriculum presents these three different types of assessment in regard to when they are used in the teaching process with each of the three types being presented in the form of one short paragraph. According to the curriculum, diagnostic assessment is used at the beginning (and also during) the learning process to identify the previous knowledge and experience of children; formative assessment which is used during the learning process and serves as a way of checking children's progress towards set learning goals and outcomes; and summative assessment at the conclusion of the learning process to provide information on the progress of children from where they were at the beginning and where they are at the conclusion of the teaching process.

Assessment in pre-primary education for science

Assessment guidelines on methods and materials are provided as part of the pre-primary curriculum but no specific instruction is given for the different learning areas. Assessment is presented consistently to what is presented above but it is stated that in pre-primary education, "there is no set learning path. Assessment is continuous and integrated to the everyday process and is based on summatively evaluating learning and teaching" (GPI, 2003, p. 592).

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Diagnostic, formative and summative assessment are again stated as the types of assessment used during teaching and, similarly to the general section of assessment, the only distinction between them is when they are used. Summative assessment is defined as a comparison between intended and acquired learning goals in both cognitive and social development of children either individually or collectively. It is also emphasised that assessment is used to evaluate the development of each child separately and not in relation to other children.

It is clearly stated that traditional assessment methods have no place in pre-primary education and alternative methods should be used. These are:

- progress and results of "Projects"
- children collectively assess the group
- task portfolio

Details are provided only for the task portfolio, which is described as a continuous recording tool that includes information on the child's interests, learning progress, way of thinking, creative and analytical processes. The task portfolio contains children's work and not ready-made evaluation sheets and is organized in chronological order.

Assessment in primary education for science

Assessment purposes, priorities and methods are presented in the opening section of the entire National Curriculum already mentioned above. The section for assessment in science is one paragraph long and states "that to provide well-rounded assessment it is necessary to determine:

- what is assessed
- how is it assessed
- what is the purpose of assessment
- who is responsible for assessment"

The methodological approach used in "Study of the Environment" favours implementing alternative ways of assessment, such as acquiring knowledge using experimental procedures and especially "Projects", which allow the study a topic using different scientific perspectives emphasising on the main characteristics of the curriculum's cross-thematic approach" (GPI, 2003, p. 335).

4.9.2 Role of creativity

The aims of assessment attempt to assess the development of children holistically and not just focus on cognitive development. However, there is limited guidance provided for assessment in science and a large part of what is described in the curriculum stays at the level of general guidance without providing much help for practitioners.

In mathematics the focus for assessment is placed on conceptual understanding, content and thinking skills. The only element which could provide data to assess creativity or creative attributes is the one dedicated to problem solving.

4.9.3 What are the differences, if any, between science and mathematics?

The assessment approach for mathematics is somewhat different than the approach for science. The mathematics curriculum adds a number of specific elements to the guidelines

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presented in the general section of the curriculum that need to be taken into account in the assessment of mathematics due to the nature of mathematics.

The additional elements presented are:

- purposes and aims of mathematics as stated in the curriculum;
- content (concepts, processes, representations, etc.);
- thought processes (analysis, interpretation, calculation, comparison, organisation of data, formulate arguments and explanations; etc.);
- different kinds of problems children have to be ready to solve;
- external learning conditions (time constraints, individual/group work, materials used).

(GPI, 2003, p. 304)

It is also interesting to note that while not mentioned in the elements mentioned above, self-assessment is as an integral part of the initial learning activities suggested not just for the two first grades, but for all six. Self-assessment is presented as a useful tool for diagnostic assessment so that children can revisit the knowledge and skills acquired in previous years so they can “provide feedback to the learning process” (GPI, 2003, p. 257).

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5. Approaches to Teacher Education

5.1 Initial teacher education

The first University Pedagogical Departments were established in 1982 according to the state law (Law 1268/1982) at the Universities of Athens, Thessaloniki, Patras, Ioannina, Thrace and Crete. However, the organization and the beginning of their operation were gradually implemented, beginning from the academic year 1984-85. The Pedagogical Departments of Early Childhood Education began its operation in the academic year 1987-88 and the first students graduated in 1991.

The mission of the Pedagogical Departments is also regulated by the same law (Law 1268/1982) that established them. In accordance with Article 2 of the Presidential Decree 544/1989, Article 5 of the Presidential Decree 99/1993 and within the mission of the University (Law 1268/1982) Pedagogical Departments should:

- cultivate and promote the Pedagogical Sciences through academic and applied teaching and research;
- provide their graduates with the necessary qualification that will ensure an integral background for their scientific and professional career;
- contribute to the enhancement of the level and the supply of the increasing demands of Education in relation to Pedagogy;
- contribute to the treatment and the resolution of pedagogical problems in general.

There is only one requirement for admission to the Pedagogical Departments and that is going over a grade threshold in the Pan-Hellenic examinations, which follow the completion of secondary education.

The aims of each Department are only regulated by its own General Assembly without any influence from any governmental agency. Each of the Departments has the authority to set its own curriculum with complete autonomy in content. That is the reason that courses offered differ significantly in content, methodology and approach depending on the Department. The required duration to graduate is 8 semesters for all Departments. Teacher trainers are members of the faculty but there are no set requirements except from a PhD in a relevant field. There is also no standard amount of school experience mentioned as a requirement to become a teacher trainer. As mentioned above curricula differ among Departments, but in common areas of study include: pedagogical knowledge, subject knowledge (language, science, mathematics), psychology, ICT in education, curriculum knowledge, special educational needs, assessment and history of education.

Almost all courses offered in the Pedagogical Departments are assessed through written examinations at the end of the semester. There are however courses which are assessed through an oral examination. There are also courses where there might be additional assessment ways used like a mid-term test or an essay. The professor teaching the course has complete control over assessment methods and requirements.

All students of the Pedagogical Departments are required to attend school days as observers, teach a number of supervised or “trial” lessons and during the final two semesters teach on their own for a number of days depending on their University’s requirements (e.g. for the Pedagogical Department of the University of Athens students have to complete one week’s classes).

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Finally, in order for a graduate of the Pedagogic Departments to become a public school teacher he/she must participate in an examination held by the Supreme Council for Civil Personnel Selection (ASEP) and register in a list of provisional supplementary teachers. Apart from success in the written exams, the following are being taken into account as additional requirements: a) Grade of first degree, b) Postgraduate degree(s), c) PhD(s), d) past experience in the field. All these different elements get a score depending on their significance and then are added up. Those with the highest number have priority in becoming a teacher. Private schools are obliged to hire graduates of the Pedagogical Departments by law, but they usually also conduct interviews and observe trial lessons by applicants.

5.2 Continuing professional development

The largest professional development initiative ever to be carried out in Greece entitled "Major Professional Development Programme" began in June 2011 and will run until the end of 2013. The programme aims to promote the values and guidance of the emerging "New School" curriculum so that the vision of the "New School" as presented by MinEdu is implemented into practice. MinEdu has estimated that by the end of the programme 150.000 teachers (of early years, primary and secondary education) will have taken part in the program. By the time this report was written (July 2012), due to the recent changes in government, it is still unknown whether the programme will be implemented as broadly as it was initially announced.

Participation in the programme is optional for teachers. The duration for the entire programme is 200 hours divide into 55 hours of face-to-face teaching and 145 hours distance learning. The face-to-face portion of the programme is conducted in 3 two-day seminars covering one third of the overall duration.

The competences the teachers will attain by the end of the programme include:

- being able to create educational schemes of work and not just following ready-made lesson plans;
- incorporating new teaching methods into their repertoire in order to be able to move away from traditional ways of teaching;
- being able to effectively utilise ICT, environmental awareness and Arts in their teaching;
- thinking and acting towards forming a safe and productive collaborative environment;
- acquiring a holistic view of education;
- being able to maintain sustainable links with society and current events by teaching about topics relevant to school settings and recent developments.

The qualifications required for being a teacher trainer are:

- a Bachelor's degree from a Greek or foreign University;
- a Master's degree in the field of education;
- being a teacher with increased qualifications, school Advisor, University professor or educational researcher;
- Greek citizen.

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Teachers who participate in the programme have to submit two essays. The grades for the assignments are A, B (passing grades) and C (fail). Participants have to receive passing grades in all submissions to receive a certificate of completion.

The guidelines for assessment are:

- Teachers should evidence coherent as well as creative grasp of the material taught.
- Teachers' assignments should display the same philosophy, aim and methodology as the programme and "New School".
- Teachers should clearly display an understanding of the theoretical framework presented during the programme and implement that understanding into practice.

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6. Summary

The Greek educational system is controlled by the Ministry of Education and Religious Affairs, Culture and Sports (MinEdu) and regulated through official state legislation. The Greek Pedagogical Institute (GPI) was the only agency with the authority to develop and publish curricula and operated under the supervision of MinEdu. The educational system in Greece has been criticised for being centralised and bureaucratic (Kazamias *et al.,* 2001; Georgiadis, 2005).

The cross-thematic curriculum reform

The curriculum reform of 2003, aimed to adapt the decisions of the European Union in order for the Greek educational system to follow the new trends in education as these occur in other EU countries, especially after the poor performance of Greek pupils in the PISA 2000 test (Alahiotis & Karatzia, 2006). The cross-thematic curriculum, introduced a different instructive approach that requires the active participation of students for the acquisition of knowledge. Although cross-disciplinarity is the main element of the curriculum, existence of separate courses was not altered and teachers continue to divide content into thematic areas. The central idea of change is based on the fact that the teacher can select some of the topics and plan his/her teaching to incorporate elements from several thematic areas.

Science in both pre-primary and primary education is not a separate thematic area. It is only taught as a separate subject during the final two grades of primary education (11 – 12 year old children). Science is taught along with a variety of other disciplines in a thematic area entitled “Study of the Environment” (“The Child and the Environment”, in pre-school). In pre-school, development of the child is stated as the main purpose of education (the purpose is common for all thematic areas), while in primary education acquiring knowledge and relevant competencies is presented as the main driver for science learning.

“The aim of teaching science is incorporated in the general aims of education, which are the well-rounded and balanced development of the individual through the development of critical thinking abilities and a positive attitude towards creative action on a personal and a social level” (GPI 2003, p. 177). The aims for science, as translated into desired learning outcomes, are mostly focused on providing the necessary instruction using the cross-thematic approach to allow children to acquire the necessary knowledge. Fostering collaboration is heavily mentioned, keeping in line with the humanitarian approach of the entire curriculum (Alahiotis & Karatzia, 2006). Familiarising children with basic science processes is also viewed as a priority of teaching science, as is being able to start formulating explanations and presenting the results of basic investigations conducted by the children. Reasoning skills commonly associated with science are also promoted again through exploration and hands-on investigations.

Suggested learning activities for science follow the methodology specified in the curriculum for “Projects”. These are defined as investigations of topics chosen by the children. However, the approach presented in the curriculum resembles more a teacher-guided approach, due to the fact that the teacher is obliged to cover specific topics during the course of the school year. Nonetheless, suggested learning activities aim to promote observation, familiarize children with using tools to conduct their inquiries, carry out simple investigations, record data and communicate their results. The preferred teaching approach

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presented in the curriculum is open/unstructured play. These activities usually involve physical exploration of materials while encouraging children to handle tools or use a variety of different ways to gather data. Open play along with "Projects" are the main teaching approaches in teaching science. "Projects" are more often small group inquiries usually having some kind of teacher guidance, either in the planning stage or during the actual field work. The teacher is required to create the conditions to motivate children and be able to organise interesting and meaningful classroom activities which foster collaboration and encourage children to learn.

Assessment is presented as a continuous effort entwined in the everyday school life. Its purpose is to identify problematic issues in teaching and learning and provide meaningful feedback to both children and teachers. The three different types of assessment, diagnostic, formative and summative are mentioned in the methodology each with a specific purpose to serve. The process for assessing learning however is not provided in detail for practitioners. The assessment section for "Study of the Environment" for example is only one paragraph long and provides minimal guidance.

Tensions and criticisms

Tensions identified within the cross-thematic curriculum will be presented in the following paragraphs along with public criticisms from various academics who have reviewed the curriculum and the effort to reform compulsory education in Greece.

The central tension within the current curriculum, also identified by previous studies, is the one between the cross-thematic approach and the organisation of content in separate thematic areas. As Sofou and Tsafos (2010) point out, subject-based teaching is neither questioned nor transformed and instead "emphasis is placed on the fact that for a more effective implementation of the innovative strategies subject-based teaching should be maintained, or at least taken into consideration" (Sofou & Tsafos, 2010, p. 413). Aggelakos (2007) adds that the concepts permeate the different thematic areas in a rather vague way and criticizes the lack of clarity regarding the concept of the cross-thematic approach. This is evident by the lack of detailed guidance on the teaching methodology presented. An example of this is evident in the curriculum for "Study of the Environment" where in the topic of energy for the first grade the general goals are to become aware of the ways electricity is used in everyday life and demonstrate attitudes and actions for saving energy, and the cross-thematic concepts linked to these are 'interaction' and 'change'. No further guidance is provided to teachers on how they should link the intended goals to these cross-thematic concepts in their teaching.

There are also significant tensions between content and the teaching methodology presented in the curriculum. The quantity and quality of content to be covered is not in line with children being free to control their learning and guide their inquiries, especially through "Projects" or open play, according to their interests and prior knowledge and experiences. Koustourakis (2007) found that a commonly found situation in schools using the current curriculum is the increase of pace compared to the previous one and he attributes the eventual readjustment of the curriculum of the kindergarten to this fact. The reform for kindergarten advocated the need for supporting the transition to primary education and as Koustourakis concludes led to the decision to establish the one-year compulsory pre-primary education.

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A similar tension can be found within the curriculum between teacher role as it is presented and the role which is evident through the suggested learning activities. The role of the teacher can be summarized as assistant, collaborator, intermediary and facilitator to the educational process. However, the teacher remains the powerful factor in the Greek school. It is still in the hands of the teacher to create the frame of communication in the school class, determine the ways of work of students and its evaluation.

The "New School" reform of 2011

The emerging "New School" curriculum and its vision attempts to address some of the previously mentioned tensions. The focus on cross-thematic approach, although still existing, has given its place to promoting lifelong learning, key competencies and shedding light into teaching practice. The associated Professional Development Programme will assist immensely in providing the necessary instruction and allow teachers to form an interpretation that is closer to the intentions of the curriculum. There are however a number of related tensions which can be identified.

Political leadership and its significant influence on leading and sustaining reform efforts have caused substantial resistance to previous reforms. As a recent OECD review (2011) points out, "there appears to be wide gap between this leadership team and the large core of public servants who have been, and will continue to be, the ongoing capacity of the Ministry" (p. 54). This gap is further widened by the political instability and constant change in leadership. It has to be noted that the team of senior policy advisors responsible for the reform are in the process of being replaced due to changes in government. Another decisive factor relevant to the influence of political leadership is that reforms are heavily influenced by the academic background of Ministry leadership. For example, several of the highly ranked advisors behind the current reform had science education backgrounds, which explain the attention given to science and the emergence of IBSE methodology and other similar current developments in science education. One additional point that has to be noted is that policy advisors are academics with vast experience in educational research but lack of experience in actual classroom settings. As a result the emerging curriculum is closer to an academic text, rather than a document which teachers can easily integrate into their practice.

Another issue with the current reform is that it is funded by the European Commission and it follows the structure of an EC research project. This means that there is a scheduled conclusion of the programme (both curriculum design and pedagogical guidance and support of educational work), which ends with the evaluation phase and is not followed by any other planned action. This is an enduring issue with educational reforms in Greece, as they are often not followed through to implementation. The OECD (2011) report concludes that progress in Greece has been delayed due to the difficulties of implementing well-intentioned reforms. This seems to be the case for this effort for reform. Another aspect that seems to be overlooked is the lack of professional development for school leaders and administrators. No such initiative has been announced so far, leaving an important influential group of educational professionals without proper guidance to support the planned reform.

This change could be accelerated by a comprehensive professional development programme for school directors and other educational administrators. At the time this report was prepared, there was no evidence of such a comprehensive initiative.

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Differences between pre-primary and primary curricula

One of the main differences between pre-primary and primary curricula is the increased focus on well-rounded development and cultivating interest in learning in the former and acquiring knowledge in the latter. Conceptual understanding and developing specific skills is emphasised in primary education, while building on children's prior knowledge and experience through conducting simple investigations and familiarising children with basic processes of science is seen as important for pre-primary education.

Both curricula promote scientific inquiry through the use of "Projects". In primary education they are more aimed towards developing competencies related to science and relevant skills, rather than to encouraging collaboration, a sense of initiative, creativity and dialogue, promoted more in pre-primary education.

The lack of significant differences between pre-primary and primary curricula can be justified by looking at two interrelated facts. First, there is the common format and philosophy behind the entire curriculum which ensures a certain level of consistency. Second, a conscious effort for a smooth transition from kindergarten to primary school is evident, allowing children to be better prepared for primary education. As Sofou and Tsafos (2010) found, infusing elements of the primary curriculum (and its rationale and teaching methodology) in pre-primary education causes concerns for a portion of the pre-primary teachers as they feel that teachers might begin to treat preschool as school.

Differences between science and mathematics

There are specific purposes in the pre-primary curriculum for mathematics as opposed to the ones for science. There is an effort to promote the acquisition of specific mathematical skills in pre-primary education, often translated into rather closed-ended learning activities, mostly for numeracy. This is evident by the suggest learning activities promoted and the lack of children asking questions and planning and conducting simple investigations to gather data, formulate explanations which will lead them to get answers to their questions. There are more teacher-led activities, where the teacher often has to use transmission to teach certain mathematical topics. Children are also often called to repeat what the teacher has presented and learn by repetition. There is less group work and classroom discussion is limited in the suggested learning activities.

Mathematics, as opposed to science, is a separate thematic area in both pre-primary and primary education. The learning topics for both pre-primary and primary school for mathematics are focused on numeracy and simple mathematical processes. An important difference between science and mathematics is that problem solving is explicitly stated as a learning topic in mathematics and only implicitly in science. Assessment in mathematics is expressed through an additional list of specific assessment requirements for teachers to adhere, but it is interesting to note that self-assessment is as an integral part of the learning activities in the beginning of the school year as part of diagnostic assessment. This is standard practice in mathematics education across primary school, not just for the two first grades examined here, but for all six.

Creativity and IBSE synergies in the Greek pre-primary and primary curricula

The current curriculum reflects an international trend (e.g. QCA, 2005) by prominently featuring creativity/creative thinking as one of its central objectives. It highlights the need to develop children's creativity and creative thinking from the beginning of compulsory

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education. However, as Kampylis (2008) comments, the term creative thinking and its cognates are used within the cross-thematic curriculum in a vague and confusing way. He continues by stressing the necessity of getting the message of fostering creativity across practitioners in a clear way for it to be implemented in classroom reality (Kampylis, 2008). The lack of a definition, either borrowed from academic research or based on more practical working terms, is absent from the curriculum.

There is a tension between the intentions of the curriculum as they are presented through purposes and aims, and the suggested learning activities. There are a number of instances where children are forced to remain passive consumers instead of actively leading their path to learning. This is less the case for science than the other thematic areas due to the focus on inquiry and "Projects". Additional guidance for practitioners is provided in the form of a teacher guide which was published in 2006 and offers more detailed information on suggested activities and theoretical background.

Inquiry-based approaches are emphasised throughout the science curriculum with the introduction of "Projects". The "Project" methodology features a number of IBSE methodological elements, although not in the concrete and coherent way accomplished by IBSE. Children have the option of taking control over their learning and conducting open investigations based on their interests. Building on, as well as taking advantage of children's innate curiosity is one of the creative/inquiry-based synergies identified in D2.2-*Conceptual Framework*. Other inquiry-based and creative synergies that play a strong part in the cross-thematic curriculum include the already mentioned focus on open play, actively pursuing children's collaboration and fostering motivation for science learning as in learning in general. One more synergy identified, although in large part only in mathematics, is the inclusion of problem solving as a separate section of the mathematics curriculum. It has to be noted that problem solving as defined in the mathematics curriculum embodies a rather narrow view of problem solving as referred to in D2.2 and IBSE methodology. Problem solving in the mathematics curriculum refers most commonly to children finding their way around given numerical tasks solutions leading them to the solution.

6.1 Limitations

There are a number of limitations for the evaluation of policy presented in this report. By reviewing only the current and emerging curricula a portion of the direction of educational policy in Greece is left out. Direction of policy plays a very significant role in understanding the essence of curricula and provides proper context for further study. Going further to the past and reviewing previous curricula would provide the necessary information to understand the direction which policy has taken but more importantly, make it easier to understand current practice and teachers who have spent the majority of their professional life (both teacher training and school teaching) following a different curriculum. In addition, appropriate guidance and professional development for teachers to work with the current curriculum framework was never carried out in a large-scale effort or consistently and consequently there is a large number of teachers which lack the proper theoretical background and training to support the changes the current curriculum brought.

An important limitation of this report is the absence of input from policy makers. The perspective offered by those who contributed in the writing of the curricula reviewed and made decisions on the implementation of the reform would provide a much needed insight to the Cross-thematic curriculum reform. This lack of feedback from the viewpoint of policy

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makers confines the analysis and commentary presented in this report to the viewpoint of a researcher's academic perspective. The external review process of this report however, provided a much necessary additional perspective to this report from both a practising teacher, who has also a leading role in science in primary education, as well as of an academic, who is a specialist in the field and who served as an external consultant on the "Major Professional Development Programme".

A further limitation is that currently there is no official decision on when the emerging "New School" curriculum will be implemented. The piloting phase has been extended to the 2012-13 school year and by looking at the financial insecurity and recent change of government, whether the emerging "New School" curriculum is ever going to be put into practice remains to be seen. This is the reason why the emerging curriculum is not featured prominently in this report but only serves as a source to provide additional information for the intended direction of early years science and mathematics education.

The range of additional articles or unofficial sources of guidance to practitioners is another limitation to this Report. This is more due to the fact that the majority of articles found on the cross-thematic curriculum were not peer-reviewed, but Masters or undergraduate degree dissertations. The peer-reviewed articles reviewed provided useful information and highlighted some of the criticisms of the curriculum.

6.2 Implications

It is necessary to look at the interpretations that these texts have been given in practice in order to determine the coherence or incoherence between a policy and its impact. A very important topic in curriculum reform is how teachers interpret the guidance offered and the way that this newly-found direction affects their teaching practice. Little research has been done on the implementation of the changes brought by the current curriculum in teachers' everyday practice; the ways and the extent to which preschool teachers have used it remains unclear (Sofou & Tsafos, 2010).

The case study approach planned for WP4 could provide the necessary data to examine the current situation in depth and allow, for Greece at least, to formulate a complete picture of the changes brought by the cross-thematic curriculum in science and mathematics curriculum. The research focus on creativity and IBSE also provide a unique opportunity for taking a step further and exploring two constructs which have been attracting interest from both official agencies (local governments, EC), as well as the academic community.

The National Report on Policy for Greece reveals several opportunities for recommendations to policy makers. The biggest opportunity is for the project to offer well-thought and complete recommendations for policy. As Sofou & Tsafos (2010) identified in their study of preschool teachers' understandings of the national pre-primary curriculum, the current curriculum was not accompanied by the necessary in-service training and this led teachers to develop a curriculum based more on their personal interpretation, professional experience and beliefs rather than on the guidance of the official curriculum documents. However, the proposed national programme for in-service training for the emerging "New School" curriculum seems to cover some of the issues mentioned here, but it is still uncertain if it is going to be fully implemented and of its impact.

In regard to creativity, a working definition should be provided in the curriculum for teachers to grasp. The emerging curriculum has made considerable efforts towards defining

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creativity, but in a rather narrow sense compared to what D2.2-*Conceptual Framework* suggests.

The combination of the knowledge developed in the *Conceptual Framework*, the subsequent policy review and a clear picture of the realities of school practice could provide significant guidance for a multitude of different settings as the nine countries represented in *Creative Little Scientists* are. Such guidance should involve all members of the educational community while at the same time allowing them considerable input in the decisions taken.

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APPENDICES

Appendix A

Survey Ratings: Analysis of Approaches to Teaching and Learning

Key
E: Early (Preschool)
P: Primary

Rationale or Vision

Ai. What are the purposes of science Education?

	Not Mentioned	Single Mention	Various Mentions	Emphasised
a. To provide a foundational education for future scientists and engineers	E / P			
b. To develop socially and environmentally aware and responsible citizens				E / P
c. To enrich the understanding and interaction with phenomena in nature and technology	E			P
d. To develop more innovative thinkers	P	E		
e. To develop positive attitudes to science	E / P			
f. To develop important attitudes and dispositions as a foundation for future learning	P			E

Aii. What is the emphasis, if any, on the role of creativity in the purposes of science Education? (Adapted from T survey Q23)

	Counter Creative Emphasis	No Creative Emphasis	Slight Creative Emphasis	Highly Creative Emphasis
a. To provide a foundational education for future scientists and engineers		E / P		
b. To develop socially and environmentally aware and responsible citizens				E / P
c. To enrich the understanding and interaction with phenomena in nature and technology			P	E
d. To develop more innovative thinkers			E / P	
e. To develop positive attitudes to science			E / P	
f. To develop important attitudes and dispositions as a foundation for future learning		P	E	

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Aims and Objectives

Ai. What views are indicated about the importance of the following Science learning outcomes?

	Not Mentioned	Single Mention	Various Mentions	Emphasised
a. To know and understand the important scientific ideas (facts, concepts, laws and theories).				E / P
b. To understand that scientists describe the investigations in ways that enable others to repeat the investigations.	E / P			
c. To be able to ask a question about objects, organisms, and events in the environment.	E / P			
d. To be able to employ simple equipment and tools, such as magnifiers, thermometers, and rulers, to gather data and extend to the senses.	P			E
e. To know and understand the important scientific processes.	E		P	
f. To be able to communicate investigations and explanations.	E			P
g. To understand that scientific investigations involve asking and answering a question and comparing the answer with what scientists already know about the world.	P	E		
h. To have positive attitudes to science learning.	E	P		
i. To be interested in science.	P	E		
j. To be able to plan and conduct a simple investigation.		E		P
k. To have positive attitudes to learning.	P			E
l. To understand that scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge).	E / P			
m. To be able to collaborate with other children				E / P

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Aii. What is the emphasis, if any, on the role of Creativity in the following Science learning outcomes?

	Not Mentioned	Single Mention	Various Mentions	Emphasised
a. To know and understand the important scientific ideas (facts, concepts, laws and theories).		E / P		
b. To understand that scientists describe the investigations in ways that enable others to repeat the investigations.		E / P		
c. To be able to ask a question about objects, organisms, and events in the environment.		E / P		
d. To be able to employ simple equipment and tools, such as magnifiers, thermometers, and rulers, to gather data and extend to the senses.		P		E
e. To know and understand the important scientific processes.			E / P	
f. To be able to communicate investigations and explanations.		E	P	
g. To understand that scientific investigations involve asking and answering a question and comparing the answer with what scientists already know about the world.		E / P		
h. To have positive attitudes to science learning.		E / P		
i. To be interested in science.		E / P		
j. To be able to plan and conduct a simple investigation.			E / P	
k. To have positive attitudes to learning.		E	P	
l. To understand that scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge).		P	E	
m. To be able to collaborate with other children		P		E

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Content

A. How are Science and Mathematics presented as learning domains?

	As its own learning area	Encompassed within other social sciences (e.g. geography)	Encompassed within more general understanding
Science		E / P	
Mathematics	E / P		

B. What are the key Science and Mathematics topics/strands/themes?

	Science	Mathematics
1	5 senses	Counting and sorting objects
2	Plants and animals	Simple measurements
3	Sources of energy (the sun, fire, electricity)	Time
4	Simple machines and inventions	Shapes
6	Air and water	Seasons and weather

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Learning Activities

Ai. What activities are encouraged?

	Not Mentioned	Single Mention	Various Mentions	Emphasised
a. Observe natural phenomena such as the weather or a plant growing and describe what they see.				E / P
b. Ask questions about objects, organisms, and events in the environment.		E / P		
c. Design or plan simple investigations or projects.	E	P		
d. Conduct simple investigations or projects				E / P
e. Employ simple equipment and tools to gather data and extend to the senses.				E / P
f. Use data to construct reasonable explanations.		P		E
g. Communicate the results of their investigations and explanations.		E		P

Aii. What is the emphasis, if any, on the role of Creativity in the following activities?

	Counter Creative Emphasis	No Creative Emphasis	Slight Creative Emphasis	Highly Creative Emphasis
a. Observe natural phenomena such as the weather or a plant growing and describe what they see.			P	E
b. Ask questions about objects, organisms, and events in the environment.		E / P		
c. Design or plan simple investigations or projects.			E	P
d. Conduct simple investigations or projects		P	E	
e. Employ simple equipment and tools to gather data and extend to the senses.			E / P	
f. Use data to construct reasonable explanations.		P	E	
g. Communicate the results of their investigations and explanations.		E	P	
h. Other				

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Teacher Role / Location

Ai. What learning/teaching contexts and approaches are mentioned?

	Not Mentioned	Single Mention	Various Mentions	Emphasised
a. Open/unstructured play				E / P
b. Role/Pretend play		E		P
c. Drama	E			P
d. Teaching science from stories	P	E		
e. Using history to teach science (e.g. transport, the work of scientists)	E / P			
f. Working in small groups	E			P
g. Physical exploration of materials				E / P
h. Using outdoor learning activities	E			P
i. Taking children on field trips and/or visits to science museums and industry		E		P
j. Integrating science with other curricular areas				E / P
k. Building on children's prior experiences		E		P
l. Fostering collaboration				E / P
m. Encouraging different ways of recording and expressing ideas – oral, visual, digital, practical				E / P
n. Encouraging problem finding – e.g. children asking questions	P			E
o. Encouraging problem solving – e.g. children solving practical tasks	E			P
p. Encouraging children to try out their own ideas in investigations	E / P			
q. Fostering classroom discussion and evaluation of alternative ideas		E / P		
r. Fostering imagination	E / P			
s. Relating science to everyday life		E		P
t. Using questioning as a tool in science teaching	P		E	
u. Using digital technologies with children for science teaching and learning	E / P			
v. Fostering autonomous learning	E / P			

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Aii. What is the emphasis, if any, on the role of Creativity in the following learning/teaching contexts and approaches?

	Counter Creative Emphasis	No Creative Emphasis	Slight Creative Emphasis	Highly Creative Emphasis
a. Open/unstructured play				E / P
b. Role/Pretend play			E / P	
c. Drama		E		P
d. Teaching science from stories		E / P		
e. Using history to teach science (e.g. transport, the work of scientists)		E / P		
f. Working in small groups		E / P		
g. Physical exploration of materials		P		E
h. Using outdoor learning activities		E / P		
i. Taking children on field trips and/or visits to science museums and industry		E / P		
j. Integrating science with other curricular areas		P		E
k. Building on children's prior experiences		E / P		
l. Fostering collaboration			P	E
m. Encouraging different ways of recording and expressing ideas – oral, visual, digital, practical			E / P	
n. Encouraging problem finding – e.g. children asking questions		P	E	
o. Encouraging problem solving – e.g. children solving practical tasks		E		P
p. Encouraging children to try out their own ideas in investigations		E / P		
q. Fostering classroom discussion and evaluation of alternative ideas		E / P		
r. Fostering imagination		E / P		
s. Relating science to everyday life		E / P		
t. Using questioning as a tool in science teaching		P		E
u. Using digital technologies with children for science teaching and learning		E / P		
v. Fostering autonomous learning		E / P		

C. What, if any, Inquiry Approaches are discussed?

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

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Materials and Resources

A. What materials are suggested?

	Not Mentioned	Single Mention	Various Mentions	Emphasised
a. Instructional materials (e.g. textbooks)	E		P	
b. Audio-visual resources				E / P
c. Relevant library materials (e.g. story books)			E / P	
d. Equipment and materials for hands-on exploration in the classroom (e.g. magnets, building blocks)				E / P
e. Equipment and materials for hands-on exploration outside the classroom	E / P			
f. Computers	E / P			
g. ICT resources (e.g. computer applications)	E	P		
h. Other digital technologies (e.g. interactive whiteboard, camera)	P		E	
i. Budget for supplies (e.g. paper, drawing materials)	E / P			
j. Teaching support personnel (e.g. classroom assistant)	E / P			
k. Other support personnel (e.g. technical support)	E / P			

Groupings

A. What groupings, if any, are suggested for teaching Mathematics and Science?

	Not Mentioned	Single Mention	Various Mentions	Emphasised
Individual work			E	
Pair work	E			
Small group work				E / P
Whole class activities			E / P	

Time

A. How much time should be planned for teaching Science and Mathematics per week?

	Science	Mathematics	Evidence or comments
a. Less than an hour			
b. 1-2 h			
c. 3-4 h			
d. More than 4 h			
e. N/A (Please explain)	E	E	There are is no specific time frame for any of the activities and approaches presented in the curriculum

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Assessment

A. What purposes of assessment are included?

	Not Mentioned	Single Mention	Various Mentions	Emphasised
a. To identify areas for improvement in your science teaching		P		E
b. To identify aspects of the science curriculum that could be improved	E / P			
c. To identify ways to improve child science learning				E / P
d. To monitor regularly individual children's or cohorts of children's progress towards a set of desirable science learning outcomes				E / P
e. To inform parents of their child's progress in science	P	E		
f. To help group children for science instruction purposes	E / P			
g. To monitor year-to-year child progress in science	E / P			
h. To provide feedback to children about their progress in science		P		E
i. To set targets with children for their own development in science	E / P			

B. What importance is given to of the following priorities for children's assessment in Science?
To assess the development of children's:

	Not Mentioned	Single Mention	Various Mentions	Emphasised
a. Knowledge and understanding of scientific ideas (facts, concepts, laws and theories)	E			P
b. Knowledge and understanding of scientific processes	E / P			
c. Competencies necessary to carry out scientific inquiry	E / P			
d. Understandings about scientific inquiry (e.g. how science and scientists work)	E / P			
e. Positive attitudes and increase of interest in science	E / P			
f. Positive attitudes and increase of interest in learning science	E / P			

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C. What ways of assessing are advocated?

	Not Mentioned	Single Mention	Various Mentions	Emphasised
a. Using checklists to record observations of children	E / P			
b. During classroom interaction				E / P
c. Evaluating children's pictures, graphs etc which show their scientific reasoning	E / P			
d. Evaluating children's relevant gestures or physical activity	E / P			
e. Marking their homework	E / P			
f. Using authentic problem-based tasks	E / P			
g. Asking each child to reflect on their own learning and progress	E	P		
h. Using closed question tests	E	P		
i. Using open question tests	E	P		
j. Using questions in context	E / P			
k. Using portfolios (collection of evidence of children's work and progress)		P		E
l. Children correcting each other's work and giving each other feedback		E / P		

D. What Creative attributes are addressed in assessment?

	Not Mentioned	Single Mention	Various Mentions	Emphasised
a. Sense of initiative	P	E		
b. Motivation			E / P	
c. Ability to come up with something new	E / P			
d. Ability to connect what they have learnt during your lessons with topics in other subjects				E / P
e. Imagination			E / P	
f. Curiosity				E / P
g. Ability to work together			E	P
h. Thinking skills				E / P

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