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 4 of 13:
National Report on Approaches in French Policy

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

Project Information
Project no. 289081
Project acronym: CreativeLittleScientists
Start date of project: 01/10/2011
Duration: 30 months
Project title:

Creative Little Scientists: Enabling Creativity through Science and Mathematics in Preschool and First Years of Primary Education

EU Strategic Objective
Funding scheme: FP7/ CP/ Capacities
Call ID: FP7-Science-In-Society-2011-1
Topic: SiS.2011.2.2.3-1 Science and mathematics-related activities carried out in pre-school and in the first years of primary school: their link to the development of creative skills

Information about the deliverable
Dissemination level: **PUBLIC**
Due date of deliverable: August 2012
Actual submission date: 30/09/2012
Deliverable title:

D3.2 Report on Mapping and Comparing Recorded Practices

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

Executive Summary

This National report examines the way in which teaching, learning and assessment is conceptualised in French policy for early years science and mathematics, and the role for creativity. This report is one of 13 European national policy reports that are contributing to the Creative Little Scientist 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 French 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 is 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 from the survey were then discussed in sections within this report that drew upon other sources / commentaries to interpret approaches with the particular context of French Education and policy.

While Eurypedia provides comprehensive and comparable information, further information may also be found on the websites of the Department for Education, Youth and Community Life (Eduscol) and of the Department for Higher Education and Research.

We notice that if the various official web-sites offer lighting on the content and form of teaching science and mathematics, it is very difficult to obtain information about the role of creativity in these teachings. However, sites such as “la main à la pâte” emphasize the importance of putting in place mechanisms for learning and understanding objects and phenomena that surround and develop curiosity, creativity and critical thinking. But we notice that these objectives are specific to the teaching of science, and the development of these skills in contrary it is very little emphasize in the case of mathematics.

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 for policy recommendations.

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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 Scotland. 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 question for this phase of the project was: *How is teaching, learning and assessment of science and mathematics conceptualised? What role does creativity play in these?*

In order to analyse French 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 French policy.

1.1 Defining terms

Three terms often used in this report that would benefit from defining are: Policy, Curriculum, and Creativity.

1.1.1 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 according to messages in formal written documentation. This may include either statutory requirements or guidance.

1.1.2 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.

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1.1.3 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 Review of Science and Mathematics education in pre-school and early years of primary school (Task 2.2), an appendix to the *Conceptual Framework*, the following definition is used in relation to creativity in Science and Mathematics: '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 is compulsory between the ages of 6 and 16 years. However, France has a **long tradition of pre-primary education**: for the past twenty years, almost all children attend nursery school from the age of three, even though it is optional; it is therefore an integral part of the French education system and falls under the responsibility of the Departement of National Education which sets the curricula. **French pupils tend to specialize quite late on**: since the 1975 Act, they are taught common subjects until the age of 15 within a "*collège unique*" (ISCED 2). The first phase of specialization occurs at the end of *collège* (lower secondary education): pupils are streamed to attend either a general and technological high school (lycée) or a professional one (lycée). Both types of school prepare pupils to obtain the *baccalauréat* in three years, marking the end of secondary education: pupils who pass successfully the national exams obtain the State-issued diploma (general, technological or vocational) which opens up access to higher education and entitles them in order to be inscribed at university. **Higher education in France is characterized by the coexistence of two systems**: universities, – public institutions that have an open admissions policy, except for the IUT - technological university institutes (instituts universitaires de technologie) or the integrated preparatory classes (classes préparatoires intégrées) – and a non-university sector, including, mainly , the Grandes Ecoles, institutions with a highly selective admission policy open to *baccalauréat* holders having attended two years of preparatory classes, themselves highly selective on entry and during the course. The French education system is organized into several **levels of education**:

- Pre-primary education (ISCED 0), which is dispensed at "nursery schools" and take children from 2/3 up to 6 years of age. Almost all children attend nursery school from the age of three, even though it is optional. Such schools therefore form – together with the elementary level - an integral part of the French "primary level of education", which is under the aegis of the Department for National Education.
- Primary education (ISCED 1), which is provided in "elementary schools" and admits children between the ages of 6 and 11. It marks the start of compulsory Instruction and is secular and free of charge when dispensed in State schools. At the end of this 5-year-course, pupils automatically access to the secondary level of education (there is neither standardized tests nor guidance procedures).
- Lower secondary education (ISCED 2), which is provided in *collèges* for 4 school years (pupils between the ages of 11 and 15 years). Education in *collèges* is compulsory and common to all pupils. A national diploma (the *brevet*) is awarded at the end of *collège* schooling. Admission to upper secondary level is not conditional upon success in the brevet. At the end of collège schooling (15 year-old pupils), the school recommends the appropriate scholastic path to families, basing its recommendation on the pupil's school reports and particular interests. Children will continue their schooling either in general, technological

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or professional education, provided at upper secondary level.

- Upper secondary education (ISCED 3), which is dispensed in "general and technological lycées" or in "professional lycées", which extends over 3 years (pupils between the ages of 15 and 18 years). Upper secondary education provides three educational paths: general path (which prepares pupils for long-term higher studies), technological path (which mainly prepares pupils for higher technological studies) and professional path (which leads mainly to active working life, but also enables students to continue their studies in higher education). A national diploma is awarded at the end of secondary schooling: the baccalauréat. It which is both a sign of successful completion of secondary studies and the first step in university education, access to higher studies being conditional upon its obtention. Pupils at professional lycées can prepare the CAP (*Certificat d'aptitude professionnelle*), a course of study extending over 2 years, after what they can either integrate active working life or prepare the professional baccalauréat after 2 additional years of studies.
- Higher education (ISCED 5 and ISCED 6), which is dispensed in higher educational institutions. These institutions have a wide variety of legal statuses that are listed in the French Code of Education (book VII). Courses dispensed at these institutions have different aims and conditions for admission, but most of them are structured into three study cycles (Bachelor's degree, Master's degree and Doctorate) and in ECTS credits, in compliance with the principles of the Bologna Process.

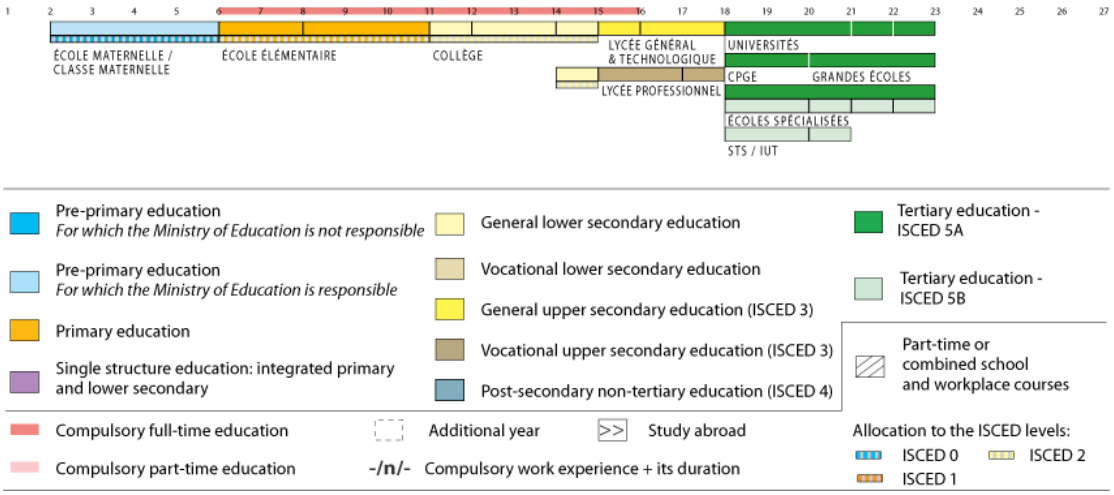

Figure 1: Structure of the French Education system (Eurypedia, 2012)

2.2 Regulation

The French education system is characterized by **strong State presence in the organization and funding of Education**. The State defines the details of curricula at all education levels; it organizes the teachers' admissions procedure, defines content, recruits teachers who become civil servants, provides them with in-service training.

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2.3 Inspection

The State recruits and trains inspectors, responsible for controlling the quality of the education system.

The evaluation of teachers on one part foresees all forms of examinations, competitions, scoring, skills assessment, counseling or screening, and on the other part the evaluation of actions which_includes forms of assessment methods, activities, devices. The inspection of teachers is one of the most commonly used terms. It includes the assessment of skills in professional situations as well as counseling and support (ESEN). The inspection aims to control teachers and their teaching ability. It is conducted by a General Inspector of Education who gives a final report and a teaching assessment as well. The teacher may request an inspection. All visits by inspectors in the establishments are announced in advance and in order to attain concrete objectives. A meeting with the head teacher and a tour of the facility are recommended for preliminary observation providing information about the sociocultural environment, the school plan, the curriculum and pupils. The individual inspection includes a thorough interview with the teacher and the teaching team as well.

The inspection report covers all activities of the teacher (http://premier-degre.snec-cftc.fr)

2.4 Curriculum

In France, the definition and implementation of educational policy are the responsibility of government, within the general framework established by the legislator which, pursuant to the Constitution, sets the general rules applicable to the education system. The **State**'s role, through its ministers, remains key in the governance of the education system. Not only is it in charge of elaborating education policies but also of recruitment, training and remuneration of teaching staff and funding of educational activities. It also guarantees consistency of training - school programmes are designed and set at the national level.

"The fundamental requirement of the French Republic and the main objective of the **primary school** is to give children the keys to knowledge and teach them how to integrate with the society in which they are growing up" (extract from the preamble to primary school programmes, Official Bulletin special edition no.3 of 19 June 2008). Its missions are also evoked by the Guidance and Planning Law for the Future of Schools of 23 April 2005 :

- to guarantee satisfactory mastery of basic skills;
- to provide equal opportunities to all, and ensure successful integration into French society;
- to accompany each and every pupil by helping them overcome any difficulties they might encounter;
- to enable each and every pupil to express their excellence to the full.

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"The main objective of **pre-primary** education is acquisition of rich, organized spoken language that can be understood by others. At nursery school, a child establishes relationships with other children and with adults. It practices its motor, sensory, affective, interpersonal and intellectual skills, progressively becoming a student. It discovers the world of the written word" (extract from the Official Bulletin special edition no.3 of 19 June 2008). A child's right to receive pre-primary education and the nursery school's educational responsibilities are asserted in the two fundamental guidance laws for schools:

- the Guidance Law on Education (*Loi d'orientation sur l'éducation*) of 10 July 1989 (Article 2, codified in Article L113-1 of the French Code of Education);
- the Guidance and Planning Law for the Future of Schools (*Loi d'orientation et de programme pour l'avenir de l'école*) of 23 April 2005 (Article 24, codified in Article L321-2 of the French Code of Education).

The most recent regulatory provisions on timetables and programmes are detailed in the Official Bulletin special edition no.3 of 19 June 2008.

Currently applicable primary school curricula are described in the B.O hors série no.3 of 19 June 2008. They "define, for each teaching domain, the knowledge and skills to be attained within the framework of cycles; they indicate annual references to organize progressive learning in French and Maths. They however leave teachers free choice as to their methods and approaches, adapted to pupils' requirements" (Preamble to primary school curricula).The times and content of curricula are set out per subject (French, Maths, Physical and Sports Education, Discovery of the World, Art and History of Art, Experimental Science and Technology, Modern Languages, History-Geography-Civic and Moral Instruction), whereas the objectives to be attained are defined by the multi-annual learning cycle (basic learning cycle and consolidation cycle). One of the finalities of the primary school curricula is to lead children to reach the first two stages of the common base of knowledge and skills. Each of the two stages is assessed in a standard way: the first stage is assessed at the end of the first learning cycle (CE1 class, 7-8 year olds), the second at the end of the second cycle (CM2 class, 10-11 year olds). The objectives to be attained for each stage are also defined in the curricula.

Common base of knowledge and skills

The common base of knowledge and skills is a key provision of the guidance and planning law for the future of schools of 23 April 2005, a law whereby the French State redefined what each citizen should be taught in school. It was enforced by the decree of 11 July 2006. This law designates all knowledge and skills that each pupil should master at the end of compulsory education, considered to be necessary to have successfully completed education, to continue training, build personal and professional life and contribute to success of life in society. The Department of Education is committed to transmitting 7 major skills:

- mastery of the French language;

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- practice of a foreign modern language;
- the main components of mathematics and scientific and technological culture;
- mastery of usual information and communication techniques;
- humanist culture;
- social and civic skills;
- autonomy and initiative.

Each major skill is designed as a combination of fundamental knowledge, capacities to be implemented in various situations and attitudes needed throughout life. This "common base" acts as the reference for drafting school and college curricula (ISCED 1 and 2). The 7 skills are progressively acquired from nursery school to the end of compulsory education (which corresponds to the first year of lycée - ISCED 3). Each skill requires the contribution of several subjects and, reciprocally, a subject contributes to the acquisition of several skills. At primary school and collège, all teaching and subjects play a role in the acquisition of the base. Official texts specify that compulsory education is not reduced to a common base: "even though it is the foundation, the base does not replace primary school and collège curricula; nor is it their condensed version. Its specific feature lies in the will to give meaning to basic educational culture" (Department of Education).The common base is organized into three stages, which are assessed throughout compulsory education: the first stage is monitored by a standard test in the second year of elementary school; the second stage in the last year of elementary school; the third stage in the last year of collège. Education Code - art. L.122-1-1 Education Code - art. D 122-2: "Objectives and missions of school education".

Elaboration of curricula

Elementary school curricula are devised at national level, following the same procedure as curricula of other teaching levels.

Content of curricula - basic learning cycle

The basic learning cycle starts during the "final year section" of nursery school and, at that level, uses its teaching method. It continues in the first two years of elementary school, during the "cours préparatoire" (CP - preparatory class) and in the first year "cours élémentaire (CE1 - elementary class). Reading, writing and the French language, knowledge and understanding of numbers, their numeric writing and arithmetic in small quantities are the main learning objectives of the CP and CE1. Here is the list of subjects taught, followed by a few extracts of curriculum content for each subject (B.O hors-série no.3 of 19 June 2008):

- French;
- Maths;
- Physical and sports education;
- Modern language;

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- Art and history of art;
- Discovery of the world (introduction to the world of Information and Communication Technology);
- Civil and moral instruction.

Maths

Maths teaching develops rigor and precision and a taste for reasoning. Knowledge of numbers and arithmetic are the priority aims of CP and CE1. Problem-solving is progressively taught and helps to build a sense of operations. Together with regular mental arithmetic, it is indispensable. Pupils become progressively familiar with usual representations: tables, graphs.

Discovery of the world

In CP and CE1, pupils have easier access to knowledge resulting from their reading and mathematical skills. They acquire references in time and space, knowledge of the world and master corresponding specific vocabulary. Pupils start to acquire skills required for the brevet computers and internet certificate. They discover and use basic computer functions. They use reference and time measuring tools: calendar, clock, etc. Pupils discover and memorize references that are more distant in time: a few dates and characters in French history; they become aware of changes in lifestyles. In CP and CE1, pupils start to identify the features of living entities: birth, growth and reproduction; nutrition and animal diets. They learn a few rules of personal and collective hygiene and safety.

2.5 Science and mathematics attainment

The minister of national education in 2011 has presented a new reform that aims to improve the performance of pupils in mathematics, sciences and technology. This reform was imposed by enquiries and studies that show that the declining performance of French pupils in international evaluation test can be reversed only by measures like:

- Changes in the recruitment of teachers. Henceforth the recruitment competition for the primary schoolteachers contains a written test in mathematics and in sciences and technology in order to guarantee the candidates' teaching proficiency in these didactic fields and their ability for reasoning logically and for precise and rigorous communication.
- A new training-instruction program for the teachers in mathematics and sciences because the majority of them emanates from schools of letters or of social sciences (approximately 75%), and consequently doesn't master the teaching of mathematics and sciences.
- A new didactic aid by manuals (like the catalogue SCÉRÉN-CNDP) and internet sites (like eduscol.fr, ASTEP, la main à la pâte) that offers to teachers the necessary resources in order to improve their teaching efficiency in the classroom.

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3. Research Questions and Methodology

3.1 Research Question

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 French?

The sub questions identified within this overarching research question were:

- *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 French?*
- *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 French?*
- *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 French?*

In order to examine how teaching, learning and assessment are conceptualised across *French* 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 a 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 project set out to examine Teacher factors addressed in policy, in particular the approaches documented in relation to both:

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

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. As there are no specific early years science and mathematics documents in *French*, this meant drawing upon documents that related more generally to the early years, as well as more generally to science and mathematics.

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 French 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 French 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; Location; Learning activities; Teacher role; 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 the *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 Scottish 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, 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

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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.

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 questionnaire. 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

What are the key summary points?

The key points of the common base for the learning of mathematics and science in schools converge on the necessity to provide pupils a « scientific literacy ». That means, to know and go to the right sources of information such as scientific articles. The objective is for the pupil to obtain « a coherent representation of the world ». The child must know to find his place among objects in the environment, to understand the interaction between himself and the world, and the relations between objects. Children must have « an approach to the complexity of fundamental laws ». They must begin to understand how events and natural phenomena occur, and how their environment works. These basic skills pass through the "handicraft" and foster an "intellectual rigor» based on the "scientific reasoning" (Socle commun des connaissances et des competences).

What issues / tensions / policy criticisms exist?

This view of learning science and mathematics appears to be a consensus into the educational community in France.

In what ways is the role of creativity emphasised?

In *sciences* (experimental sciences and technologies) the principal objective is to help pupils understand and describe the real world, the nature and the human interventions. Observation, questioning, experimentation and argumentation are extremely important in order to achieve these goals. That explains why the knowledge and the competences

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are acquired within the scaffold of an investigation process. This process serves to develop the pupils' curiosity, creativity and critical thought for the scientific and technical progress (education.gouv.fr).

What are the main differences between preschool and school?

In pre-school, learning science and mathematics lie in a holistic view focusing, according to the State Inspectorate, on "a posture of research that aims to discover." What is intended here is primarily the discovery of the world.

In school, this learning will become more concrete, and go through the knowledge and understanding of key scientific ideas. This will be for teaching science and mathematics to develop a social and environmental awareness among children, and foster the development of civic conduct (Socle commun des connaissances).

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

According to the common core of learning, mathematics would provide pathways for pupils to "act, choose and decide in everyday life". This teaching would develop a form of logical thinking, the capacity for abstract and spatial orientation. It would allow children to acquire logical reasoning and the taste of the demonstration.

Science education in turn, would above all an understanding of the real world based on observation, questioning, handling, and experimentation. It would provide a taste of science and technology, and enables complex scientific concepts with everyday life.

4.2 Aims and Objectives

What are the key summary points?

The key points about the main objectives of education policy in France, are primarily summarized into:

- offer the child an "understanding of the real world,
- know how to "describe" it ,
- get adapted to it,
- acquiring the basics of investigative approach" based on "observation, questioning, experimentation and reasoning. "

From pre-school, children are introduced to the investigative approach that develops curiosity, creativity, critical thinking and interest in the scientific and technical progress.

The objectives are the understanding and description of the nature and the world created by man and of changes induced by human activity.

The practice of mathematics develops a taste for research and reasoning, imagination and abstraction capabilities, rigor and precision.

Mathematics, technology and science experiments are an integral part of teaching which allows pupil to build a comprehensive and coherent representation of the world and

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understand his everyday environment. Mathematics is considered to be a fundamental dimension of pupil learning and science and technology based on knowledge of the principles and purposes of scientific reasoning are also an effective practice of the scientific method. Mathematics is one of the seven competencies defined by the common core that all pupils must master at the end of compulsory schooling (eduscol).

What issues / tensions / policy criticisms exist?

Again, we found no major objections

In what ways is the role of creativity emphasised?

In school curricula, only in CE2 appears the notion of creativity as one of the main goals of science learning. However creativity is not mentioned in the texts concerning the mathematics learning. It comes out only in science as part of the process of investigation that leads through creativity in the acquisition of the skills for the understanding the real world.

What are the main differences between preschool and school?

In pre-school, the main objective is to allow child to discover his "close world". The main objectives, according to the Ministry of Education, are to teach him to use the spatial and temporal landmarks, and to adopt a different point of view than his own. Similarly, pupil learns to confront the logical thinking and get familiarized with reasoning.

Finally, the purpose of learning sciences and mathematics through the "discovery of the world" is to give pupil the ability to distinguish what belongs to the living world and what not.

In CP and CE1, the child learns to determine time and space. Schools Curricula stipulate the importance of acquiring knowledge about the world and of mastering the relevant vocabulary. Pupil learns to exceed his initial representations through manipulation and observation. One of the main objectives is also learn the basic functions of the computer.

For CE2, in mathematics, the aim is pupils to begin developing abilities like researching and reasoning, imagination, capacity for abstraction, rigor and precision in order to enhance their knowledge and acquire new tools for solving problems. Another important goal is also to strengthen mental math skills and to develop new automations.

In science, the aim is children to "understand and describe the real world, that of nature and the manmade, and master the changes induced by the human activity.» Formal programs indicate the importance of proceeding through observation, questioning, experimentation and reasoning in order to achieve these goals. Using the investigative approach pupils foster curiosity, creativity, critical thinking and interest in scientific progress (education.gouv.fr; Socle commun des connaissances; Guide ptratique des parents).

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

In pre-school, CP and CE1, the main objective of learning science and mathematics is to teach pupil discover the world.

Later, in CE2, the two disciplines have goals more distinct. In mathematics, it will be to focus on the development of logical thinking, while the sciences foster the emergence of experimental reasoning leading to conduct experiment, to investigate.

4.3 Content

What are the key summary points?

"Pre-school education contributes to children's overall development and prepares them for elementary school (primary education). Games play an important part, which does not preclude discipline and effort and helps to explore life settings, action in or on the nearby world, imitating others, inventing new gestures, communicating in all its dimensions, looking at oneself which encourages observation and reflection, discovering the opulence of imaginary worlds… It is the starting point of a number of didactic situations offered by the teacher. It carries on towards more structured education which remains to be no less fun.

It is the responsibility of the team of teachers to ensure that their pupils, throughout their schooling, explore a large variety of situations and cultural worlds along with the use of various tools and instruments. There is room for digital supports in pre-school, alongside toys, games, play areas or books (Eurydice 2009/10).

For the pre-school the duration of courses for the pupils is twenty-four hours per week.

The learning aims are organized in many diverse domains:

- Enhance the language
- discover the writing
- become pupil
- act and express themselves with their body
- discover the world
- perceive, feel, imagine, create

In the pre-school, the child discovers the direct, close world; he learns how to take and use space and temporal reference marks. He observes, he raises questions and he learns how to adopt another point of view and his confrontation with the logical thought that gives him a taste of the reasoning. The pupil becomes able to classify, to order and to describe, thanks to the language and to other varied forms of representation (drawings, diagrams). He starts to understand what distinguishes living, from not-alive (matter, objects). In sciences, the new programs foresee that the child carries out alone his own experiments and uses an observation notebook in order to keep in what he thinks

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important during his experimentation. That gives him the opportunity to learn how to argue, describe and present assumptions.

The elementary school is obligatory for all the children, French and foreigners, from 6 to 11 years old. The basic objectives are to inculcate the first knowledge in young children and educate a good citizen.

The duration of courses for the pupils is twenty-four hours per week. Pupils meeting difficulties can profit in addition two more hours of individualized learning program.

The French elementary education contains 2 "circles", one for the 2 first classes C.P and C.E1 (the circle of fundamental knowledge) and a second for the rest 3 C.E2, C.M1, C.M2 (the circle of profound knowledge).

The circle of fundamental knowledge begins already in the nursery school and continues in the 2 first years of the elementary education. The priority objectives of the C.P and C.E1 are:

- read and write in French
- good knowledge and comprehension of numbers
- learning and use of the decimal numeration
- calculation using small numbers

Especially in ***mathematics*** curricula the aims are: - to provide pupils with all knowledge needed in order to learn progressively how to solve a problem and how to make mental calculations; - to develop pupils' mental ability for research and reasoning, their imagination and the capacities of abstraction, of rigor and precision.

In ***sciences*** **(discover the world)** the main objective is pupils to understand the world, their environment and to learn and use properly the vocabulary of natural science. Observation, questioning, experimentation, manipulation and argumentation are extremely important in order to achieve these goals. That explains why the knowledge and the competences are acquired within the scaffold of an investigation process. This process serves to develop the pupils' curiosity, creativity and critical thought for the scientific and technical progress.

The pupils discover the basic functions of computer and they develop the basic IT competences.

What issues / tensions / policy criticisms exist?

No tensions were found.

In what ways is the role of creativity emphasised?

Creativity is emphasised in content for science in a very similar implicit sense as in the aims and objectives section above.

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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 the primary school.

For nursery pupils, the emphasis is given, according to the Ministry of Education, to discover objects, materials, the living world, shapes and sizes. They learn also to navigate in time and space.

According to "the practical guide for parents," the content of education consists in recognizing, naming, comparing, storing and classifying objects and materials according to their qualities and uses. Pupils learn observing the animal and plant life and communicate major functions such as growth, nutrition, locomotion and reproduction. They get used to the rules of hygiene. They learn also to name the main parts of the human body and develop the ability to spot and avoid danger. Similarly, the child learns to use the notions of the day, week and year in order to place the events by chronological serial. He learns how to drawing rounds, squares, triangle, compare quantities and solve small problems. Pupils should learn to corresponding numbers with their names and write ciphers. They learn to navigate in space and understand and use appropriately the temporal and spatial vocabulary.

In CP and CE1, the child enhances the knowledge gained during the nursery school. He learns to master digital environment, to observe and describe, to investigate. He learns to apply the basic safety rules and how to prevent the risk of home accidents. He should be able to distinguish the recent past from the more distant past. He acquires the basics of numbers and calculation, of problem solving, and of mental arithmetic. He develops and strengthens his skills in mental calculation.

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

In pre-school, the two disciplines are combined, in a much more global approach into one: "the discovery of the world." We have to wait until CE2 in order to see the two disciplines distinguish themselves by their hours of instruction, content, and their teaching practices.

4.4 Learning Activities

What are the key summary points?

The purpose of learning activities is promoting education based on scientific investigation. Exploring the world, scientific learning, experimentation and reasoning, argumentation and citizenship education are associated. Every child should deepen its understanding of objects and phenomena that surround and develop curiosity, creativity and critical thinking.

The aim of the proposed ‘‘hands on" activities for teachers in order to teach science in school, is to develop pupils’ "curiosity" about "objects and phenomena around them "in a interesting and inspiring scientific inquiry ". This process offers to the pupil the chance

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to formulate "assumptions planned to be tested by experiment or verified by a documentary approach." The purpose of playful learning contexts is to permit children to clarify «scientific concepts and operative techniques".

What issues / tensions / policy criticisms exist?

The initiative called «hands-on" is a real consensus among the actors of the French educational community. It is a real assisting manual provided to teachers about teaching practices in science and mathematics. The device has earned the respect of educational community and it is managed in national level by a team of teachers, trainers, education inspectors, and science students. However, authors like Florin (2007) warn about the necessity to upgrade the game and the action of children in the educational procedure

In what ways is the role of creativity emphasised?

Creativity is emphasised in implicit sense as in the aims and objectives section above.

What are the main differences between preschool and school?

The science learning is promoted by the application of the "hands on" activities, by means of theater, of various equipment exploration, or of outdoor activities like gardening.

In cycles 1 and 2, pupils learn science and mathematics through fun activities. Spatio-temporal learning for example may be made through designing and layout class or school plans. The animal and plant biology or the various vital functions (nutrition, reproduction ...) are integrated in an activity called "Oh a cow" that foresees a farm visit by the children where they can meet a veterinarian. Human anatomy can be taught through an activity in which pupils should handle the weigh-yards in order to measure their size and weight. Through small races, bending exercises or jumping rope, they may observe how physical activity is accompanied by physical changes. The discovery of living can also be promoted through projects like “citizens clean nature”. This is a project focusing on the environment and sustainable development. The child develops environmental conscience and learns the significance of species preservation and through several topics like: control of water consumption, waste, and the diversity of life observing his "little animals"...

Environmental learning offer in both cycles similar activities, but it isn’t focus on the same skills. Each activity focuses on specific points of the program. For example, gardening aims to promote the discovering of the native plant world by the child. This activity gives pupil the opportunity to observe the growth of a plant. In primary school, the same activity permits children to conduct simple experiments, to fit into and progressively complete a project. The "common core" manual made by the government for the teachers, underline the importance of putting learning science in its historical context. Through the history of science and the science evolution, the child can extract the principal theoretical knowledge.

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The "Practical Guide for Parents", for all school parents serves for monitoring the progress of the children, and give details about the importance of using other areas of activities in order to promote science learning. This will generally encourage the child to solve problems and ask questions in everyday life (for example encourage the child to use digital technologies) (lamap.fr; Socle commun des connaissances).

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

As we noted earlier, in the first cycle of learning there is no big difference between the contexts of learning science and mathematics. Until CE2, the two subjects are taught through various activities that aim to help children to discover the world. Thus, these activities permit children to approach at the same time the basics of both, science and mathematics. For example, an activity of weights and measures comparison can help children to understand notions like heavy and light. Children can also observe physical changes in their own body as a consequence of making effort (after carrying a heavy weight for example).

In CE2, the two disciplines are becoming distinct. Recreational activities, promoted in the "hands on" permit children to continue learning both disciplines, but eventually they are focusing on scientific and experimental knowledge. Mathematics instruction becomes more formal, more “traditional”.(for example children are asked to learn by heart the multiplication tables)(Guide pratique des parents)

4.5 Teacher Role / Location

What are the key summary points?

Mainly to encourage children to ask questions, to observe and investigate his environment.

What issues / tensions / policy criticisms exist?

No tensions was found

In what ways is the role of creativity emphasised?

As above

What are the main differences between preschool and school?

In general, independently of the level of school (nursery or elementary), tools like the «hands on", are helping teachers to make their lessons using activities that allow them to foster the "curiosity of their pupils about objects and phenomena of the world and to promote the scientific inquiry.

In primary school, the aim is to formulate hypotheses and test them afterward-using experiment. "The pupils are invited and motivated to observe the natural phenomena (for example, observation of plant growth). The manifestations of life can be more systematically observed by the child, paying attention on himself as on animals and plants as well. The aim of this approach is to foster the questioning of children about

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objects, events and phenomena around them in the world where they live. They are also asked to plan and conduct a simple inquiry and to use tools that permit them to collect data and to attain results. They learn how to build small electric circuits and adopt attitudes that can help them avoid any potential danger. The objective here is to teach them give reasonable and reasoned explanations.

In pre-school pedagogy, activities involving the exploration of the environment, manipulation and games have a preponderant place. Teachers observe precisely the behavior and the achievement of the children to help them and adjust their demands on knowledge acquired and needs of everyone. The teacher is completely free to choose the teaching methodology and the pedagogical equipment (toys, educational games, books, audio-visual material, etc.). There is no State control for the publication of school books. The State sets the national programme of pedagogical contents for all levels and publishers freely put together the pedagogical material according to this programme. There is no national policy regarding supplies for this level of education.

In general, in pre-school, pupils are provided with a rich, open educational environment promoting action and questioning, that help them structuring acquisitions, like expression and communication, in order to permit to communicate the results of their investigations (lamap.fr).

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

There are no major differences between the sciences and mathematics at this level.

4.6 Materials and Resources

What are the key summary points?

The main “tool” existing for the teachers is "the bank of assessment tools" offered by the Ministry of Education. It provides "assistance" to teachers and "the opportunity to assess pupils easily, immediately in the classroom at any times during the school year." Other features like "the device ASTEP" provide assistance (a “support” or “accompaniment”) from their part to the teacher in his daily classroom practice.

What issues / tensions / policy criticisms exist?

The teacher has a large autonomy regarding the choice of tools that can facilitate the practice of science teaching. There is no hardware or approach imposed by the Department or the Ministry. Teachers can simply help themselves if they wish using tools offered like the «tool bank" or the ASTEP device. Teachers can use the hardware of their choice for exploration in the classroom, computers, or any other type of ICT.

In what ways is the role of creativity emphasised?

Creativity is not explicitly mentioned

What are the main differences between preschool and school?

No differences were identified for materials

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

The difference noted here is in the learning context. The tools available for science teachers are much more fun than those of mathematics. Indeed, science exercises make often part of fun activities (like drawing or singing). For mathematics the teaching material is much more formal demanding the use of pencil and paper in order to solve "severe" and sometimes "boring" exercises.

4.7 Groupings

What are the key summary points?

To promote

- the "collective learning"
- the "spirit of collaboration."

What issues / tensions / policy criticisms exist?

There is a clear consensus about the importance of encouraging collective activities for learning science and mathematics.

In what ways is the role of creativity emphasised?

There was no clear emphasis on creativity

What are the main differences between preschool and school?

In nursery, CP, CE1, and CE2, devices like "hands on" or "the bank tools" provide contexts and learning tools. "Discovering the world" and then science are channeled mainly through group activities in which the child will learn while working. We cite for example activities like "Oh Cow! We have to note that the most of the activities proposed by the hands-on focus on a collective and collaborative basis. The bank PROSERA tools propose also a variety of evaluation contexts. It contains many tools individuals and collective tools (lamap.fr; education.gouv.fr).

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

No clear differences were identified. The two disciplines are combined into a single, discovering the world.

4.8 Time

What are the key summary points?

The teaching schedule of "the discovery of the world" is "not determined" in nursery. However, in primary school, despite the fact that the teacher is "not subjected to strict observance of weekly hourly rate (schedule) for teaching science and mathematics, he must however "respect an annual hourly rate" for both disciplines (Guide pratique des parents; education.gouv.fr).

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What issues / tensions / policy criticisms exist?

We didn't identify any major opposition or contradiction in official texts.

In what ways is the role of creativity emphasised?

No mentioned

What are the main differences between preschool and school?

The time dedicated for learning science and mathematics is not clearly determined in nursery. The schedule concerning the "discovering the world" is flexible and depends on teacher's pedagogical project.

In primary school, schooling covers twenty-four hours a week from Monday to Friday.

In CP and CE1, at least five hours per week must be booked for the teaching of mathematics. The variation of the weekly schedules depends on the teacher's pedagogical project in accordance with the number of hours determined for each subject, moreover, eighty-one hours annually for teaching the discovery the world (parent handbook).

In CE2, at least five hours per week must be booked for the teaching of mathematics. Eleven hours per week are dedicated to the teaching of modern languages, artistic practices, sports practice, history and geography, and experimental sciences. The variation of the weekly schedules will depend on teacher's pedagogical project in accordance with the number of hours determined for each subject, moreover, seventy eight hours annually to the teaching of experimental sciences (Guide pratique des parents; education.gouv.fr).

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

Since the CP, the time reserved for mathematics is clearly determined by the official texts. The teacher must respect a weekly schedule. Regarding the teaching of science, it is more flexible and depends on the teacher's pedagogical project.

4.9 Assessment

What are the key summary points?

There are two types of pupil assessment: regular assessments and standardized assessments.

At elementary school, regular assessments are made by teachers during each cycle to test pupils' acquired skills. These assessments do not use national standardized tests. They are based on conventional tools such as written assignments, tests, etc. These regular assessments are featured in the "school report book" tracing the pupil's school record from the end of nursery school to the end of elementary school and observing skills acquired in view of his/her college entrance. This book is used to inform parents

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regularly of their children's progress and to organise exchanges between primary school and college teachers to guarantee continuity of teaching.

Progressive assessment of knowledge and skills of the "common base" is done through national standardized assessment, organised in three stages:

a) the first assesses acquisition of reading and writing, as well as initial mathematical elements. The test is taken by CE1 pupils (second year of elementary school; 7 to 8 year olds);

b) the second stage is an appraisal of CM2 pupils' acquisitions (last year of elementary school; 10-11 year olds) in the seven major skill areas.

c) the third stage concerns college pupils (last year of lower secondary education); 14-15 year olds) It assesses the seven skill areas of the common base.

A pupil's progression in each cycle is determined on the basis of the teacher's proposal to the cycle teachers' council. After examination of the situation of each child, the cycle teachers' council states an opinion concerning the transfer from one cycle to another and the time taken by pupils in the cycle: this can be lengthened or shortened by one year, depending on children's learning rhythms. The school head informs the parents of the proposals made. Parents can dispute the decision within a 15 day deadline, sending a justified appeal to the academy inspector, the department's director of the Department of Education, who makes the final decision.

What issues / tensions / policy criticisms exist?

The assessment of children is not clearly defined, nor in primary school or in pre-school. The government imposes in its program to acquire certain skills at the end of each cycle but does not foresee any tools or evaluation context to achieve their evaluation. Each teacher and each school has its own means of assessing the acquisitions of children in science. The Ministry of Education, however, has defined the objectives to be met by all pupils' evaluations. Thus in his June 2007 report it determines the importance of evaluation to allow the teacher to identify areas of his teaching to develop, and points to change in the way of delivering science to children. Through this evaluation teacher can follow the progress of pupils individually or of groups of pupils according to the determined learning bases, and he can give them feedback on their progress. According to the common core of skills, evaluation should also aim to enable parents to monitor their children.

However, it seems difficult to obtain clear recommendations about what has to be evaluated in terms of acquisitions, knowledge and scientific skills. Official documents issued by the Government underscore just for the nursery school the importance for children to acquire knowledge about the main ideas and the key scientific processes. The same report underlines that "at school, the programs are well organized in terms of skills, concerning the bearing end of the cycle which is generally well located… the intermediate steps, however, are poorly defined».

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This fact poses both, a problem of education (including a lack of continuity and of progression in the teaching learning) and an evaluation problem. The choice of skills assessed for the same level can vary from one school, but also from one class to another depending on individual choices of the teachers.

This situation is directly related to the fact that the official documents do not specify the teaching progress of skills during the various cycles. This reflection has been delegated to schools and finally abandoned to the discretion of local initiatives resulting in wide disparities from one school to another. We cannot revive the discussion on the book to be selected without having a clear definition of expected skills, without giving teachers more specific benchmarks. This also requires a clearer definition of the concept of competence and an elucidation of what has to be evaluated (global competence, component, knowledge, ...).

Thus, despite the "bank of assessment tools", proposed by the Ministry of Education the teachers remain perfectly free to choose how and with what equipment they will access their students' progress (Rapport n°2007-048, 2007).

Finally we have to underline that the principal criticisms concerns the national evaluations (at the end of CE1 and of CM2) are :

- First of all because they take place too late -almost at the end of the year- to be useful to teachers and
- Secondly they are used as statistics, as numbers the most of all for the internal administrative Government communication.

In what ways is the role of creativity emphasised?

Creativity is not explicitly mentioned.

What are the main differences between preschool and school?

In pre-school and in primary school, forty-two assessment tools and teaching support proposals are offered to teachers by the "tool bank". Some of them seek a collaborative assessment and other an individual-one. The teacher chose finally the assessment method and the tools to use according to his priorities. We can spot eighteen exercises to assess the competency areas related to “the discovery the world”. They consist the tools to master skills like: quantities and numbers, structuring of time and space, mathematics, basic motor actions, memory and attention. For each tool, the teacher has a set of presentation, a set of procurement, as a support to proceed with the evaluation. We have to note that this type of assessment is not mandatory.

In primary schools, programs are tailored to permit pupils the mastery of the common base of knowledge and skills. Teachers are responsible for assessing acquisitions on a regular basis depending on the programs. They must find a good assessment procedure during the year and communicate to parents the results of their children. Every two years, national evaluations are taking place at national level in French and mathematics

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for the pupils in CE1 and CE2. These assessments allow teachers to measure the acquisition of common ground, the basic knowledge, and the results are recorded in a personal booklet of competence, provided with the school record.

This is "a first observation of the skills in the areas ... of early learning in mathematics" In order to identify and to analyze the difficulties faced by some pupils of CE1 in these areas. From this analysis, teams of teachers can determine more accurately the responses to these challenges "(Florin, 2007).

The device remains a mandatory diagnostic assessment for all primary school in France since 2006. This is to assess students' skills and identify their problems in order to provide then differentiated teaching assistance (Florin, 2007).

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

The main difference regarding the assessment of mathematics and science at school is that assessments in science are not mandatory. Au contrary the mathematic skills are tested in CE1 and in CE2.

In the pre-school the teacher is not obliged to evaluate and he is completely independent in the choice of tools to be used.

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5. Approaches to Teacher Education

5.1 Initial teacher education

The initial training of teachers is based on obtaining a "license" and a "special master". All studies take place at the "university".

The initial teacher training remains the same whether for the teachers of primary school as for them of the pre-school as well. The candidate teachers have to reach the level bac+4 that corresponds to a master1. The most common route is after obtaining a bachelor, to follow the three-year license (that was enough as a teaching qualification), or in some discipline, to continue even further in the two-year master degree in teacher education. The entire training takes place today in the university, but can also be completed in IUFM (University Institutes of Teacher Training) that provides Master1.

The entrance in IUFM emphasizes the importance of a competitive master in areas like: tools of expression, communication, computation and reasoning, French, mathematics, languages, science, and art. After the IUFM (which is not mandatory) there is a national test in order to chose the bests for becoming teachers. The test also focuses on the knowledge of the education system.

5.2 Continuing professional development

The continuing professional development of teachers in France is not compulsory and it depends on the personal initiative of each teacher.

Studies show today that teachers are becoming increasingly aware of their role in society and of the need to be continually trained. They search to find and use new resources, methods and devices. They seek their own answers to their job needs. The new digital possibilities, the access to information (Internet, CD-ROMs, cultural programs, educational forums ...) have facilitated the teaching and they provide answers giving to the insecure teachers the self-confidence and the self-esteem they need for.

However the continuing professional development has to become more formal. We cannot leave the teachers training to the personal initiative. Unfortunately the reality in France is that the teachers have today an average formation of 2 or more days, every 3 years!!! Every year seminars aimed in the professional development are still a dream for the big majority of the teachers.

In what ways is the role of creativity emphasized?

There is no training promoting the creativity despite the fact that creativity is one of the main objectives of the new pedagogy in France

What are the main differences between preschool and school?

Whether it is in primary school or in pre-school, teachers have no obligation to continue learning throughout their careers. The Ministry of National Education puts nevertheless provisions of websites for teachers to begin their update progress of school practices.

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Demailly (1991) notes that the "university as continuing education has become very rare". This is traditionally addressed to high school teachers, and was based on the development of a personal right to cultural enrichment, based on monitoring and support, counseling, working groups, research groups action. "It considers these types of training as the most innovative, because they modify the report to training and approach of different professionals, invent new professional knowledge, their ownership and allow their use and create a new professional environment. Thus, the success of this model depends on the relationship between trainer and trainees, who are in the range of "technical assistance". More, knowledge and training content must be co-produced and co-constructed progressively by the actors.

According to Agnes Florin, the initial and continuing training of teachers in the first degree is not enough…too little time is dedicated to training for pre-school children. It has been proposed to strengthen the initial and continuing training of school teachers especially regarding the care of children under 3 years.

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6. Summary

The main objective of teaching science and mathematics in pre-school and in primary school is helping children to better understand the world around them. Science education aims not only to acquire theoretical knowledge, but above all, to provide children the ability to questioning and to developing arguments based on data provided by their environment. Generally, the objective of teaching science and mathematics is to develop a social and environmental awareness among children, and foster the development of good citizens.

The school years used to familiarize children with that environment. This is to introduce the world to the child, to take it slowly in the early years of primary school to refine his knowledge and understanding. The child must understand how the universe is structured, the fundamental laws that rules the planet on which he lives and those of its inhabitants. Questioning, manipulation and experimentation can contribute to better understand and describe the real world and that of nature. Pupils can question, formulate hypotheses and become able to explain, communicate and exploit the results of their investigations. That is fostering their interest in scientific progress.

It is clear that the investigative approach focusing on solving small problems aims primarily in a familiarization with the surrounding world. The observation, during a game, during a workshop or a collective activity, provides opportunities sufficient for the acquisition of information.

It should be noted that science and mathematics in pre-school are combined in a broader discipline called "discovery of the world." For nursery pupils, the emphasis is given, according to the Ministry of Education, to discover objects, materials, the living world, shapes and sizes. They should learn to navigate in time and space. Only in CE2 science and mathematics become specific distinct subjects.

In CP and CE1, children learn

- to identify time and space,
- discover the world, and the
- basic functions of the computer.

In mathematics, they learn

- the numeration and computation,
- solving problems, and
- mental arithmetic.

In CE2 pupils understand and describe the real world that of nature and the one built by humans. They develop a taste of research and reasoning, the imagination, the capacity for abstraction, the rigor and the precision. They strengthen their mental math skills. To finish, science remain throughout primary school taught in ways much more fun than mathematics.

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The use of the investigative approach in teaching mathematics appears also very rare compared to that of science.

6.1 Limitations / Implications / recommendations

"The first limitation lies in the autonomy of teachers. Indeed, they are subject to strict curriculum, but they are not restricted in how they provide and assess them. Should thus consider ways to standardize the tools used, learning environments and assessment, to provide real support to teachers. Florin (2007) proposed to launch a companion program for improving assessment and learning support. The culture of evaluation and the assistance in the differentiated initial teacher training have to be developed. To overcome the lack of uniformity, it would be better to establish coordination mechanisms to permit the regulation of practices related to the objectives defined by the programs. Considering the liberty of teaching, it would be interesting to think about the ways to strengthen teacher training and provide training devices based on science, mathematics, and the process of learning. Florin (2007) mentioned that the approach to the teaching of science and mathematics is based mainly on large collaborative projects. This approach allows teachers to feel supported and to improve the implementation of new activities. It would make available for the majority of teachers to have an access to the existing devices such as those proposed by the ASTEP, the “hands-on” or National Education. Finally, it should be pointed out also the absence of the concept of creativity in the process of investigation as mentioned in the programs and the official texts. Despite the regular use of mentions like curiosity or imagination in the texts about children learning there is no reference to creativity.

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Appendix A:
Survey Ratings: Analysis of Approaches to Teaching and Learning

Key

E: Early (Nursery and P1)

F: First (P2, P3 and P4)

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/F			
b. To develop socially and environmentally aware and responsible citizens				E/F
c. To enrich the understanding and interaction with phenomena in nature and technology				E/F
d. To develop more innovative thinkers	E/F			
e. To develop positive attitudes to science	E/F			
f. To develop important attitudes and dispositions as a foundation for future learning	E/F			

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 / F		
b. To develop socially and environmentally aware and responsible citizens		E / F		
c. To enrich the understanding and interaction with phenomena in nature and technology		E / F		
d. To develop more innovative thinkers		E / F		
e. To develop positive attitudes to science		E / F		
f. To develop important attitudes and dispositions as a foundation for future learning		E / F		

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

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

	Counter Creative Emphasis	No Creative Emphasis	Slight Creative Emphasis	Highly Creative Emphasis
To know and understand the important scientific ideas (facts, concepts, laws and theories).		E / F		
To understand that scientists describe the investigations in ways that enable others to repeat the investigations.		E / F		
To be able to ask a question about objects, organisms, and events in the environment.		E / F		
To be able to employ simple equipment and tools, such as magnifiers, thermometers, and rulers, to gather data and extend to the senses.		E / F		
To know and understand the important scientific processes.		E / F		
To be able to communicate investigations and explanations.		E / F		
To understand that scientific investigations involve asking and answering a question and comparing the answer with what scientists already know about the world.		E / F		
To have positive attitudes to science learning.		E / F		
To be interested in science.		E / F		
To be able to plan and conduct a simple investigation.		E / F		
To have positive attitudes to learning.		E / F		
To understand that scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge).		E / F		
To be able to collaborate with other children		E / F		
.n. Other				

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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	Yes, for CE2		Yes, for pre-school, CP and CE1: “discovery of the world”
mathematics	Yes		

B. What are the key science and mathematics topics/strands/themes?

	science	mathematics
1	Discovering objects"	Approaching quantities and number”
2	"Discover the living non living"	Discovering shapes and sizes
3	Get oriented in space	
4	Get used to the time	
5		

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Learning Activities

Ai. What activities are encouraged?

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

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
Observe natural phenomena such as the weather or a plant growing and describe what they see.		E / F		
Ask questions about objects, organisms, and events in the environment.		E / F		
Design or plan simple investigations or projects.		E / F		
Conduct simple investigations or projects		E / F		
Employ simple equipment and tools to gather data and extend to the senses.		E / F		
Use data to construct reasonable explanations.		E / F		
Communicate the results of their investigations and explanations.		E / F		

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Teacher Role / Location

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

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

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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
Open/unstructured play		E/F		
Role/Pretend play		E/F		
Drama		E/F		
Teaching science from stories		E/F		
Using history to teach science (e.g. transport, the work of scientists)		E/F		
Working in small groups		E/F		
Physical exploration of materials		E/F		
Using outdoor learning activities		E/F		
Taking children on field trips and/or visits to science museums and industry		E/F		
Integrating science with other curricular areas		E/F		
Building on children's prior experiences		E/F		
Fostering collaboration		E/F		
Encouraging different ways of recording and expressing ideas – oral, visual, digital, practical		E/F		
Encouraging problem finding – e.g. children asking questions		E/F		
Encouraging problem solving – e.g. children solving practical tasks		E/F		
Encouraging children to try out their own ideas in investigations		E/F		
Fostering classroom discussion and evaluation of alternative ideas		E/F		
Fostering imagination		E/F		
Relating science to everyday life		E/F		
Using questioning as a tool in science teaching		E/F		
Using digital technologies with children for science teaching and learning		E/F		
Fostering autonomous learning		E/F		

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

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

Materials and Resources

A. What materials are suggested?

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

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Groupings

A. What groupings, if any, are suggested for teaching mathematics and science

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

Time

A. How much time should be planned for teaching science and mathematics per week? (Adapted from T survey Q21)

	science	mathematics
Less than an hour		
1-2 h		
3-4 h		
More than 4 h	F	F
N/A (Please explain)	E NOT DETERMINED	E NOT DETERMINED

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Assessment

A: What purposes of assessment are included?

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

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
Knowledge and understanding of scientific ideas (facts, concepts, laws and theories)	F			E
Knowledge and understanding of scientific processes	F			E
Competencies necessary to carry out scientific inquiry	E / F			
Understandings about scientific inquiry (e.g. how science and scientists work)	E / F			
Positive attitudes and increase of interest in science	E / F			
Positive attitudes and increase of interest in learning science	E / F			

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C. What ways of assessing are advocated?

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

D. What Creative attributes are addressed in assessment?

	Not Mentioned	Single Mention	Various Mentions	Emphasised
Sense of initiative	E / F			
Motivation	E / F			
Ability to come up with something new	E / F			
Ability to connect what they have learnt during your lessons with topics in other subjects	E / F			
Imagination	E / F			
Curiosity	E / F			
Ability to work together	E / F			
Thinking skills	E / F			
Other				

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