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 9 of 13:

National Report on Approaches in Romanian Policy

Authors:
Dr. Dan Sporea and Dr. Adelina Sporea
National Institute for Laser, Plasma and Radiation Physics,
Center for Science Education and Training
Romania

www.creative-little-scientists.eu

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

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 document
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

Contact Information
Coordinator:
Ellinogermaniki Agogi, Dr. Fani Stylianidou

Lead partners for this deliverable
Institute of Education, University of London, UK
Dr. Esmé Glauert, Dr. Andrew Manches

Website: http://www.creative-little-scientists.eu

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

EXECUTIVE SUMMARY

This document represents the Romanian contribution to deliverable 3.2 "Report on Mapping and Comparing Recorded Practices" of the project "CreativeLittleScientists", aiming to provide a radiography of the Romanian educational system through the prism of the "Conceptual Framework" previously developed in the project frame.

In the last years, the Romanian education system had undergone important changes as a new Law of National Education was promoted and came into effect. According to this Law, a pre-school preparatory class was added to the primary school education and a new vision on Early Education emerged. In the mean time, a new paradigm of teaching and learning in early years is promoted, shifting from knowledge transfers and reproduction towards understanding of the surrounding world, development of key competences, active participation of the leaner, individual learning planning, inter-disciplinary approach, applied mathematics, formative assessment. All these new concepts are more or less present in official documents and mark the transformation process underway.

In designing this report the team faced a major difficulty: the mapping process is planned to follow the "Conceptual Framework" by trying to localize in official Romanian policy documents answers to a previously defined "policy questionnaire". This questionnaire addresses two major issues:

A. Approaches to Teaching, Learning and Assessment, subdivided into:
   - Rationale or Vision;
   - Aims and objectives;
   - Content;
   - Learning Activities;
   - Teacher role/Location;
   - Materials and resources;
   - Groupings;
   - Time;
   - Assessment

B. Approaches to Teacher Education, subdivided into:
   - Initial teacher education;
   - Continuing professional development.

The challenge of this investigation resides in the fact that, at this stage, the Romanian educational policy on science and mathematics teaching in Early Education misses the structure and coherence of the "Conceptual Framework". For this reason, it is difficult to easily find in the policy documents most of the concepts included in the "policy

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

questionnaire". In this situation, a lot of documents available in the literature were studied in order to compose an image from numerous little pieces of information spread in many documents, trying to find similar meanings or at least vague formulation of the researched problems. Because the investigated concepts are not always clearly expressed in the studied documents (as compared to the questionnaire items), a synthesis of different forms of these concepts are presented under each chapter, so that the reader catches a better understanding of the official vision on science and mathematics teaching and learning in Early Education.

The analysis is based on the desk research carried out over 100 documents available on-line and falling into the following categories: different versions of the Law of Education; laws and projects of laws concerning pre-university education; orders of the Minister of Education; school curricula and pedagogical methodologies on science, mathematics, technology and development of practical skills, environment and/or health education; official documents and recommendations on teachers' competences and their training programs; teaching plans and curricula on ITE and master degree programs on education from major accredited providers; best practice guides for teaching science, mathematics and ecology; strategic plans for the development of specific educational segments; recommended evaluation standards and norms; national reports on the educational system situation; European reports concerning pre-university education in which the Romanian educational system is presented/ analyzed; several scholar papers analyzing the pre-school or primary education. The majority of the documents employed are official Romanian documents.

The report starts with a brief presentation of the Romanian educational system with a focus on pre-school and primary school. Further development of the report is based on the answers found to questions of the questionnaire grid. In most cases, several aspects/ formulations/ meanings derived from the studied documents were assembled in order to build up a coherent answer to each investigated issue. In other cases, the original statements were cited or reproduced to avoid any authors induced bias. In some situations, information from similar documents issued at different temporal instances was included in order to provide information on the evolution of a concept. Whenever possible the same subject was analyzed from both pre-school and primary school perspective. For reader's convenience, all the documents used are referred in the text.

In general terms, at pre-school level science and mathematics are studied together, as this holistic approach is expected to increase students' interest and help them in the learning process.

In the case of primary education, if mathematics and environment exploration (or natural sciences) are taught together, mathematical concepts can be perceived by the learner in their concrete form, bound to applications, and more accessible. When distinctions existing between science and mathematics education are present, the report highlights them.

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

Creativity is referred quite occasionally in relation to science and mathematics teaching, but official documents underline its importance by quoting terms such “innovation”, “imagination” or similar words.

The subject of teacher’s training and education is treated quite extensively as information on this issues is abundant. The report approach reflects in general terms these aspects, not strictly linked to science and mathematics education, as far as the policy addresses problems common to all educators involved in Early Education.

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

TABLE OF CONTENTS

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

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 Romania. 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 Romanian 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 Romanian 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 [1] (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[2] (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

[1] Ozga, J. (2000). *Policy Research in Educational Settings: Contested Terrain*. Buckingham, UK: Open University Press.

[2] Alexander, R. J. (Ed.). (2010). *Children, their world, their education: Final report and recommendations of the Cambridge Primary Review*. Abingdon: Routledge.

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

experienced)'. In a similar way, van den Akker[3] 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.

1.1.3 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'.

[3] van den Akker, J. (2007). Curriculum Design Research. In T. Plomp & N. Nieveen (Eds.), *An Introduction to Educational Design Research* (pp. 37-52). Enschede: Netherlands institute for curriculum development.

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

2. Overview of National Early Years Education provision and policy

2.1 The National Educational System - Early Years Education

The goal of the Romanian educational system is to develop the human personality in an integrated, free of any constrains, and equilibrated manner, based on a system of values which integrates the entrepreneurial skills, for the active citizenship participation, social inclusion and access on the workforce market. Education is a national priority [1]. Generally speaking, the educational establishment has as major task the improvement of human personality by: obtaining scientific knowledge; the development of intellectual capacities, affective state and practical skills through acquiring scientific and technical knowledge; assimilation of learning abilities able to help self-education and life long learning [2].

The Romanian Ministry of Education, Research, Youth and Sport is the main body of the central public administration in charge with the design and implementation of the national policy at pre-university level. It accounts also for the management of the human resources active in this educational segment, by coordinating and monitoring the Initial Teachers Education (ITE) and Continuing Professional Development (CPD) of teachers. At each Romanian county level and for the municipality of Bucharest, school inspectorates apply the Ministry policies and strategies as it concerns, among other of its duties, teaching activities, implementation of recommended standards and indicators, periodic audit of human resources [1].

The Romanian educational system, as per 2009, is illustrated in Fig. 1, where Eurydice compiled data are detailed. Five out of the six levels of education defined by UNESCO' s "International Standard Classification of Education I S C E D 1997" [3] are adopted in Romania, from pre-primary education (ISCED 0) to the tertiary education (ISCED 5). The Early Education covers the child life interval from the birth to six years, and is divided in the ante pre-school early education (0 to 3 years) and pre-school early education (3 to 6 years) [1]. For the scope of this study only to ISCED 0 and ISCED 1 levels are addressed. The numerical scale in the drawing designates the children/student's age, defining the entering and exist point for each educational level. The former Law of Education (published in 1995) and its amendments assigned the preparatory class to the pre-school level, organized the primary educational level with four grades (I to IV), the lower secondary level included the "gimnaziu" (grades V to VIII) and the low part of the "liceu" (grades IX and X) [2].

According to the newly adopted "Law of National Education" (2011) the compulsory full-time education starts at the age of six, ends at the age of 16, and covers 10 grades [1], [4]. The compulsory education spreads over the primary school ("clasa pregatitoare" – pre-primary level and "invatamantul primar" - grades I to IV), and the lower secondary school

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

level ("gimnaziu", grades V to IX). The changes introduced by the new Law as compared to the situation presented in Figure 1 refer to the inclusion in the primary school of the preparatory class, and the addition to the first grade of the higher secondary school ("liceu") to the lower secondary school level ("gimnaziu").

At pre-school level, groups counts 15 children, but not less than 10 and no more than 20, while for the primary school the mean number of children is 20, but a class can not be organized with less than 12 pupils and no more than 24 children [1], [6].

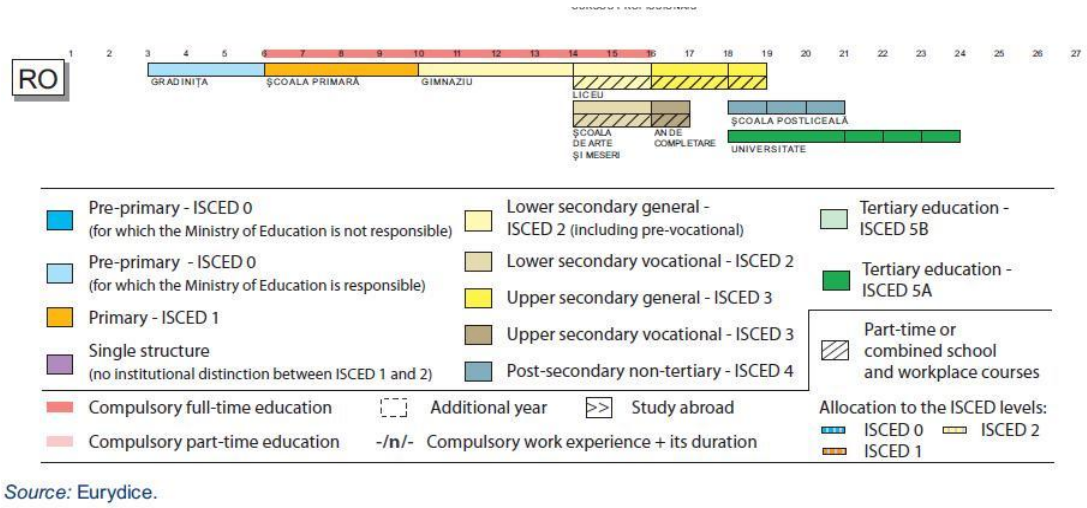

Figure 1. The division of the Romanian educational system according to the UNESCO's "International Standard Classification of Education [5].

According to [7] there is a national strategy for science education in Romania, science teaching being recommended to be performed in an integrated manner, as opposed to the separate subject science teaching model. At Early Education level, the same teacher teaches Romanian language, science (natural/ environment), and mathematics. Foreign languages, religion and physics education are taught, according to the circumstances, by special personnel.

2.2 Policy documents

Table 1 summarizes the major documents addressing policy issues on science and mathematics teaching which were studied.

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

Table 1: Major policy documents addressing pre-school/ primary school education.

Document title	Issuing body	Date
Law of Education	Ministry of Education, Research, Youth	1995
Strategy for the Development of Pre-university Education, 2001-2004	Ministry of Education, Research, Youth and Sports	2002
Reference Standards and Performance Indicators for the Evaluation and the Quality Assessment in Pre-university Education	Ministry of Education, Research, Youth and Sports	2008
Methodology for CPD of Teachers from the Pre-university Education	Ministry of Education, Research, Youth and Sports	2009
Report on the National Educational System	Ministry of Education, Research, and Innovation	2009
Law of Pre-university Education, project for pubic debate	Ministry of Education, Research, Youth and Sports	-
Performance Criteria for the Evaluation of Teachers in the Pre-university Education	Ministry of Education, Research, and Innovation	2009
Law of National Education	Ministry of Education, Research, Youth and Sports	2011
Methodology for the Organization of Evaluation for Basic Competences by the End of Grade II	Ministry of Education, Research, Youth and Sports	2012
Methodology for the Organization of Evaluation Students by the End of Grade IV	Ministry of Education, Research, Youth and Sports	2012

2.3 Curriculum documents

Table 2 lists the main curriculum related documents of interest for this report. Apart from these documents, over 80 other official papers were scanned for this report.

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

Table 2: Major curriculum documents addressing pre-school/ primary school education.

Document title	Issuing body	Date
School Curriculum, Environment Knowledge for grades I and II	Ministry of Education, Research and Youth	2003
School Curriculum – Mathematics grades I and II	Ministry of Education, Research and Youth	2003
School Curriculum for Grades III and IV – Education on Technology	Ministry of Education, Research and Youth	2004
School Curriculum for Mathematics, grade III	Ministry of Education, Research and Youth	2004
School Curriculum, Natural Sciences for grades III and IV	Ministry of Education, Research and Youth	2004
Education on Ecology and Environment Protection, Methodological Guide for Teachers, pre-school II level (5-6/7 years old)	Ministry of Education, Research and Youth	2007
Education on Ecology and Environment Protection, Methodological Guide for Teachers, primary school	Ministry of Education, Research and Youth	2007
Curriculum for Early Education of Children from 0 to 6/7 years	Ministry of Education, Research and Youth	2008
Pre-school Curriculum (3-6/7 years old)	Ministry of Education, Research and Youth	2008
Curriculum for Early Education of Children (3-6/7 years old)	Ministry of Education, Research and Youth	2008
Good Practice Guide for Children Early Education from 3-6/7 years old	Ministry of Education, Research and Youth	2008
Pre-school Curriculum for "ICT (play with computer)", project for public debate	Ministry of Education, Research, Youth and Sports	2012
School Curriculum for "Mathematics and Environment Exploration", project for public debate	Ministry of Education, Research, Youth and Sports	2012
Note on the Design of Curriculum for preparatory class and grades I and II	Ministry of Education, Research, Youth and Sports	2012

2.4 Monitoring and evaluation of teaching/ learning quality process

The Ministry of Education, through its special bodies and institutions and counties agencies, is responsible for the evaluation of the educational process quality at pre-school and primary levels, as parts of the pre-university education [6]. The process of monitoring and evaluation, aiming to improve the system activity and to set-up educational policies, is done periodically, based on quality standards, following specific procedures. This practice has two components: one internal and one external. The internal evaluation includes a self-

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

evaluation component and one directed towards “institutional and process evaluation”, and it is mandatory to be carried out yearly.

National assessment sessions are organized to evaluate students basic competences and to derive a national mean score [8]. The aim of the national evaluation is to: a) “evaluate knowledge; b) diagnose students’ performances; c) compare these performances with classroom results; d) offer a feedback to the educational system; e) inform in a transparent manner social partners; f) develop a national database” [9]. Results are compared to national standards. Part of the educational reform under way, the assessment process has to “change the educational culture”. A bank of assessment items was designed and relevant software tools were distributed to schools, hence a diagnostic assessment can be run by the teacher at the beginning of the school year for diagnostic purposes [10].

Every school year teachers are evaluated at school level through [11]: a) self-evaluation; b) peers evaluation; c) evaluation by the administrative council, based on some files to be filed and an interview.

Direct evaluation of teachers is done for classroom activities and extra curricular activities, and its fundaments are questionnaires/ interviews with students, parents and other interested parties [11]. These results are correlated with an analysis of teachers’ activities outcomes: publications, books, guides, students notebooks, practical works, video and audio recordings, lesson plans, projects, portfolios, didactical materials, results from school evaluation reports, certificates, diplomas. Teachers attending courses devoted to special training programs receive a recognition based on their portfolio and practical work [12]. Indirect evaluation of teachers is done during national tests for students, when qualification and results of teachers are assessed [9].

A “revolution” in approaching Early Education arises with the new Law of Education, which is supported by additional legislative proposals [6]. Only in the last three years several universities started to offer courses and Master degree in Early Education [13], [14]. For this reason, to speak about an established policy in this field, is a little bit hazardous. In 2012 the preparatory class was included in the compulsory educational system as part of primary school. Implementing this new system proved to be a difficult task, with a lot of unanswered questions. In this transitory regime, a smooth transition from the preparatory class to lower primary one seems to be a far to reach objective for the moment.

A change appeared also in the way science and mathematics are planned to be taught in pre-school and primary school. Science and mathematics are proposed as a common body of knowledge, mathematics being more applicative, closer to the real life situations.

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

3. Methodology for mapping approaches

3.1 Overview

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 Romania***?"

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 Romania?
- 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 Romania?
- 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 Romania?

In order to examine how teaching, learning and assessment are conceptualised across Romanian 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:

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

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

3.2 Selection of Documents

From the beginning, by analyzing the project's "Conceptual Framework" (Deliverable D2.2), the deliverable 3.1 "List of Mapping and Comparison Factors", and the list of questions which have to be answered by the teachers during the first survey, and by scanning the Romanian policy documents accounting for science and mathematics in relation to early education and creativity development it is obvious that the information addressing basic concepts acting as pillars of the "CreativeLittleScientists" project is poorly represented in Romanian official documents. For this reason, the Romanian team was forced to dig quite a lot in the available literature in order to compose an image from numerous little pieces of information spread in many documents, trying to find similar meanings or at least vague formulation of the investigated problems (see the structure of the "Policy questionnaire" used by each partner to identify policy patterns close to the project focus).

The desk research, completely based on Internet-located documents, focused on the following categories of official documents which were used to answer the items of the "Policy questionnaires": different versions of the Law of Education; laws and projects of laws concerning pre-university education; orders of the Minister of Education; school curricula and pedagogical methodologies on science, mathematics, technology and development of practical skills, environment and/or health education; official documents and recommendations on teachers' competences and their training programs; teaching plans and curricula on ITE and master degree programs on education from major accredited providers; best practice guides for teaching science, mathematics and ecology; strategic plans for the development of specific educational segments; recommended evaluation standards and norms; national reports on the educational system situation; European reports concerning pre-university education in which the Romanian educational system is presented/ analyzed; several scholar papers analyzing the pre-school or primary education. Overall, more than 100 such documents were examined, the significant ones being listed in the "References" section of this report.

3.3 Questionnaire and analysis method of the document

The investigations tried to locate in the studied literature ideas and statements which can offer answers to as many questions of the provided "Policy questionnaire" as possible. The body of this report represents a structured response to the complex enquiry formulated in the "Conceptual Framework" (Deliverable D2.2) and the 'List of Mapping and Comparison Factors' (deliverable 3.1). All the assertions are based on official declarations, their sources being indicated in each case. Wherever there is not an explicitly articulated answer to the

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

suggested question similar formulations to those expressed in the question or for some more or less implied ideas/ strategies/ solutions at policy level were indicated.

The summary of findings according to the employed "Policy questionnaire" is given in **Annex A** to this Report.

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

4. Approaches to Teaching, Learning and Assessment

4.1 Rationale or Vision

4.1.1 Key summary points

According to the Romanian educational policy, a mixture of goals is stated in relation to science teaching and learning, as the educational process is affected by the social and economic changes the society is facing [15]. Within this context several layers of understanding the role of science teaching emerge:

- Children are educated towards "scientific literacy", not to grow to be a researcher/ engineer/ technician, but to become a responsible citizen able to use the scientific approach to understand the world, to be an active participant to the social life [1], [16], [17], and to be a person able to provide an objective point of view to the surrounding environment challenges [18].
- After completion of the compulsory education, children have to understand and to experiment universal laws through which humans can act on the nature, the effects of human activities on the environment [19] and to consider the responsibilities associated to these actions [17], [20].
- Science education assists children: to observe and interpret natural processes; to investigate connections inside and between physical, chemical and biological systems [20]; to learn to discover patterns [21], [22]; to develop the capability to formulate simple opinions on the objects/ facts/ phenomena in the surrounding world [21] in association with the development of critical thinking by investigation, exploration and solving problems [23]; to be aware of the meta-scientific dimension of the scientific knowledge as well as of its limits [17] .
- Science education plays an important role in changing the paradigm of education: to transform the learner from a spectator into an actor participant to scientific activities [16], [17]; to teach children on "learning to learn", "learning to know to do", "permanent learning" [24]; to assist children in developing favorable attitudes towards science and more generally towards knowledge.

The study of natural sciences in primary education targets anymore the transfer of knowledge and scientific information (even if they are confirmed or infirmed by test and experiments) but is concerns to "report the child to his/ her environment" [20].

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

4.1.2 Role of creativity

Establishing a link between creativity and science/ mathematics education at early ages, as reflected by official Romanian documents on education policy, the following picture can be derived:

- The education system in Romania aims to the "development of critical thinking and creativity" to children [6], who have to demonstrate creative thinking capabilities [22].
- "The main goals of early childhood education for 3 to 6/7-year-olds are: …. support of their (N.B. children) autonomous and creative training" [25].
- The aim of the education at early age is to help children: to express their curiosity towards elements/ phenomena/ patterns observed in the surrounding world [21], [22]; to show curiosity towards a) changes and transformations; b) active learning methods as projects proposed by the teacher [22].
- The curriculum for "the knowledge of the environment" (grades I and II) was designed to "stimulate the scientific curiosity of children to understand facts and phenomena of the surrounding world" [26], and to "initiate and develop creative investigations, starting from a proposed subject" [17].
- "The introduction of new methods and forms of evaluation and for the development of creativity, adaptability and transferability of knowledge for its use in other circumstance" [24], "the increase of innovation and creativity at all educational levels" [27].The proposed curriculum "has to develop to the young student attitudes and capacities of creative, reflexive, cognitive type.." [28],[29].

4.1.3 Existing tensions / policy criticisms

A criticism on the interest for the development to students of critical thinking/ critical analysis abilities comes from the study "Is Romanian Science School Curricula Open towards the Development of School Students' Critical Thinking Skills?", as authors conclude, after investigating 56 school curricula for primary and secondary level, that "critical thinking is not a real concern for the authors of the Romanian science curricula since the terminological entries (critical thinking, critical analysis, criticism etc.) are poor and the critical thinking skills are disproportionately represented in the curricula of the primary and secondary science education" [29].

4.1.4 Main differences between preschool and school

It is worth to mention that starting from pre-school level, science education is viewed as a guide and an opportunity for the child to head towards a future profession, to rise his/ her interest for future studies in specific fields [20], [30], to become able to answer to socio-economic and personal development needs [1](P), and to assist his/ her integration in social and professional life [31].

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

Even at very early age, emphasis is placed on the exploration of the surrounding world, on the understanding of the cause-effect connection between natural and man produced phenomena [32]. Official documents indicate an interest towards the development of children's positive skills and attitudes towards ecology associated problems and the environment protection [18], [33], and to the care he/ she has to pay to Nature [21], [26], [30], [32].

In this context, it is of interest to underline one objective of the pre-school curriculum, which can be linked in a way or another to creativity: "the development of the capacity to learn about and to understand the world surrounding the child, and more important, the stimulation of his/ her curiosity to investigate this world and to try to offer some explanations" [32].

4.1.5 Differences between science and mathematics

The policy documents mention quite vague the aim to develop children's interest and motivation in learning mathematics at primary school level [34]. On the other side, the study of mathematics has to support the formation and the development of capabilities to communicate using mathematics language [34]. The official policy states that education at this age has to support the development of children's "interest and motivation to study mathematics and its applications in various contexts" [23].

As the interest towards science and mathematics education at early age received an increase attention in the last 3-4 years in Romanian educational establishment, it is of interest to analyze here more deeply a document issued by the Ministry of Education, Research and Youth dedicated to "Curriculum for the pre-school education (3 – 6/7 years)" [32]. The main objectives/ goals of mathematics education at this age are: a) "the development of pre-mathematics intellectual operation; b) the development of the capability to understand and use units measuring, numbers, and to employ an appropriate vocabulary; c) the development of the capability to recognize, name, build and use geometric forms; d) the development of the capability to solve problem like situations, by acquiring appropriate strategies; e) the development of the capability to observe and to establish causal, spatial and temporal connections".

4.2 Aims and Objectives

4.2.1 Key summary points

"The guide for good practice in early education of children between 3 and 6/7 years" developed for the Ministry of Education by the Unit for the Management of Projects Dedicated to Pre-university Education underlines some objectives of Early Education of interest to this report [35]:

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

- "the cognitive development reflecting child abilities: to understand relations between objects, phenomena, events and persons, which transcend the physical characteristics; to solve problems based on logical thinking";
- "the development of knowledge and understanding of the world (mathematical representations); the understanding of the living world; the knowledge of the scientific methods".

At primary school level, objectives of interest related to science and mathematics teaching can be summarized as follows:

- To assist children to elaborate hypothesis concerning scientific processes [16]; to formulate questions related to things [18] or phenomena [26] they observe in the surrounding world; to observe and interpret natural processes; to investigate and to interpret the dependences existing inside and between biological, chemical and physical systems [16], [17]; to infer in an appropriate manner events succession [16] and to highlight the patterns observed based on measurements they are carrying [16]; to apply scientific procedures in their own activities [16] and to solve problems [22]; to run simple experiments based on given hypothesis [16]; to learn to use various techniques, materials and tools [28]; to plan the development of some products [31], [36].
- To train children to take group responsibility [31], to work in groups [24]; to cooperate [17].
- To help students to engage themselves into discussions which can help them to discover the core of scientific phenomena [26], to understand and use mathematical concepts [23], [34], [37], , and concepts/ terminology specific to natural sciences [19](P).
- To bring science education closer to scientific community's activities [16].

In analyzing the science teaching policy in Romanian primary and secondary schools it is of interest to refer to the Eurydice report "Science Teaching in Schools in Europe Policies and Research", were expected learning outcomes and activities are highlighted (Tables 3 and 4) [38].

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

Table 3: Aspects of recommended/ prescribed "practical works" in Romanian school curricula [38]

Type of activity	Status in the curriculum
teacher demonstrations	included
carrying out experiments following a pre-defined protocol	included
ability to follow experimental instructions accurately	included
making observations	included
ability to make scientific observations	included
ability to select and use appropriate apparatus and equipment	not included
ability to propose and discuss experimental protocols in response to defined objectives	not included
proposing experimental protocols in response to defined objectives	not included
verifying a scientific law through experiment	included
formulating and testing hypotheses	not included
science-related project work	included

Table 4: Aspects of recommended/ prescribed "communication in science learning" in Romanian school curricula [38]

Type of activity	Status in the curriculum
engaging in discussion in relation to science in society and in everyday life	Included
engaging in discussion in relation to researching information	Not included
engaging in discussion in relation to experiments	Included
ability to present and communicate procedures and results	Included
presenting and communicating procedures and results	Included
presenting and communicating information	Included
communicating with other pupils using information technology	Not included

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

4.2.2 Role of creativity

As a more general objective, the primary curriculum for the study of the environment targets the development of children curiosity by involving them into exploring activities [26].

4.2.3 Main differences between preschool and school

The national curriculum for ICT dedicated to pre-school level, launched in 2012 for the first time, encourages children to express their opinions in relation to various context where ICT is used and to assist, during such activities, less experienced colleagues [15].

The curriculum for the pre-school education aims to support the aesthetic and creative fields by offering support for processes such as building, composing and inventing [37].

4.2.4 Differences between science and mathematics

At primary school level, children are assisted to develop their own capability to express results of an investigation/ experiment by employing mathematical language [23].

4.3 Content

4.3.1 Key summary points

In the first half of XX century the last decade, the primary and secondary school curricula were designed on a subject-center approach; the syllabus addreses in most cases subjects separately, without emphasizing their inter-dependency. It was not a "unitary and coherent curriculum (both on a synchronic and diachronic basis)" [10]. These conflicts were only partially solved by the "interim" curriculum developed between 1992 and 1997. Starting from 1997 the National Curriculum Board decided on the design of a "new coherent and flexible methodology for planning, developing, implementing, evaluating and reviewing the new curriculum" [10]. In this approach, an integrated curriculum (including the so called frame-plan – "plan-cadru"; school planning programs – "programe scolare"; school manuals; methodological guides; materials and portfolios) addressing different subjects, representing a balance between the compulsory national curriculum (at a level of 70%) and the curriculum which can be set by the school (the rest of 30%), was planned. The next step in imposing the new type curriculum was marked in 1998/1999 when specific curriculum areas were defined, in an integrated style, encouraging cross-curricular and interdisciplinary educational activities [10].

According the national curriculum, science teaching is an "integrated subject", contextual aspects (to reflect "contemporary and societal issues") in science teaching are recommended, and discussions on everyday life and society related subjects are prescribed [38].

Primary science studies focus on [18], [19]:

A. "Characteristics and properties of bodies:

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

- the equilibrium and weighing: spring scale, balance;
- the volume, density; floating bodies;
- the behaviors and adaptation of plants and animals; defense reactions and adaptation to light, humidity, wind , cold;
- the properties of metals and their uses: magnets; simple electrical circuits;
- light sources; producing rainbow colors, shadows, visible bodies;
- the solar system and planets.

B. Transformations of bodies and materials:

- heating and cooling, heat absorbed and heat transferred;
- forces leading to bodies movement: gravity, push and pull forces; the movement and the rest;
- life cycle: birth, growth and development, breeding, death, life cycles of organisms (plants, butterflies, frogs, people);
- transformations of materials into other materials with different properties: rusting, rotting, alteration, burning.

C. Man and the environment: the garden; the forest; the pond; the delta; the cave; the ocean. Feeding habits.

D. Natural resources: water, soil, rocks, minerals, wood, fuel, food, waste materials. Environment protection. ”

4.3.2 Role of creativity

Science learning has the tasks [10], [39]:

- to stimulate the child creative potential and to form the motivation to learn;
- to develop creativity and to stimulate autonomy.

Mathematics teaching must encourage the development of curiosity towards phenomena/ relations/ patterns present in child’s environment [40].

4.3.3 Main differences between preschool and school

At pre-school level, science and mathematics are studied together in a holistic approach, as it is expected to raise students’ interest and help them in the learning process [30].

In science learning pre-school children are taught [41], [42], [43]:

- through six integrated activities (Who am I? Who are we? When, how and why things happened? How we plan and organize an activity? How and by what means we express what we feel? What and how I would like to be?);
- to create simple objects by using materials, instruments and techniques specific to their age;

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

- to use the basic functions of a computer or other digital devices;
- to operate simple procedures and instruments to explore and create digital contents in audio/ video format.

4.3.4 Differences between science and mathematics

For the primary education, if mathematics and environment exploration (or natural sciences) are taught together, mathematical concepts can be perceived by the learner in their concrete form, bound to applications, and more accessible [17], [22].

The study of mathematics has to assist children [23]:

- to understand and to use mathematical concepts;
- to develop their capability to explore and to investigate, in order to solve problems;
- to develop their ability to communicate and to explain results using mathematical terms.

4.4 Learning Activities

4.4.1 Key summary points

Learning activities related to science teaching have to provide to children opportunities to interact with the natural world in various contexts (by observing, questioning, manipulating objects and information, measuring) [16], [26]; to plan and to run simple experiments starting from his/ her own hypothesis or from instructions or a working plan [17], [18] [19], [20]; to develop project like activities; to handle/ manipulate toys, objects, materials and simple tools/ equipments/ instruments [16], [28]; to develop simple working models and mock-ups; to use of ICT techniques as instrument for learning and knowledge acquisition [22]; to perform measurements with "available conventional and non-conventional instruments" [19], [37], employing "standard and non-standard units" (length, mass, capacity, time, monetary values) in various context [20] , [34]; to engage a dialog on simple science related issues [20] and to describe in oral and graphic format their ideas and to communicate results to others [16], [19], [23], [36].

Science teaching will assist children in building competences for data handling (data collection, sorting, and classification based on some given criteria), to support the results of their investigations and offer explanations, by using tables [16], [18], [34], these activities being complemented by the search of additional information to solve specific problems [22].

Children will be trained to understand and to use specific terms in order to communicate/ report their findings/ observations in verbal or written format, in a figurative manner if appropriate, by offering concrete examples to illustrate their results [16], [18], [26].

A synthesis of science learning activities, supporting and encouraging inquiry-based teaching methods and designed to motivate students in science learning, activities derived from a

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

comparative study run at European level, is summarized in Table 5. The study emphasizes if these activities are recommended in steering documents or are left to school decision.

Table 5: Science learning activities in primary education [7]

Type of activity	Activity class	Status
making scientific observations	experiments and explanations	recommended in steering documents
recognising issues that are possible to investigate scientifically	experiments and explanations	recommended in steering documents
designing and planning experiments/ investigations	experiments and explanations	recommended in steering documents
conducting experiments/ investigations	experiments and explanations	recommended in steering documents
evaluating explanations	experiments and explanations	school autonomy
justifying explanations	experiments and explanations	school autonomy
presenting experimental result	experiments and explanations	recommended in steering documents
describing or interpreting phenomena scientifically	discussions and argumentations	recommended in steering documents
framing problems in scientific terms	discussions and argumentations	recommended in steering documents
formulating potential explanations	discussions and argumentations	recommended in steering documents
debating current scientific and societal issues	discussions and argumentations	recommended in steering documents
self-directed (individual) project work	project-work	recommended in steering documents
collaborative project work	project-work	recommended in steering documents
computer simulations	use of specific ICT applications	school autonomy
video conferences (e.g. for demonstrations, other)	use of specific ICT applications	school autonomy

4.4.2 Role of creativity

Activities related to the initiation and implementation of creative investigations starting from a suggested subject are supported by science teaching [16].

4.4.3 Main differences between preschool and school

The approaches in pre-school education in most of the cases are simplified expressions of those prescribed for primary science teaching, with an emphasis on: recognizing natural phenomena and processes in real situations or in images, reproducing them by drawings and story telling; learning to identify components of the real world (air, water, soil, vegetation, fauna) and distinguish their interactions; noticing the changes produced in the life of humans, animals and plants by seasons alternation; identifying senses and using them to explore the world [30], [32]; development of small scale projects based on measurements (using standard and non-standard units, comparing the results, ordering objects based on the measurements), projects used to present in a structured manner the results of their findings [30]; the use, under safety conditions, of simple instruments or equipments,

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

accompanied by data recording and the presentation/ discussion of results, along with the investigations of other information sources [32]; delivery of some explanations based on logical elements and the organization of results for problem solving [30]; manipulation of some ICT resources and their applications in the learning process and to carry out investigations/ explorations [15].

4.4.4 Differences between science and mathematics

A European study on mathematics education reveals that there were, at national level, some attempts to improve students interest towards mathematics education (see Table 6) in 2010/2011 [44].

Table 6: Activities supported by central education authorities to improve students' perceptions of mathematics, ISCED level 1, 2010/11 [44]

Action	Promoted in Romania
promotion of specific teaching methods to improve engagement	Yes
involvement of parents in the learning process	Yes
addressing the gender issue in mathematics education	No
promotion of extra-curricular activities	No
promotion of partnerships with companies, universities and other organisations	Yes
running awareness-raising campaigns in wider society	No

4.5 Teacher Role/Location

4.5.1 Key summary points

Learning activities have to be based on observation, exploration, play/ role playing, conversation [36], [45]. Children are guided to assume roles in the construction and evaluation of products they made, to interpret roles in play-like activities which mimic everyday situations [22], [36]. The connection between science learning and the everyday life takes different forms [17], [36], [37]: solving everyday problems/ situations based on the acquired knowledge; becoming aware on the use of mathematics in everyday life; reflecting everyday life situation by using models.

Science teaching implies rising questions, the analysis of the steps in solving a problem and arguing the solutions adopted, along with the effort to answer to questions such as “Why?, When? How?” [21], [23]. In science and mathematics education it is important to help children to locate and identify problems [16], [17], [23]. They are encouraged to offer their own solutions and express their ideas [16], [17], [19], [22], [23], [26], [34].

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

According to the new Law of National Education, key competences are transversal ones, hence the interest towards intra and inter disciplinary science teaching [1P], [16], [17], [18], [19], [20], [22], [24], [36]. In designing the curriculum teachers must consider the knowledge acquired by the child during his/ her previous personal experiences, which have to be identified and consolidated and integrated with the new information acquired through the learning process [11], [22], [24], [26], [46]. Physical, direct interaction with various materials is viewed as being the cornerstone of science teaching at this age [20], [28], [31], [36]. Outdoor activities are encouraged. During trips and excursions children have to observe the environment, to identify and use natural resources [20], [26], to address mathematical (counting objects – leaves, stones, ants; comparing geometrical forms) or science knowledge (evaluation of objects characteristics) [30], [35]. The official policy supports such non-formal education on science [47]. Children direct knowledge on some realities or processes can be acquired trough: a) visits to some institution to see the way specific devices work; b) visits to technical museums or enterprises (plant processing units for pharmaceutical use); c) the use of audio and video recording of real life situations; d) discussions with specialists/ experts (dietician, forester) [15], [33].

Children are trained to record data they collect in observation files, tables, and lists. It is needed also to develop children ability to use different types of data representations [16], [17], [19], [20], [23], [34], [37] to be able to organize the results (for classification, sorting, to highlight the characteristics of objects, phenomena, processes, to illustrate the results) in tables, diagrams, schemes or graphs. ICT is used in science teaching [22], [24] for playing, to build literacy on digital technology and for the development of digital competences.

Teachers will encourage children to accept collaboration; to respect their peers ideas, practice, experiments [21], [23], [26]. They are asked to support collaboration among children through group activities, discussions, and common work in developing a product and to encourage them to be open to collaboration and partnership, when participants can answer questions, discuss and comment [18], [19], [20]. Good examples are environmental related projects, when tasks are undertook at individual level, in pairs or small groups [16], [18], [23], [28], [31], [33], [35], [37].

The official literature underlines some of the “roles” or attributes of the educator [16], [19], [23], [41]:

- manager – takes care on the educational environment, space, materials, time keeping;
- observer and evaluator – monitors child actions, attitudes, reactions, answers for evaluation purposes and for future activities planning;
- guide/ mentor/ facilitator – assists children in running activities/ investigations/ experiments, to observe common things and events, to ask/ answer questions, promotes scientific terminology and mathematical concepts;

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

- stage director – build-up learning opportunities, proposes individual tailored scenarios, suggests means/ tools to be used.

All these actions have to develop to children: the capacity for autonomous learning, the competence "to learn how to learn", self confidence, and the ability to learn from their experience and to take responsibilities inside a group [11], [16], [17], [19], [21], [22], [46].

For the purpose of this study, it is of interest to have a closer look on the way inquiry-based science education (IBSE) is reflected in Romanian official documents. IBSE principles are addressed directly or indirectly in the pre-school related programmatic documents [30], [32], [33], [35], [48].

Competences and abilities specific to the scientific inquiry (observation, formulation of hypothesis, proposing alternative solutions, running experiments, organizing acquired data) have to be developed. Students have to face situations enabling them to "observe, analyze and investigate phenomena and processes of the environment", and to "observe repetitive models in order to identify patterns". "Learning by discovery (exploration and experiment) is recommended, when the child, after observing various objects and phenomena, starts to formulate conclusions, while the teacher acts as a guide".

The recommended pedagogy includes "capacities and attitudes reflecting the way the child "involves himself in the learning process, and approaches tasks to be solved and learning contexts". The educational process has to stimulate auto-reflection, auto-evaluation, auto-regulation during the learning activities. Child's evaluation has to consider both the students' results and their "reflections on the educational process".

These basic IBSE principles are elaborated further in documents pertinent to primary education [7], [16], [17], [18], [19], [23], [37].

Children have to prove skills: "to explore/ investigate and solve problems", "to describe simple procedures, of scientific nature, used in experiments", "to use observation as part of a scientific approach", "to describe or interpret phenomena in a scientific manner", "to formulate problems in scientific terms"; "to understand and explain the observed phenomena"; "to explain interconnections they noticed between the analyzed parts", "to ask questions, to analyze the steps needed to solve a problem, to offer an explanation for the decisions/ solutions they propose", "to evidence to observed patterns based on measurements, and providing appropriate results", "to understand and to use during communication scientific concepts and terms", "to be able to communicate using mathematical terminology", "to compare the results with their initial hypothesis", "to be able to recognize issues that can be investigated scientifically", to "formulation possible explanations". The use of "common scientific practices – theoretical and practical investigation, communication of results", has to be applied.

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

4.5.2 Role of creativity

Within this context (Teacher Role / Location), several aspects related to creativity are referred in the scanned literature in relation to pre-school education [15], [30], [32], [33], [35], [41]: a) at early age the play is the fundament for the development of creativity of future adults; b) the curriculum for ICT leads to an "active, innovative and creative learning" approach; c) children are guided to invent new rules for the games they play; d) the environment education encourage creativity and imagination; e) as they are playing, children became inventive, produce new ideas and suggest new means for problem solving; f) one of the reference objectives of the pre-school curriculum is to develop creativity and the expressivity of oral communication; g) development of child capacities and attitudes includes among other topics: creativity, initiative, perseverance; h) in relation to the use of ICT children are taught to create new digital, video and audio contents.

At primary school level, creativity is mentioned as follows [16], [36]: a) children have to express interest towards "...logical argument, curiosity for the phenomena of the environment, ..., creativity"; b) they have to learn to initiate and conduct investigations in a creative manner; c) "pedagogical activities must be directed to independent work, encouraging initiative and creativity"; d) practical education targets the development of attitudes and capacities of creative, cognitive and reflexive type.

Asking children to offer solution to a new situation gives them the opportunity to employ their experience in a creative/ innovative way [15].

4.5.3 Existing tensions / policy criticisms

In the official documents studied the "evaluation of explanations" and the "justification of explanations" are not present as IBSE related competences to be developed to children.

4.5.4 Main differences between preschool and school

An analysis of differences existing in approaching IBSE methodology at pre-school and primary levels was done under the heading "Key summary points**".**

4.5.5 Differences between science and mathematics

Here are some comments addressing approaches in mathematics education [30], [32]:

A. for the pre-school education:

- The field of science education includes also mathematics education both through practical experiences and the understanding of nature. Some mathematics concepts (volume, number) and operations (classifying, sorting, discriminating, quantitative description) can be introduced to pre-school child through controlled play, as the child manipulates water or sand. In this way, abstract thinking can be developed by running experiments and solving problems.

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

- Children must develop the capability to: a) solve problems staring from images; b) create problems based on concrete objects; c) identify contextual situations when mathematics can be applied.

B. for primary school education:

- The accent falls on the explorative/ investigative approach in mathematics education, by developing abilities related to the curriculum objectives.
- Table 7 provides a review of national foci on mathematics education, as derived from a European study.

Table 7: Issues related to mathematics education in Romanian primary schools [44]

Category	Sub-category	Status
Decision-making authorities involved in developing and approving the principal steering documents for mathematics teaching, ISCED levels 1, 2010/11	Curriculum	Central/top level
	Guidelines for teachers	Central/top level
	School plans	Schools
Objectives, outcomes and assessment criteria in the mathematics curriculum and/or other mathematics steering documents, ISCED levels 1, 2010/11	Learning objectives	Prescribed
	Learning outcomes	Prescribed
	Assessment criteria	Prescribed
Skills and competences in the mathematics curriculum and/or other mathematics steering documents , ISCED levels 1, 2010/11	Mastering basic skills and procedures	• General reference; • Specific teaching methods; • Specific assessment recommended
	Understanding mathematical concepts and principles	• General reference; • Specific teaching methods; • Specific assessment recommended
	Applying mathematics in real life contexts	• General reference; • Specific teaching methods; • Specific assessment recommended
	Communicating about mathematics	• General reference; • Specific teaching methods; • Specific assessment recommended
	Reasoning mathematically	• General reference; • Specific teaching methods; • Specific assessment recommended
Levels of autonomy for choosing mathematics textbooks, ISCED levels 1 and 2, 2010/11		Limited autonomy
Central level guidelines regarding teaching methods in mathematics, ISCED levels 1 and 2, 2010/11		Prescribed or recommended methods
National surveys on teachers' choice of		National surveys/reports

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

teaching methods and activities, 2010/11		
Knowledge and skills for mathematics teaching to be developed through CPD, as advocated by central authorities, 2010/11: a) Knowledge and skills related to subject content	Mathematics curriculum and curriculum reform	Areas of learning advocated by central authorities
	Integrating mathematics with other subjects	Areas of learning advocated by central authorities
	Improving pupils' critical thinking or problem-solving skills	Areas of learning advocated by central authorities
	Applying mathematics in real-life contexts	Areas of learning advocated by central authorities
	Communicating about mathematics	Areas of learning advocated by central authorities
Knowledge and skills for mathematics teaching to be developed through CPD, as advocated by central authorities, 2010/11: b) Knowledge and skills related to teaching methods	Using assessment for formative purposes	Areas of learning advocated by central authorities
	Integrating ICT into mathematics	No central-level guidance
	Detecting and tackling pupils' difficulties in mathematics	No central-level guidance
	Addressing potential differences between boys and girls	No central-level guidance
	Differentiating teaching for pupils with different abilities and motivation levels	No central-level guidance
	Using research findings for improving mathematics teaching	No central-level guidance

4.6 Materials and Resources

4.6.1 Key summary points

In the case of primary education, the official documents indicate the use of various materials, devices and tools for science teaching such as: instructional materials [11], [20], [45], [49] (guides; students notebooks; posters, maps; collections of post cards; journals papers); audio-visual resources [20], [49](educational and documentary movies; Slides); equipment and materials for hands-on exploration in the classroom [20], [23], [49] (didactic games; various objects which can be used in the educational process; mock-ups; geometrical bodies; musical instruments; magnets, compass, thermometers, magnifies, balances, microscopes; various educational kits for geometry and measurements; workshops and laboratories [24].

All schools have to posses computers [24] and, according to the available financial means, some ICT devices/ facilities are recommended [24], [46], [47], [49]: access to Internet;

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

educational software; the system "Video on demand"; access to an "info-kiosk"; printer, scanner, video projector, DVD player, video projector and screen, copying machine, digital camera, video camera, audio system, intelligent board.

Consumables for experiments and practical activities have to be available in schools, according to official documents. For low income families school consumables will be provided for free.

4.6.2 Role of creativity

In relation to the use of teaching materials and resources no special emphasis is placed on the development or employment of creativity.

4.6.3 Main differences between preschool and school

In pre-school education science teaching resources refer to the use of posters and models, "literarily text, image or audio and video materials resources", "books and magazines, notebooks, illustrated albums, postal envelops, postcards, greeting cards" [30], [32], [35]. Equipments and materials for hands-on exploration in the classroom are suggested [30], [33], [35], [47]: construction building blocks of wood and plastic; LEGO type toys; recyclable objects of plastic and paper, cubs marked with letters, cars, various games, plastic forms, small size characters, as well as magnifiers, microscopes, sound generating instruments, software applications, video/ web camera, digital photo camera, printer, interactive table and various consumable [35]: back and color pencils, plasticine, water and oil colors, notebooks, cardboard sheets, paper.

4.6.4 Differences between science and mathematics

On these issues no special mention exists in relation to differences between science and mathematical education. An exception could be the emphasis on the use of ICT in mathematics teaching.

4.7 Groupings

4.7.1 Key summary points

At primary level, the activities children attend have to make possible both individual work and team work, aiming to encourage creativity and initiative. [36].

4.8 Time

4.8.1 Key summary points

The recommended durations for different science and mathematics related teaching activities for pre-school education are given in Table 8.

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

Table 8: Recommended durations of activities for pre-school education [21], [32], [33], [50]

Activity	Duration
ICT (playing with the computer)	0-1 h / week
education on ecology	1 h
mathematics and investigation of the environment	4-5 h / week
integrated activities (optional)	0-4 h/ week
selected didactic activities and paying	5 h / week
practical and experimental activities	15 h / week

* Generally, each activity last for 30-45 min

For the primary education the situation is given in Table 9.

Table 9: Recommended durations of activities for primary education [18], [21], [22], [28], [45]

Activity	Duration
ICT (playing with the computer)	0-1 h / week
education on ecology	1 h
mathematics and investigation of the environment	4-5 h / week
education for health	optional
integrated activities (optional)	0-4 h/ week
selected didactic activities and paying	5 h / week
practical and experimental activities	15 h / week

* Practical activities are planned by the teachers to better fit to other thematic activities they are running or in relation to other disciplines

4.9 Assessment

4.9.1 Key summary points

Purposes of assessment

For primary education the assessment goals are [1], [8], [11], [24], [37], [46], [51], [52]: to diagnose the educational system; to orient and optimize the learning process; to make possible the design of an individual educational path to every child and to plan his/ her "school career"; to identify missing parts and difficulties in learning each student faces; to provide a feedback to the educator and parents, results of the evaluation being communicated to all interested parties; to assess individual competences developed by the child; to develop an individual progress plan which includes diagnostic information and prognoses for future work; to monitor schools and the educational system.

The activity is integral part of the educational system, the results being recorded and communicated [23], [46]. It is planned that a unique methodology of assessment, not mandatory, will be developed to guide educators in their work [1].

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

Priorities for children's assessment in Science

In the primary education context the focus of the evaluation process is represented by [16], [17], [18]: the understanding of scientific concepts (i.e. the relation cause-effect); the way investigations are carried out, based on the available means; the fact that qualitative terms have to prevail in the evaluation process - both the acquired knowledge and its attributes (profoundness, functionality, durability, stability, diversity, mobility, applicability) are evaluated; the education purposes (i.e. to encourage initiative, creativity, perseverance, development of intellectual abilities).

Assessment methods

Assessment aspects advocated for primary school education [1], [7], [10], [18], [23], [25], [44], [46] are: continuous observation; assessment done during class work/ practical activities/ didactic play/ project implementation; the shift from rigorous mark-based evaluation towards self-assessment/ auto-correction/ stimulation for learning; both oral and written questioning are recommended, according to the case; evaluation can be performed based on a project/ investigation/ portfolio; the portfolio is the educational identity card of the child (it includes all certificates, diplomas, or other written proves concerning his/ her activity); the evaluation process can include also inter-evaluation/ peers evaluation/ self-evaluation.

Pupils are assessed by the classroom teacher, who establishes the means and methods used. By the end of the 2 grade, the teacher organizes and implements, based on the methodology provided by the Ministry of Education, an evaluation followed by an evaluation report, in order to further prepare the individual leaning plans. The results of the assessments (continuous, formative, summative) are represented by ratings ("insufficient", "sufficient", "good", "very good" and "excellent").

Several components can be distinguished for the assessment process: a) initial evaluation; b) summative evaluation; c) formative evaluation [35]. It is expected that the evaluation activity include additional functions such as: data collection, decision taking, pedagogical and socio-economical directed towards the improvement of the learning process.

4.9.2 Role of creativity

In the evaluation context, the teacher has to use appropriate assessment methods to encourage creativity, active participation, and group work of children. Such methods and evaluation techniques have to support children capacity to respond to real life challenges [24].

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

4.9.3 Main differences between preschool and school

Purposes of assessment

At pre-school level there is "no official assessment system", excepting the "Step-by-Step" approach. The process is organized at class level, the teacher having the responsibility to design and run the assessment process [10].

Priorities for children's assessment in Science

For environmental education in pre-school, it is recommended to perform the evaluation in conditions close to the real life situations [33].

Assessment methods

The major means to be used in children assessment at pre-school level emerging from the studied documents are [32], [33], [35], [41], [50], [53]: individual observation files, testing and control grids, evaluation files/ reports; observations during different activities; dialog session occurring in connection with a real or imaginary situation; evaluation interviews organized without disturbing current activities; practical abilities and capabilities assessment during applied tests.

Conversation has to be combined with observation, the questioning session being connected to the ongoing activities (i.e. explanation of child drawings, or discussions on the product he/ she made), in this way, the evaluation emphasizes both child capacities, the results of his/ her activities and his/ her reflections on these outcomes. The educator is advised to make observations and record data during the learning process, child work and play, to evaluate the way he/ she acts and interacts with colleagues, and look for behavioral patterns , his/ her progress, preferences, style of learning. Role play, story telling, a shot trip are good opportunities for assessment.

Suggestions for the child evaluation portfolio: products and objects; recording files; information of main activities; results from outdoor activities; diagrams; graphs; correspondence with parents; personalized intervention plans; posters; group works; photos; nature calendar; questionnaires; various types of records (audio, video); child own reflections on his/ her work.

4.9.4 Differences between science and mathematics

The assessment is done according to national standards for each discipline and field of learning [1].

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

5. Approaches to Teacher Education

At this moment Romanian is in a transition period as it concerns early age education; a new law of education was just promoted and its implementation is under way. Until now, it was a distinction between persons involved in pre-school education ("educatoare") and primary school teachers ("invatatori", "institutori"). As far as the present system requires for such personnel a higher education degree, this distinction disappears. Within this context, the report provide information on both aspects: pre-school and primary, highlighting differences when is it the case.

For pre-school "teachers having the same qualifications as their colleagues teaching in primary schools and a nationally defined curriculum, the transition between pre-school and compulsory school is a difficult issue. In Romania, the compulsory last year of pre-school should be the opportunity for the teachers of this grade to work with their colleagues teaching in the first year of primary and organize together activities according to the spirit of the new curriculum. The teachers of the first primary year should express their expectations and also conceive their own teaching by respecting certain continuity with the pedagogic practices of the last year of pre-school" [17].

5.1 Initial teacher education

A grid indicating educational requirements for pre-school and primary school teaching personnel is given in Table 10.

Table 10: Background educational requirements for teaching personnel in pre-school and primary school education [10], [25], [39], [54], [55].

Teaching position	Required studies
"educatoare"	graduates of "pedagogical high school/ specialty pre-school education"/ five years studies in teacher-training schools
"institutori"	graduates of pedagogical high school & superior studies in another field/ "teacher-training colleges in a two-year course (for those who have completed an upper secondary teacher-training school) or, in a three-year course (for those who have completed another type of upper secondary school)"
"institutori invatamant prescolar"	graduates of "College for Preschool Teachers"
"profesori pentru invatamantul primar si prescolar"	graduates of double specialties: teacher for pre-school and primary school

Few years ago, to become a teacher for pre-school/ primary school required the completion, according to the case, of appropriate studies: "high school (no pedagogical education); high school pedagogical / «scoala normala»; college of primary school teaching; university degree

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

without psycho-pedagogical module; university degree with psycho-pedagogical module" [9], [12], [56].

Initial teacher training as teacher or tutor requires completion of courses of a HE institution, completed by pedagogical training. Teacher / tutor diploma can be received by means of [22]: "professional lay-out, "pedagogical notebook"; written examination; diploma essay (with psycho – pedagogical - methodological contents)".

According to the new regulations, teachers for pre-school and primary school have to be trained in a University for three years, obtaining a first degree in pre-school and primary pedagogy. Those already active in the educational system, who completed courses to a pedagogical high school can pursue their studies by considering a first degree or a Master degree at a University [25], [57]. Graduates of "educational sciences" are certified, at the Bachelor level, by a license diploma after they attend specific courses, some of them compulsory and other optional, such as: Psychology of education, educational sciences, subject focused studies, ICT, a foreign language, fundamentals of pedagogy and curriculum, theory and methodology of instruction and assessment, theory of education, logic, the subjects to be taught and their specific didactics, practical work, methodology of education research, pedagogy for preschool education, psychological and pedagogical counseling, the education of children with special needs, sociology of education, computer-assisted instruction, pedagogical doctrines" [12], [57], [58].

Practical activities of pre-service teachers are organized in schools under a double tutor scheme (a person nominated by the HE institution and a mentor selected from school teachers), based on an agreement existing between the school and the teachers' training department [12], [58].

The teacher– mentor is defined as "the teacher responsible for guidance and evaluation of teaching practice students or students and teachers in the period of probation [59]. He/ she acts as a model to the student/ teacher doing the practical work; provides advise and is a resource person; offers feedback to the supervised person; is a counselor; is involved into the evaluation process of the supervised person. Official documents detail the competences of the teacher- mentor [59]: didactical competences; competences for planning and organizing the mentoring activities; communication competences; evaluation competences.

The entry requirements for university studies are set by the HE institution to which the would-be student applies for a degree. The minimum requirement is to have a high school graduation degree (in Romania the "Bacalaureat" diploma). The admission in some cases implies an interview, the pass of an examination (or the presentation of a certificate) for linguistics competences for a foreign language, and a test for physical education [12], [58], [60]. Initial teachers' education for pre-school and primary level adopted a "concurrent model" [61].

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

Tables 11 to 13 summarize the existing regulations for initial teacher training in primary education.

Table 11: Regulations in initial teacher education for subject-specific teaching knowledge and skills in primary school, 2004/05 [38].

Knowledge/ skill	Status
Knowledge of school science curricula and their objectives	Science as an integrated subject
Scope for experimental/ investigative activities	Science as an integrated subject
Knowledge of children's 'common sense' understanding of scientific concepts and phenomena	Science as an integrated subject
Taking account of children's 'common sense' understanding of scientific concepts and phenomena	Science as an integrated subject
Ability to keep up to date with recent scientific developments	Science as an integrated subject

Table 12: Regulations in initial teacher education for scientific knowledge and skills in primary school, 2004/05 [38].

Knowledge	Status
Scientific concepts and theories	There are regulations
Scientific experimentation/investigation	There are regulations
History and epistemology of science	No regulations

Table 13: Regulations in initial teacher education for scientific experimental investigative skills in primary school, 2004/05 [38].

Skill	Status
Laboratory-based work	No regulations
Science-related projects	No regulations
Type of activity not specified	There are regulations

As an example of the curriculum pre-school teachers have to study, curriculum which is set by the HE establishment offering such a qualification is given for the Department of Pedagogy for Primary and Pre-school Education, in Bucharest (teacher education - 3 years, 6 semesters, 180 ECTS credits) [39]:

- "Information and communication technologies – compulsory, Credits Total (4PS); Hours per week (2+2); Evaluation (written/ oral - WO);
- Mathematics – compulsory, Credits Total (10PS); Hours per week (4+3); Evaluation (WO);
- Methods of mathematical activities – compulsory, Credits Total (4PS); Hours per week (1+2); Evaluation (WO);

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

- Methods of teaching Arithmetic – compulsory, Credits Total (4PS); Hours per week (2+1); Evaluation (WO);
- Geography and methods of teaching Geography – compulsory, Credits Total (4PS); Hours per week (2+1); Evaluation (WO);
- Sciences/ Environmental sciences education and methods of teaching Sciences/ Environmental sciences education – compulsory, Credits Total (4PS); Hours per week (2+1); Evaluation (WO);
- Methods of teaching Practical abilities – compulsory, Credits Total (4PS); Hours per week (2PS); Evaluation (WO)".

Teachers trainers responsible for initial professional training of science teachers have to fulfill the following requirements [38]: scientific qualification - minimum at Bachelor level; teaching an teaching training qualification - compulsory; teaching experience - compulsory; experience in education research - recommended.

Upon the graduation, teachers enter a probation period when they can be supervised by a school inspector working in cooperation with a teacher-mentor designated by the school principal [58].

5.2 Continuing professional development

CDP is offered through public or private institutions, agencies or NGOs run courses [12]. Those courses have to be accredited by a special department of the Ministry of Education. Such courses are provided by Teachers Training Centers (Casa Corpului Didactic – CCD) in cooperation with county school inspectorates, and are finalized with: a) a participation certificate; b) "atestat" (for < 89 credits); c) certificate (for > 90 credits) [26]. An Order of the Ministry of Education lists the categories of institutions and public/ private bodies which can offer CPD courses for in-service teachers [62]. In addition, specific programs for professional development of teachers, graduates of university studies, are available such as: Master degree, doctoral studies or post university studies in specific fields [13], [14], [62].

Teachers' CPD can be organized as [56]: a) modular courses delivered during school holidays, weekends, or specially designed period; b) distance learning schemes; c) courses without obligation to attend, based on self-study, combined with ordinary courses requiring attendance to the course; d) additional seminary, laboratory practice, and independent learning.

The methodology for teachers' CPD requires teachers to participate every 5 years to a training/ development program, accounting for 90 credits [58], [62].

Competences acquired by teachers are assessed based on their results in different types of activities [12], [56]:

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

- scientific, methodical and pedagogical activities, made at the school level or within a group of schools, methodical commissions, departments or educational circles;
- methodological, and scientific communication sessions, symposia and professional exchange and pedagogical sessions;
- attending specialized scientific information and science education sessions;
- attending courses organized by scientific societies and professional teachers organizations;
- attending special, methodological and pedagogical training courses;
- participating to internship / mentoring programs conducted by professional organizations;
- training scholarships and internships and documentary study, conducted in the country and abroad;
- participation in distance learning courses organized by HEI;
- distance education programmers;
- postgraduate specialization;
- Master degree studies;
- post-university and doctoral studies.

The described situation applies to pre-school and primary school teachers' CPD without any special emphasis on Science and Mathematics education. The only initiative up to now are the two accredited courses (the first ones in Romania) for primary and secondary school teachers in relation to Science teaching by inquiry-based methods, courses delivered by the Center for Science Education and Training at the National Institute for Laser, Plasma and Radiation Physics (http://education.inflpr.ro/ro/Descopera.htm). These courses include both classical frontal delivered sessions and an e-learning platform, and is assisted by a video conference system through which educational videos can be accessed.

Referring to competences/ knowledge acquired by pre-school/ primary school teachers following professional development courses we shall cite some examples of training programs proposed by HEIs, as they are of interest for this report for comparative purpose:

A. Mathematics for primary school, University "Dunarea de Jos", Galati [63]:
    - means for the development of capacities and skills for mental calculus at early age;
    - methods and procedures used to form mathematical representations at early age;
    - role played by logical-mathematical games in the development of intellectual capacity of young child;
    - pedagogical and methodical aspects in learning the concept of number, as an instrument of knowledge for grades II-V;

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

- particularities of mathematical solving and formulating problems at primary school level;
- modalities for efficient teaching-learning strategies in Mathematics education;
- modalities of exercise use in Mathematics teaching and learning for grades I-IV;
- use of Mathematics lessons in stimulating young child's creativity;
- methodical aspects in solving and formulating Mathematical problems in primary school;
- specific problems of teaching and learning of in the "natural number" in primary school;
- assessment strategies for Mathematical activities in primary school;
- incentives to stimulate small pupil independent work by Mathematics lessons;
- role, place and methodology of the didactic game in Mathematics teaching in primary school;
- evaluation strategies used in Mathematics and Science curriculum".

B. Sciences for primary school, University "Dunarea de Jos", Galati [63]:

- "modalities of use the didactic game in teaching environmental awareness activities in elementary school;
- specific of teaching strategies used in teaching and learning sciences in grades I-IV;
- modalities for achieving inter-disciplinarily science teaching in grades I-IV;
- role of Science lessons in the formation of environmental and life science concepts in primary education;
- modalities to stimulate creativity through primary school curriculum, "Mathematics and Science";
- optimization of Science teaching evaluation in primary school;
- role of reality exploration methods for educational activities in primary science education;
- rising the efficiency of evaluation in Sciences teaching for grades I to IV;
- modalities to use extracurricular activities in Science education;
- development of ecological attitudes to young child".

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

6. Conclusion/ Summary

The report is the first one in Romanian, trying to highlight the connections existing or presumed to exist between science and mathematics teaching and creativity in Early Education, as reflected in official documents of the last 15 years. The study was conducted also with the inquiry-based science education methods in mind: how much this approach is characteristic for the Romanian educational system. During the investigation general prescriptions provided by the project management team were observed, using as guide lines the "Conceptual Framework", the "policy questionnaire", and the frame for this report.

Trying to answer to as many questions as possible from the proposed questionnaire over 100 official documents addressing in a way or another topics of interest for the project were scanned.

The main conclusions of the report can be summarized as:

1) The reform of the Romanian educational system affecting aspects of science and mathematics education of young children started by the middle of the last decade of the XX century.
2) Today, this reform is still under way, as the new Law of National Education was adopted last year and problems of its implantation are present now.
3) A "revolution" in approaching Early Education arises with the new Law of Education and is supported by two additional projects of law. Only in the last three years several universities started to offer courses and Master degree in Early Education. For this reason, to speak about an established policy in this field, is a little bit hazardous.
4) Only in 2012 the preparatory class was included in the compulsory educational system as part of primary school. Implementing this new system proved to be a difficult task, with a lot of unanswered questions. In this transitory regime, a smooth transition from the preparatory class to lower primary one seems to be a far to reach objective for the moment.
5) A change appeared also in approaching science and mathematics as they are planned to be taught in pre-school and primary school. Generally, science and mathematics are proposed as a common body of knowledge, mathematics being more applicative, closer to the real life situations.
6) Creativity is barely mentioned and not as a focus of educational efforts. No reference to creative teaching, creativity development of children or learning for creativity was found.
7) The studied documents have no focus on inquiry-based teaching. Applying this method in science and mathematics teaching will be a difficult endeavour, as far as

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

Romania is not prepared even conceptually for it. Nevertheless, some components embedded into inquiry-based practice can be found in the official documents (the role of questioning: children running investigations/ experiments; children attempting to provide explanations; the role of observation; pair and group work; encouragement of autonomous learning; problem solving approach; children expressing their own ideas; the use of various form of data recording; different approaches for results communication). Of course, these are the seeds of a true inquiry-based model, but suggestions for such implementation of science and mathematics teaching are very few and scattered over a lot of school curricula and pedagogical methodologies, guides, teaching plans, best practice guides for teaching science, mathematics and ecology, strategic plans etc. There is no single document or collection of documents addressing unitarily IBSE principles and methodology. In any case, the experiment/ investigations are mentioned in the documents but are rarely encountered in school life.

8) A progression is noticeable in relation to students' achievements assessment, as the practice stars to shift from summative towards formative, continuous, more structured assessment.
9) The last few years brought the required clarification in the ITE practice, as university studies, Master degree and PhD degree were developed and promoted.
10) Science and mathematics education does not target the formation of future scientists and engineers; it is directed towards the education of a knowledge and aware citizen, able to understand the surrounding world.
11) The use of simple tools, devices and equipments is encouraged. Much supported is the employment of computers and digital devices starting from early age.
12) The role of the educator is expected to change dramatically; he/ she become a mentor, partner, support person, adviser, mediator, observer, discrete evaluator.
13) Integrating science and mathematics with other disciplines and outdoor activities have to become a usual practice.
14) It is worth to mention that the theme of building knowledge on child prior experience is advocated in several documents.
15) Project- and problem-based learning is widespread recommended as science teaching methods.

The complex and quasi-complete radiography of the Romanian educational system as perceived through the science and mathematics teaching/ education for creativity/ inquiry-based education objective could become a reference document for the evolving Romanian educational landscape.

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

6.1 Limitations

The study prepared on the connections existing or presumed to exist between creativity and science and mathematics education at early age, proved to be quite a complete one, as a lot of official documents issued in the last 15 years in Romania were investigated. The objective was to catch as many aspects as possible in relation to national policies in Early Education.

Because time and man-power assigned to this task were limited, few critics to policy documents are present in the report, in spite of the fact that some scholarly papers were included. For sure, media reports/ commentaries are missing.

As the information is spread over tenths of documents it was difficult in some situations to reflect the temporal evolution of some ideas, as they progress or regress from government to government. Without any doubts, such a description would help a researcher to understand how educational policies changes along with political changes. In any case, a clear improvement is noticeable in the efforts to improve, modernize and innovate pre-school and primary education.

In the report development, efforts were made to locate not only specific words but also similar meanings or at least vague formulation of the investigated question. This approach of course induces the personal bias of the authors, reflecting their understanding, professional background, preferences. It is expected that the reader will overcome these limitations as he/she will be able to compare concurrent aspects reviled by the selection made. For the same reason, to avoid bias, examples of curricula from different Higher Education Institutions offering ITE programs were included.

The study does not compare in all cases the point of view expressed into a European report to statements found in official documents. Such an approach could be of interest for the study in order to justify an external image with the national framework.

6.2 Implications

The national report has to be read in conjunction with the European report, the "Conceptual Framework", and the four documents on: science and mathematics education in early years; creativity in education; teachers training on science and mathematics in early years; comparative study on science and mathematics education. Such a set of documents will definitely assist Romanian educational policy makers, teachers' trainers, parents' organization and other stakeholders:

- to have an integral view on creativity and its connections with science and mathematics teaching and learning in Early Education;
- to compare different official documents addressing the subjects, documents issued in various political and economic contexts;
- to become aware of the importance of creativity in Early Education;

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

- to understand the UE's message in supporting IBSE in pre-school and primary school;
- to refer more easily to other similar educational approaches in Europe;
- to perceive in a more coherent manner concepts such as creativity, inter-disciplinarity, active and independent learning, social constructivism, assessment in learning;
- to design a better, more student centred curriculum and school lessons for young children.

Through this study, a coherent review of the educational system "in use" as compared to European and international trends is available to Romanian educational policy makers. The report will help in this way a more structured development of science and mathematics education in early age, addressing in the mean time creativity. The set of documents provides also the fundament for a sustained promotion of IBSE principles and practices in Romania.

An interesting feedback was received from school teachers participating to the project survey organized in Romania. After answering the questionnaire, some of them sent an e-mailed saying: "I didn't think before in this way to some issues present in the survey. Now, I have another understanding of the problem". The study done through this national report can trigger the same reaction from the readers of this report. That can be considered as a real push forward for the Romanian educational system.

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

7. References:

[1] Ministry of Education, Research, Youth and Sports, 2011. L E G EA educaţiei naţionale, Legea 1/2011. Available at: http://www.unibuc.ro/n/organizare/biro-perf/docs/2012/ian/16_12_49_00Legea_Educatiei_Nationale.pdf

[2] Legea învătământului, LEGE Nr. 84 din 24 iulie 1995. Available at: http://administraresite.edu.ro/index.php?module=uploads&func=download&fileId=9871

[3] International Standard Classification of Education I S C E D 1997, November 1997, available at: http://www.unesco.org/education/information/nfsunesco/doc/isced_1997.htm

[4] EACEA P9 Eurydice, 2012. Key Data on Education in Europe 2012, Education, Audiovisual and Culture Executive Agency, ISBN 978-92-9201-242-7, doi:10.2797/77414, available at: http://eacea.ec.europa.eu/education/eurydice/documents/key_data_series/134EN.pdf

[5] EACEA P9, 2009. Eurydice Key Data on Education in Europe Education, Audiovisual and Culture Executive Agency, ISBN 978-92-9201-033-1, DOI 10.2797/1715. Available at: http://eacea.ec.europa.eu/education/eurydice/documents/key_data_series/105EN.pdf

[6] Ministry of Education, Research, and Youth. LEGEA ÎNVATAMÂNTULUI PREUNIVERSITAR, PROIECT ÎN LUCRU. Available at: http://www.isj.albanet.ro/_documente/139_Proiect%20de%20lege%20invatamant%20preuniversitar.pdf

[7] EACEA P9 Eurydice, 2011. Science Education in Europe: National Policies, Practices and Research, 2011, Education, Audiovisual and Culture Executive Agency, ISBN 978-92-9201-218-2, doi:10.2797/7170. Available at: http://eacea.ec.europa.eu/education/eurydice/documents/thematic_reports/133EN.pdf

[8] Ministry of Education, Research, Youth and Sports, 2012. METODOLOGIA de organizare şi de administrare a evaluării naţionale la finalul clasei a IV-a, Anexa la Ordinul Ministrului Educației, Cercetării, Tineretului și Sportului nr. **3438** din **5.III.2012** privind aprobarea Metodologiei de organizare și administrare a evaluării elevilor la finalul clasei a IV-a. [pdf] Bucharest. Available at: http://www.isjcj.ro/htm/Legislatie/04_ENIV_Metodologie_27_II_2012_Anexa%20OM%203438.pdf

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

[9] Ministry of Education, Research, Youth and Sports, 2007. Evaluarea nationala la finalul clasei a IV-a, Raport tehnic, 2007. Available at: http://administraresite.edu.ro/index.php?module=uploads&func=download&fileId=6505

[10] OECD Publications Service, 2000. Reviews of National Policies for Education, Romania, Education and skills. [pdf]. Available at: http://www.see-educoop.net/education_in/pdf/analiza-politici-rom-enl-t05.pdf

[11] Ministry of Education, Research and Innovation, 2009. Ordin nr. 4595 din 22/07/2009, privind aprobarea criteriilor de performanţă pentru evaluarea cadrelor didactice din invăţămantul preuniversitar.Available at: http://legestart.ro/Ordinul-4595-2009-aprobarea-criteriilor-performanta-evaluarea-cadrelor-didactice-invatamantul-preuniversitar-(MzM2OTg1).htm

[12] *Bîrzea, C., Neacşu, I., Potolea, D. Ionescu, M., Istrate, O., Velea, L.S., 2006. National Report – Romania in The prospects of Teacher Education in South-East Europe,* P. Zgaga (Ed.), University of Ljubljana, Faculty of Education, ISBN-10 86-7735-098-. Available at: http://www.see-educoop.net/education_in/pdf/workshop/tesee/dokumenti/book/romania.pdf

[13] Universitatea ''Al. I. Cuza'' Iași. Facultatea de Psihologie și Științe ale Educației: Didactici Aplicate pentru Învățământul Primar & Educație Timpurie, Master 2010-2011. Available at: http://www.isjiasi.ro/index.php?option=com_content&view=article&id=297:oferta-programe-facultatea-de-psihologie-i-tiine-ale-educaiei-universitatea-al-i-cuza-iai&catid=64:offormare&Itemid=94

[14] Master's degree program for pre-secondary education. Policies and Strategies of Development Curriculum – Universitatea din Bucuresti, Facultatea de Psihologie si Stiintele Educatiei, Departamentul pentru Pedagogia Invatamantului Primar si Prescolar. Available at: http://admitere.unibuc.ro/infoadmitere/studii-universitare-de-masterat

[15] Ministry of Education, Research, Youth and Sports, 2012. Programa scolara pentru disciplina "TEHNOLOGII DE INFORMARE SI COMUNICARE (JOCUL CU CALCULATORUL)", Proiect propus pentru dezbatere, Februarie 2012. [pdf] Bucharest. Available at: http://clasapregatitoare.suntparinte.ro/wp-content/uploads/2012/02/document-2012-02-29-11627495-0-tehnologii-informare-comunicare.pdf

[16] Ministry of Education, Research, Youth and Sports, 2001. ŞTIINŢE, Clasa a IV-a, (*Programa de Ştiinţe pentru clasele a III-a – a IV-a a fost aprobată prin Ordin al ministrului nr. 4301/ 22 august 2001,* Available at: http://www.google.ro/url?sa=t&rct=j&q=%C5%9Ftiin%C5%A3e%2C%20clasa%20a%20iv%20a%2C%20(programa%20de%20%C5%9Ftiin%C5%A3e%20pentru%20clasele%20a%2

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

0iii-a%20%E2%80%93%20a%20iv-a%20a%20fost%20aprobat%C4%83%20prin%20ordin%20al%20ministrului%20nr.%204301%2F%2022%20august%202001&source=web&cd=4&ved=0CFUQFjAD&url=http%3A%2F%2Fadministraresite.edu.ro%2Findex.php%3Fmodule%3Duploads%26func%3Ddownload%26fileId%3D4250&ei=NzfnT_H9NY_1sgbL1ZGvAQ&usg=AFQjCNG-zOs1jdZCK2261IxcNmGrx8F6yg

[17] Ministry of Education and Research, 2005. Programe scolare pentru clasa a IV-a – stiinte ale naturii, Anexa nr. 2 la Ordinul ministrului educaţiei şi cercetării nr. 3919 / 20.04.2005. Available at: www.edu.ro_index.php_articles_c538

[18] Ministry of Education, Research, Youth and Sports, 2007. Educatia ecologica si de protectie a mediului, Ghid metodologic pentru cadrele didactice, invatamantul primar. Available at: www.edu.roindex.phparticles9330

[19] Ministry of Education, Research and Youth, 2004. Programe scolare pentru clasa a III-a – stiinte ale naturii. Available at: www.edu.ro_index.php_articles_c538

[20] Cerkez, M., Singer, M., Oghina, D., Sarivan, L., Capita, L., Ciolan, L., Tacea, F., Crocnan, D., 1999. Curriculum national – programe scolare pentru clasele a III-a- a VI-a. Aria Curriculara: matematica si stiinte ale naturii, stiinte. Available at: http://administraresite.edu.ro/index.php/articles/curriculum/c539/?startnum=61

[21] Ministry of Education, Research Youth and Sports, 2012. Ordin privind aprobarea planurilor-cadru de invatamant pentru invatamantul primar, ciclul achizitii fundamentale – clasa pregatitoare, clasa I si clasa a II-a si a Metodologiei privind aplicarea planurilor-cadru de invatamant pentru invatamantul primar, ciclul achizitii fundamentale – clasa pregatitoare, clasa I si clasa a II-a. Available at: www.edu.roindex.phparticlesc1003

[22] Ministry of Education, Research, Youth and Sports, 2012. Notă privind* elaborarea planului-cadru pentru învăţământul primar Clasa pregătitoare şi clasele I – a II-a (Proiect), [pdf] Bucharest. Available at: http://clasapregatitoare.suntparinte.ro/wp-content/uploads/2012/02/document-2012-02-29-11627502-0-plan-cadru-achizitii-fundamentale.pdf

[23] Ministry of Education and Research, 1998. Matematica – Curriculum Clasa a IV-a. Available at: http://administraresite.edu.ro/index.php/articles/4861

[24] Ministry of Education, Research, Youth and Sports, 2002. Strategia Dezvoltării Învăţământului Preuniversitar în perioada 2001 – 2004. [pdf] Bucharest. Available at: http://www.gov.ro/upload/articles/100025/strategiepreuniv.pdf

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

[25] Bilt, M., Chirea, V.G., Dumitriu, C., Ionescu, M., Litoiu, N., Negreanu, M., Tacea, F.A., Tesileanu, A., 2009/10. *Structures of Education and Training Systems in Europe.* [pdf]. Available at: http://eacea.ec.europa.eu/education/eurydice/documents/eurybase/structures/041_RO_EN.pdf

[26] Ministry of Education, Research and Youth, 2003. Programa scolara – cunoasterea mediului, clasele I-a, II-a. Available at: http://curriculum2009.edu.roCiclul_primar

[27] Ministry of Education, Research and Innovation, 2009. Raport asupra stării sistemului național de învățământ, Bucureşti – 2009 . [pdf] Bucharest. Available at: http://www.adevarul.ro/actualitate/social/Raport_asupra_starii_sistemului_national_de_invatamant_ADVFIL20101024_0001.pdf

[28] Ministry of Education, Research and Youth, 2003. Programe scolare revizuite – Abilitati practice, clasele I-a, II-a. Available at: www.edu.ro_index.php_articles_c538

[29] Ciascai, L., Haiduc, L., 2009. Is Romanian Science school Curricula open towards the Development of School Students' Critical Thinking Skills? Acta Didactica Napocensia, Volume 2, Number 3, ISSN 2065-1430. Available at: http://dppd.ubbcluj.ro/adn/article_2_3_2.pdf

[30] Ministry of Education, Research, Youth and Sports, 2012. Programa scolara pentru disciplina "MATEMATICA SI EXPLORAREA MEDIULUI", Proiect propus pentru dezbatere Februarie 2012. [pdf] Bucharest. Available at: https://www.fundatiadinupatriciu.ro/uploaded/Clasa%20pregatitoare/4_Matematica%20si%20explorarea%20mediului.pdf

[31] Ministry of Education, Research and Youth, 2004. Programe scolare pentru clasa a III-a – Educatie tehnologica. Available at: www.edu.ro_index.php_articles_c538

[32] Ministry of Education, Research and Youth, 2008. Curriculum pentru învăţământul preşcolar (3-6/7 ani). Available at: http://educatie.inmures.ro/fileadmin/docs/curriculum/curriculum%20final_18%20septembrie.pdf

[33] Ministry of Education, Research, Youth and Sports, 2007. Educatia ecologica si de protectie a mediului, Ghid metodologic pentru cadrele didactice, invatamant prescolar – nivelul II (5-6/7 ani). [pdf]. Available at: http://www.isjbraila.ro/actedu/Ed_eco-Ghid_prescolari.pdf

[34] Ministry of Education, Research and Youth, 2004. Programă şcolară pentru clasa a iii-a-Matematică. Available at: www.edu.ro_index.php_articles_c538

[35] Ministry of Education, Research and Youth, 2008. Ghid de bune practice pentru educatia timpurie a copiilor intre 3-6/7 ani. Available at:

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

http://proiecte.pmu.ro/c/document_library/get_file?p_l_id=16980&folderId=31565&name=DLFE-2702.pdf

[36] Ministry of Education, Research, Youth and Sports, 1998. Abilitati practice, clasa a IV-a. Available at: http://administraresite.edu.ro/index.php?module=uploads&func=download&fileId=4217

[37] Ministry of Education, Research and Youth, 2003. Programe scolare revizuite - Matematica, , clasele I-a, II-a. Available at: http://curriculum2009.edu.roCiclul_primar

[38] European Commission, Directorate-General for Education and Culture, Science Teaching in Schools in Europe Policies and Research, Eurydice, 2006, ISBN 92-79-01923-6. Available at: http://www.mp.gov.rs/resursi/dokumenti/dok13-eng-Science_teaching.pdf

[39] Iucu, R., Manolescu, M., Ciolan, L., Bucur, C., 2008. System of early education/care and professionalisation in Romania. [pdf]. Available at: http://www.ifp.bayern.de/imperia/md/content/stmas/ifp/commissioned_report_romania.pdf

[40] Ministry of Education, Research, Youth and Sports, 2012. Progresia competentelor în Ciclul achizitiilor fundamentale. [pdf] Bucharest. Available at: http://clasapregatitoare.suntparinte.ro/wp-content/uploads/2012/02/document-2012-02-29-11627501-0-progresia-competentelor-ciclul-achizitiilor-fundamentale.pdf

[41] Ministry of Education, Research and Youth, 2009. Noi repere ale educaţiei timpurii în grădiniţă, PRET - Proiectul pentru Reforma Educaţiei Timpurii, PROIECT NAŢIONAL COFINANŢAT DE GUVERNUL ROMÂNIEI ŞI DE BANCA DE DEZVOLTARE A CONSILIULUI EUROPEI (BDCE). [pdf] Bucharest. Available at: http://proiecte.pmu.ro/c/document_library/get_file?p_l_id=16980&folderId=21042&name=DLFE-2003.pdf

[42] Ministry of Education, Research and Youth, 2009. Gata pentru şcoală!, PRET - Proiectul pentru Reforma Educaţiei Timpurii, PROIECT NAŢIONAL COFINANŢAT DE GUVERNUL ROMÂNIEI ŞI DE BANCA DE DEZVOLTARE A CONSILIULUI EUROPEI (BDCE). [pdf] Bucharest. Available at: http://proiecte.pmu.ro/c/document_library/get_file?p_l_id=16980&folderId=21042&name=DLFE-2004.pdf

[43] UNESCO International Bureau of Education (IBE), 2006. Romania, Early Childhood Care and Education (ECCE) programmes, [pdf] Geneva. Available at: http://unesdoc.unesco.org/images/0014/001472/147227e.pdf

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

[44] EACEA P9 Eurydice, 2011. Mathematics Education in Europe: Common Challenges and National Policies, Education, Audiovisual and Culture Executive Agency, ISBN 978-92-9201-221-2, doi:10.2797/72660. Available at: http://eacea.ec.europa.eu/education/eurydice/documents/thematic_reports/132EN.pdf

[45] Ministry of Education, Research, Youth and Sports, 2003. Educaţie pentru sănătate, clasele I - a XII-a, Nota de prezentare. [pdf] Bucharest. Available at: http://staticlb.didactic.ro/uploads/assets/110/9/34//edsan112.pdf

[46] Ministry of Education, Research Youth and Sports, 2008. HOTĂRÂRE nr. 1534 din 25 noiembrie 2008 privind aprobarea Standardelor de referinţă şi a indicatorilor de performanţă pentru evaluarea şi asigurarea calităţii în învăţământul preuniversitar, [pdf] Bucharest. Available at: http://www.isj.albanet.ro/_documente/122_Hotararea%201534%202008%20privind%20standardele%20de%20referinta%20a%20indicatorilor%20de%20performanta.pdf

[47] Ministry of Education, Research, Youth and Sports, 2012. Programa scolara pentru disciplina "Dezvoltare personala, Clasa pregatitoare. Available at: https://www.fundatiadinupatriciu.ro/uploaded/Clasa%20pregatitoare/9_Consiliere.pdf

[48] Ministry of Education, Research and Youth, 2008. Curriculum pentru educaţia timpurie a copiilor de la 3 la 6/7 ani. Available at: http://proiecte.pmu.ro/c/document_library/get_file?p_l_id=16980&folderId=31565&name=DLFE-2701.pdf

[49] Ministry of Education and Research, 2006. Normativ de dotare minima pentru invatamantul primar. Available at: www.edu.ro_index.php_articles_c538

[50] Ministry of Education, Research and Youth - School Inspectorate of Bistrita-Nasaud County, 2008. PRECIZĂRI METODICE PRIVIND APLICAREA NOULUI CURRICULUM ÎN ÎNVĂŢĂMÂNTUL PRESCOLAR. Available at: http://www.scribd.com/doc/72074111/Precizari-Metodice-Privind-Aplicarea-Noului-Curriculum

[51] EACEA P9 Eurydice, 2009. National Testing of Pupils in Europe: Objectives, Organisation and Use of Results. Education, Audiovisual and Culture Executive Agency, ISBN 978-92-9201-036-2, DOI 10.2797/18294. Available at: http://eacea.ec.europa.eu/education/eurydice/documents/thematic_reports/109EN.pdf

[52] Ministry of Education, Research, Youth and Sports, 2012. METODOLOGIA de organizare a evaluării competenţelor fundamentale la finalul clasei a II-a, Anexa la Ordinul Ministrului Educației, Cercetării, Tineretului și Sportului nr. 3437 din 5.III.2012 pentru aprobarea Metodologiei de organizare a evaluării competențelor fundamentale la

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

finalul clasei a II-a, [pdf] Bucharest. Available at: http://www.isjcj.ro/htm/Legislatie/02_ENII_Metodologie_22_02_12_Anexa%20OM%203437.pdf

[53] Ministry of Education, Research and Youth, 2009. Educaţia timpurie specificul dezvoltării copilului preşcolar, PRET - Proiectul pentru Reforma Educaţiei Timpurii, PROIECT NAŢIONAL COFINANŢAT DE GUVERNUL ROMÂNIEI ŞI DE BANCA DE DEZVOLTARE A CONSILIULUI EUROPEI (BDCE). [pdf] Bucharest. Available at: http://proiecte.pmu.ro/c/document_library/get_file?p_l_id=16980&folderId=21042&name=DLFE-2001.pdf

[54] Romanian Parliament, 1997. *Law no.128 - Statutul personalului didactic.* Available at: http://www.cs.ubbcluj.ro/files/legislatie/national/statutul.html

[55] *Lege* privind *statutul personalului didactic, Suport legislativ pentru dezbaterea proiectului.* Available at: http://www.isj.albanet.ro/_documente/139_Proiect%20statutul%20personalului%20didactic.pdf

[56] Ministry of Education, Research and Innovation, 2009. Metodologia din 2009 a formarii continue a personalului didactic din invatamantul preuniversitar. Available at: http://legestart.ro/Metodologia-2009-formarii-continue-personalului-didactic-invatamantul-preuniversitar-(MzQxMzg2).htm

[57] Ministry of Education, Research, Youth and Sports, 2011. O R D I N pentru aprobarea Metodologiei privind formarea continuă a personalului din învăţământul preuniversitar. Available at: http://www.fsli.ro/metodologii/Anexa%20OMECTS%205561.pdf

[58] Velea, S., Istrate, O., 2011. Teacher Education in Romania. Recent Developments and Current Challenges, in European Dimensions of Teacher Education – Similarities and Differences, Milena Valenčič Zuljan and Janez Vogrinc (Eds.). Available at: http://www.pef.uni-lj.si/fileadmin/Datoteke/Zalozba/pdf/Zuljan_Vogrinc_Teacher_education.pdf

[59] Ministry of Education and Research. Statutul Cadrului Didactic – Mentor. Available at: http://www.isj.albanet.ro/_documente/139_Statut%20mentor.pdf

[60] Ministry of Education and Research, 2009. Plan de invatamnt, Domeniul de studii de licenta – Stiintele educatiei, 2009-2010, Universitatea de Petrol-Gaze Ploiesti, Faultatea de Litere si Stiinte. Available at: http://www.upg-ploiesti.ro/fisiere/647/Plan%20invatamant%20Pedagogia%20Invatamantului%20Primar%20si%20Prescolar.pdf

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

[61] Indicators on Initial Teacher Education extracted from Key Data on Education 2009, EACEA P9 **Eurydice.** Education, Audiovisual and Culture Executive Agency. Available at: http://eacea.ec.europa.eu/education/eurydice/documents/key_data_series/105EN.pdf

[65] Ministry of Education, Research, Youth and Sports, 2011. PLAN DE ÎNVĂŢĂMÂNT, DOMENIUL: Ştiinţe ale Educaţiei, SPECIALIZAREA: Pedagogia învăţământului primar şi preşcolar, Durata studiilor: 3 ani, cursuri cu frecvenţă, Valabil pentru anul univ. 2010/ 2011, UNIVERSITATEA DIN BUCUREŞTI FACULTATEA DE PSIHOLOGIE ŞI ŞTIINŢELE EDUCAŢIEI Available at: http://www.uav.ro/files/educatie/licenta/PIP.pdf

[62] Ministry of Education, Research, Youth and Sports, 2009. Metodologia formarii continue a personalului didactic din invatamantul preuniversitar, Anexa la OM Nr. 5720 / 20.10.2009. [pdf] Bucharest. Available at: http://www.ugal.ro/doc/ugal/metodologia_formarii_continue_a_personalului_didactic_din_invatamantul_preuniversitar.pdf

[63] COLOCVIUL DE ADMITERE LA GRADUL DIDACTIC I , seria 2011 – 2013 Specializarea: *INSTITUTORI-ÎNVĂŢĂTORI, ÎNVĂŢĂTORI,* UNIVERSITATEA "DUNĂREA DE JOS" DIN GALAŢI DEPARTAMENTUL PENTRU PREGĂTIREA PERSONALULUI DIDACTIC. Available at: http://www.ugal.ro/doc/ugal/grade2011_2012/INVATATORI.pdf?PHPSESSID=2e8710e703511010da3c729b645d2478

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

Appendix A

Survey Ratings: Analysis of Approaches to Teaching and Learning

Key
PS: Pre-school
P: Primary school

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

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

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

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).			PS	P
b. To understand that scientists describe the investigations in ways that enable others to repeat the investigations.	PS/P			
c. To be able to ask a question about objects, organisms, and events in the environment.	PS		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.	PS		P	
e. To know and understand the important scientific processes.	PS			P
f. To be able to communicate investigations and explanations.		PS		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.	PS	P		
h. To have positive attitudes to science learning.	PS	P		
i. To be interested in science.	PS/P			
j. To be able to plan and conduct a simple investigation.	PS			P
k. To have positive attitudes to learning.	P	PS		
l. To understand that scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge).	PS/P			
m. To be able to collaborate with other children		PS	P	

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

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
a. To know and understand the important scientific ideas (facts, concepts, laws and theories).		PS/P		
b. To understand that scientists describe the investigations in ways that enable others to repeat the investigations.		PS/P		
c. To be able to ask a question about objects, organisms, and events in the environment.		PS/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.		PS	P	
e. To know and understand the important scientific processes.		PS/P		
f. To be able to communicate investigations and explanations.		PS/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.		PS/P		
h. To have positive attitudes to science learning.		PS/P		
i. To be interested in science.		PS/P		
j. To be able to plan and conduct a simple investigation.		PS/P		
k. To have positive attitudes to learning.		PS/P		
l. To understand that scientists develop explanations using observations (evidence) and what they already know about the world (scientific knowledge).		PS/P		
m. To be able to collaborate with other children			PS/P	
Other			P	PS

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

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
mathematics	Yes		

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

	science	mathematics
1	Characteristics and properties of bodies	Numbers and basic mathematical operations
2	Transformations of bodies and materials	Regular geometric shapes and 3D bodies
3	Man and the environment	Use of money
4	Natural resources	Time and space orientation

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

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.				PS/P
b. Ask questions about objects, organisms, and events in the environment.	PS		P	
c. Design or plan simple investigations or projects.		PS		P
d. Conduct simple investigations or projects				PS/P
e. Employ simple equipment and tools to gather data and extend to the senses.				PS/P
f. Use data to construct reasonable explanations.		PS		P
g. Communicate the results of their investigations and explanations.			PS	P
h. Other		PS	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.		PS/P		
b. Ask questions about objects, organisms, and events in the environment.		P	PS	
c. Design or plan simple investigations or projects.		PS	P	
d. Conduct simple investigations or projects		PS/P		
e. Employ simple equipment and tools to gather data and extend to the senses.		PS/P		
f. Use data to construct reasonable explanations.		PS/P		
g. Communicate the results of their investigations and explanations.		PS/P		

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

Teacher Role / Location

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

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

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

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

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

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

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

Materials and Resources

A. What materials are suggested?

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

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

Groupings

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

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

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	P	
3-4 h		
More than 4 h		P
N/A (Please explain)		

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

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	PS/P			
b. To identify aspects of the science curriculum that could be improved	PS		P	
c. To identify ways to improve child science learning		PS	P	
d. To monitor regularly individual children's or cohorts of children's progress towards a set of desirable science learning outcomes				PS/P
e. To inform parents of their child's progress in science	PS		P	
f. To help group children for science instruction purposes	PS/P			
g. To monitor year-to-year child progress in science	PS	P		
h. To provide feedback to children about their progress in science	PS			P
i. To set targets with children for their own development in science	PS/P			
Other				PS/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)	PS	P		
b. Knowledge and understanding of scientific processes	PS	P		
c.Competencies necessary to carry out scientific inquiry	PS	P		
d. Understandings about scientific inquiry (e.g. how science and scientists work)	PS/P			
e. Positive attitudes and increase of interest in science	PS/P			
f. Positive attitudes and increase of interest in learning science	PS/P			

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

C. What ways of assessing are advocated?

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

D. What Creative attributes are addressed in assessment?

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

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