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

D4.3 Country Reports
Report 6 of 9:
Country Report on in-depth field work in Malta

Author:
Prof. Suzanne Gatt, University of Malta, Malta

www.creative-little-scientists.eu
Creative Little Scientists:
Enabling Creativity through Science and Mathematics in Preschool and First Years of Primary Education

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

Information about the deliverable
Dissemination level: PUBLIC
Due date of deliverable: April 2013
Actual submission date: 28/06/2013
Deliverable title:
D4.3 Country Reports

Contact Information
Coordinator
Ellinogermaniki Agogi, Greece:
Dr. Fani Stylianidou

Lead partner for this deliverable
Ellinogermaniki Agogi, Greece:
Dr. Fani Stylianidou, Dimitris Rossis

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

Introduction ........................................................................................................................................... 5
1. Aims of this Report .............................................................................................................................. 5
2. Methodology ...................................................................................................................................... 7
   2.1 Research Questions ....................................................................................................................... 7
   2.2 Research Instruments .................................................................................................................... 10
   2.3 Data Collection ............................................................................................................................. 11
      2.3.1 Sampling principles .................................................................................................................. 11
      2.3.2 Ethical issues ........................................................................................................................... 12
   2.4 Data Analysis .................................................................................................................................. 14
      2.4.1 Process .................................................................................................................................... 14
      2.4.2 Final sample ............................................................................................................................. 15
      2.4.3 Limitations ............................................................................................................................... 15
3. Case Studies ....................................................................................................................................... 16
   3.1 Case 1 – ‘Natasha from Sunflower School’: a case of creative skills development 16
      3.1.1 Context .................................................................................................................................... 16
      3.1.2 Episodes .................................................................................................................................. 18
      3.1.3 Case summary and conclusions ............................................................................................... 19
   3.2 Case 2 – ‘Lydia at Sunflower School – A case of scaffolding through fun’ ............. 22
      3.2.1 Context .................................................................................................................................... 22
      3.2.2 Episodes .................................................................................................................................. 23
      3.2.3 Case summary and conclusions ............................................................................................... 25
   3.3 Case 3 – ‘Sabrina at Marygold School’ – A case of creative inquiry-based learning 27
      3.3.1 Context .................................................................................................................................... 27
      3.3.2 Episodes .................................................................................................................................. 28
      3.3.3 Case summary and conclusions ............................................................................................... 30
   3.4 Case 4 – ‘Diane at marigold School’ – A case of creative construction of knowledge 33
      3.4.1 Context .................................................................................................................................... 33
      3.4.2 Episodes .................................................................................................................................. 34
      3.4.3 Case summary and conclusions ............................................................................................... 37

The project CREATIVE LITTLE SCIENTISTS has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 289081.
3.5 Case 5 – ‘Gillian at Honeysuckle School’ – A case of creative exposure to the world around us

3.5.1 Context

3.5.2 Episodes

3.5.3 Case summary and conclusions

3.6 Case 6 – ‘Fleur at Daisy School’ – A case of creative scaffolding

3.6.1 Context

3.6.2 Episodes

3.6.3 Case summary and conclusions

4. Discussion of findings

4.1 Enabling Factors or Barriers at Contextual Level

4.1.1 Differences between preschool and primary school

4.1.2 Differences between science and mathematics

4.1.3 Opportunities and challenges for creative learning and teaching

4.2 Revisiting the CLS Mapping and Comparison Factors: A summary of findings

4.2.1 Aims and Objectives

4.2.2 Learning Activities

4.2.3 Pedagogy

4.2.4 Assessment

4.2.5 Materials and Resources

4.2.6 Grouping

4.2.7 Location

5. Implications

5.1 Implications for teacher training

5.2 Implications for policy development
Introduction
This report provides the description and analysis of the research conducted in early years classrooms in Malta. It first provides an overview of the cases chosen for inclusion of the study and the ethical aspects, which needed to be respected before any data could be collected. It then moves on to provide an analysis of the qualitative data obtained in order to provide insights and answers to the research questions set.

1. Aims of this Report
The Country Report on in-depth field work in Malta forms part of the Country Reports (Deliverable D4.3) of the EU-funded project Creative Little Scientists and aims at presenting the qualitative analysis of data gathered through field work in schools in Malta.

The fieldwork was carried out during the months January-April 2013 in each of the nine participating European countries (Belgium, Finland, France, Germany, Greece, Malta, Portugal, Romania and the UK) representing a wide spectrum of educational, economic, social and cultural contexts. The findings of this qualitative study aim to reveal the potential for creativity and the role of inquiry in the classroom realities of pre-primary and first years of primary science and mathematics education, and are grounded on concepts and synergies identified in the Conceptual Framework (D2.2) and operationalized in the List of Mapping and Comparison Factors (D3.1) developed previously in the project. Moreover, they aim to complement the findings of the Report on Mapping and Comparing Recorded Practices (D3.2) and the Report on First Survey of School Practice (D3.3), previous project deliverables, which addressed the same goals through the analysis of relevant policy records and teacher survey data respectively.

The focus of the fieldwork was on sites where there were indications that we would find ‘good practice’, and covering all pupil age groups from age 3 up to 8 years and the different provisions of pre-primary and early primary education in the country. The characteristics of ‘good practice’ emerged from reflection on findings of previous project deliverables: the Conceptual Framework (D2.2), the Report on Mapping and Comparing Recorded Practices (D3.2) and the Report on First Survey of School Practice (D3.3). This has enabled the project to document and analyse practice at the cutting edge of creativity in early science and mathematics, revealing insights into whether/how:

- children’s creativity is fostered, and
- the emergence of appropriate learning outcomes is achieved.

As far as the latter is concerned, focus was placed on (but not limited to) issues of central importance in current science and mathematics education discourse, including generating children’s interest in science and mathematics, avoiding emergence of misconceptions and stereotypical images, and considering gender, socio-economic and cultural issues.
The in-depth fieldwork followed the research design and methodology specified for the project and set out in detail in the *Methodology for in-depth fieldwork* (D4.1), and involved the use of interviews and observations with teachers and children, using field notes and audio recordings. The present report presents the analysis of data in relation to six cases (each case comprises one teacher and the children they work with), based in four sites of pre-primary and early primary education. Each case contains episodes, documenting examples of science and mathematics through the lens of creativity.

Finally, this report is one of the working documents that will provide input to the *Report on Practices and their Implications* (Deliverable D4.4), which is the final outcome of Work Package 4. The latter will give a detailed account of the analysis of the evidence gathered through the field work in all partner countries, as well as identify a set of exemplary Case Studies illustrating the variety of approaches observed and the possibilities identified.
2. Methodology

The full range of methodological planning and framing for the fieldwork study presented in this report is set out in the Methodology for in-depth fieldwork (D4.1). The following sections serve as a reminder of some of its essential elements, and mainly provide the details of how this methodology was implemented in the fieldwork carried out in schools in Malta and described in this report.

2.1 Research Questions

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

RQ1 How are the teaching, learning and assessment of science and mathematics in early years in the partner countries conceptualised by teachers and what role if any does creativity play in these?

RQ2 What approaches are used in the teaching, learning and assessment of science and mathematics in early years in the partner countries and what role if any does creativity play in these?

RQ3 In what ways do these approaches seek to foster young children’s learning, interest and motivation in science and mathematics, and how do teachers perceive their role in doing so?

RQ4 How can findings emerging from analysis in relation to questions 1-3 inform the development of practice in the classroom and in teacher education (ITE and CPD)?

As articulated in the Conceptual Framework, the first question is focused on mapping conceptualisations in relation to classroom practices in preschools and early primary education, while the second and the third on probing practice in such settings in science and mathematics education using the lens of creativity. The final question draws on both the mapping and probing questions and seeks to apply what has been learned so as to develop practice (in relation to ITE and CPD).

As mentioned above, this report is dedicated to revealing current practice in the intersection between science, mathematics and creativity in both pre-school and first years of primary education in the partner countries. As such, this report has to focus on research questions RQ2, RQ3 and provide input towards RQ4.

Sub-questions running across all research questions probe:

- Aims/purpose/priorities, including teachers’ explicit and implicit perspectives and identities as scientists and mathematicians, and in relation for example to: aims and purposes of creativity in science and mathematics education; how science and mathematics are taught and learned in relation to other domains of knowledge; how these shift from pre-school to primary across the consortium; how these relate to
inquiry-based science education (IBSE); views of creativity in relation to perceived purpose.

- **Teaching, learning and assessment**, including learning activities, pedagogy and resourcing, and in relation for example to: multimodal expression and experience; learning activity types; resources used; dynamics between adults and children; exploration; questioning and argument; also how teachers assess creativity in early science and mathematics education.

- **Contextual factors**, including ethos, teacher characteristics and teacher general education and knowledge, skills and confidence, curriculum, institutional factors, home-school links and the wider cultural background, location, grouping, time.

Moreover, drawing on the framework of curriculum components ‘the vulnerable spider web’ (van den Akker, 2007, p.39) [25] these three broad strands have been broken down into ten more narrowly-defined dimensions, which focus on key questions about aspects of learning in schools. Along these dimensions and sub-questions, a number of factors reflecting the study’s scope and parameters for mapping of and comparisons between existing approaches to and practices of early years science and mathematics education, i.e. which have a strong potential to foster the development of creative skills in children, have been identified in the List of Mapping and Comparison Factors (D3.1), and are explicitly addressed in this report.

Table 1 shows these dimensions, sub-questions and factors, and their codes. Factors highlighted in yellow concern important issues identified in the previous deliverables (Conceptual Framework (D2.2), Report on Mapping and Comparing Recorded Practices (D3.2) and Report on First Survey of School Practice (D3.3)) as needing further investigation. This report focuses on these factors as they enable the mining of key issues identified by previous reports and thus ensure continuity and consistency amongst the various parts of the research study.
Table 1: Dimensions, Sub Questions and Factors

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Sub questions</th>
<th>Factors important to nurturing creativity in science and mathematics in the early years</th>
<th>Coding</th>
</tr>
</thead>
</table>
| Learning Activities       | How are children learning?                                                    | Focus on cognitive dimension incl. nature of science  
  - Questioning  
  - Designing or planning investigations  
  - Gathering evidence (observing)  
  - Gathering evidence (using equipment)  
  - Making connections  
  **Focus on social dimension:**  
  - Explaining evidence  
  - Communicating explanations | LA: Ques  
 LA: Plan  
 LA: Obs  
 LA: Equip  
 LA: Connect |
| Pedagogy Interaction      | How is teacher facilitating learning?                                         |  
  - role of play and exploration; role of play valued  
  - role of motivation and affect; Efforts made to enhance children’s attitudes in science and mathematics  
  - role of dialogue and collaboration; **collab.** between children valued  
  - role of problem solving and agency; use of IBE/PBL, Children’s agency encouraged  
  - fostering questioning and curiosity - Children’s questions encouraged  
  - Diverse forms of expression valued  
  - fostering reflection and reasoning; children’s metacognition encouraged  
  - teacher scaffolding, involvement, Sensitivity to when to guide/stand back | P: Play  
 P:Affect  
 P:Collab  
 P:Agency  
 P:Ques  
 P: Express  
 P: R and R  
 P: Scaff |
| Assessment Framing and Interaction | How is teacher assessing how far children’s learning has progressed, and how does this information inform planning and develop practice? | **Assessment function/purpose**  
  - formative  
  - summative  
  - recipient of assessment results **NO CODE**  
 **Assessment way/process**  
  - strategy  
  - forms of evidence; excellent assessment of process +product, Diverse forms of assessment valued  
 A:Summ.  
 A:Strat.  
 A:Evid.  
 A:Peer/self |
| Materials and Resources   | With what are children learning?                                              |  
  - rich physical environment for exploration; Use of physical resources thoughtful; Valuing potential of physical materials; Environment fosters creativity in sci/ma  
  - sufficient space  
  - outdoor resources; recognition of out of school learning  
  - informal learning resources  
  - ICT and digital technologies; confident use of digital technology  
  - variety of resources  
  - sufficient human resources  
  - policy documents; NO reliance on commercial schemes | M:Explor.  
 M: Cr  
 M:Space  
 M:Outd.  
 M:Inf.  
 M:ICT  
 M:Variet.  
 M:Human  
 M: Pol. |
### Dimensions

<table>
<thead>
<tr>
<th>Aims and Objectives</th>
<th>Toward which goals are the children learning?</th>
</tr>
</thead>
</table>
| Framing and Interaction | - knowledge/understanding of science content  
|                      | - understanding about scientific inquiry  
|                      | - science process skills; IBSE specifically planned  
|                      | - capabilities to carry out scientific inquiry or problem-based activities; use of IBE/PBL  
|                      | - social factors of science learning; collaboration between children valued  
|                      | - affective factors of science learning; efforts to enhance children’s attitudes in science and maths  
|                      | - creative dispositions; creativity specifically planned  

### Location

<table>
<thead>
<tr>
<th>Framing and Interaction</th>
<th>Where are they learning?</th>
</tr>
</thead>
</table>
|                         | - outdoors/indoors Recognition of out of school learning  
|                         | - formal/informal learning settings/  
|                         | - small group settings  

### Grouping

<table>
<thead>
<tr>
<th>Framing and Interaction</th>
<th>With whom are they learning?</th>
</tr>
</thead>
</table>
|                         | - multigrade teaching  
|                         | - ability grouping  
|                         | - small group settings  
|                         | - number of children in class  

### Factors important to nurturing creativity in science and mathematics in the early years

- AO: Kn.Sc  
- AO: Und. SI  
- AO: Sc Proc Skills  
- AO: IBSE/PBL  
- AO: Social  
- AO: Affect  
- AO: Creative

### Coding

- L. Out/Indoors  
- L. Formal/ Informal  
- L.grp  
- G:MG  
- G:Abil.  
- G:SmallG  
- G:No.

## 2.2 Research Instruments

The methodology document for the fieldwork (D4.1) set out a series of core and repertoire research instruments. All partners have been expected to use the same core instruments so as to collect similar data to enable comparisons. Additionally, each partner was encouraged to use a repertoire of instruments, depending on preferred approaches and existing expertise. Data was to be collected across four areas spanning site and case (see D4.1, p33):

1. **WIDER SITE CONTEXT**: encompassing data from existing Deliverables D3.2, D3.3, and D3.4.

2. **CASE PEDAGOGICAL CONTEXT**: the setting’s teaching and learning policies and planning documents as appropriate, assessment records if they exist, overview of resources and a map of the space.

3. **CASE OBSERVATION OF PEDAGOGICAL INTERACTION AND OUTCOMES** (episodes of learning involving children and teachers):

   **Core Instruments**: Sequential digital images capturing detailed interactions, with fieldnotes supplemented by audio recording (later transcribed) and an overall timeline, enabling narrative construction

   **Possible additional repertoire instruments**: teacher journals, Fibonacci style tools to support diagnostic observation, Involvement Scale, Reggio style documentation, conceptual drawing, video.
4. CASE ORAL EVIDENCE (INTERVIEWS)- PERSPECTIVES ON PEDAGOGICAL INTERACTION AND OUTCOMES (children + teachers):

Core Instruments: individual interviews (teachers), group interviews (children) using digital images from observations, ‘learning walk’ led by child, looking at children’s work.

Possible additional repertoire instruments: supplements to interviews such as conceptual drawings or teacher journals. Some oral interviews might be spoken to audio recorder.

2.3 Data Collection

This section includes a description of the sample of cases, which were included in the research exercise and how these to a degree, as much as possible represent the different ages and types of provision of early years education in Malta.

2.3.1 Sampling principles

The methodology document for the fieldwork (D4.1) specified that each partner should visit a minimum of four sites (i.e. schools/preschools), five where possible and gather data from a minimum of six cases (i.e. one teacher and the children they work with) reflecting both settings (pre-school and primary education). In order to reflect the science and mathematics focus of the project, partners were asked to aim to identify three episodes of activity per case (ensuring at least one each of science and mathematics) resulting in a total of 18 episodes being reported per partner. The episodes are meant to provide illustrations of actual practice - chosen because they exemplify one or more of the aspects identified in Table 1.

The sample of cases was thus deemed to be a purposive one, involving a range of contexts, learning opportunities and teacher populations and age ranges of children. Moreover, the following selection criteria were identified to be used as part of the selection of each national sample (see D4.1, p28):

- Includes appropriate diversity (e.g. in respect of culture, circumstance, language).
- Covers appropriate age span 3-8.
- Represents span of mainstream (i.e. not special) early years provision.
- Settings primarily focused on education not care.
- There are indications of good practice of early years mathematics, science and creativity.
- Allows us to mine one or more of the important research foci (identified in previous deliverables and shown in Table 1).
- Geographical accessibility for researchers.
With the understanding that the study was researching children between the ages of 3 and 8 years, research was conducted with both pre-school and primary school level. It has to be pointed out that teachers (or kindergarten assistants as they are known in Malta) were very reluctant to participate in the study and thus more cases from primary level of education were included in the sample. In addition, cases from the three different types of education providers: State, Church and Independent, were identified. From the six cases, two were from Independent Schools, three from Church Schools, and only one from State schools. The main reasons for this was that Church and Independent schools in Malta tend to have the class teacher allocate more time for science than in State schools where specific science teachers do most of the science teaching. In addition, Independent schools are also known for their open and creative approach to learning and thus there were more opportunities to find instances of creativity in Independent schools. Last but not least, limitations from the teachers’ perspective where very few teachers were willing to allow their practice to be researched, limited to a great degree the distribution of cases included in the research. The table below provides a summary of the cases included in this study.

Table: Details of Case Studies included in the research

<table>
<thead>
<tr>
<th>School type</th>
<th>Pre-School 4 years</th>
<th>Primary 5 years</th>
<th>Primary 6 years</th>
<th>Primary 7 years</th>
<th>Primary 8 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>1 (mixed)</td>
<td></td>
<td></td>
<td></td>
<td>1 (mixed)</td>
</tr>
<tr>
<td>Church</td>
<td></td>
<td>2 (boys)</td>
<td></td>
<td></td>
<td>1 (girls)</td>
</tr>
<tr>
<td>Independent</td>
<td></td>
<td></td>
<td>1 (mixed)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It can be noted that a range of ages within the early years was obtained, even if one more case in the early years would have been a better balance.

2.3.2 Ethical issues
Any fieldwork undertaken with young people can potentially carry ethical implications, both in terms of the conduct of the researcher whilst undertaking fieldwork, and in the collection and application of data following the fieldwork period.

Each partner was required to identify and meet the ethical approval policies for their institution, school system, region and country as appropriate. In addition, the consortium identified the following minimum standards that were applied by all partners in all cases:

- Participation to the research was on an informed voluntary basis. Letters for school staff and parents were developed for this purpose (see D4.1, Appendix 4, p72). Written consent was obtained before the fieldwork was undertaken. The right to withdrawal was clearly communicated.
• Explicit permission was requested to take and use photographs (and videos where appropriate) of the children and staff for the project in project reports and publications.

• Explicit permission was requested to interview children as part of focus groups.

• The sites used, the adults and children who were involved were given pseudonyms to protect their identities.

• Any electronic data collected was stored on password protected encrypted storage systems, where only authorised staff had access. An agreed protocol for storage and labelling of data was agreed (see D4.1, Appendix 7, p85).

The University of Malta has strict research ethics rules, and any research with children, which involves the collection of human data in the form of interviews has to obtain ethics clearance before any data can be collected. The process to obtain ethics clearance is twofold. The researcher first has to apply for ethics clearance from the Faculty of Education Research Committee (FREC). Once ethics clearance is obtained at Faculty level, the application goes to the University Research Ethics Committee (UREC) which eventually gives the full approval and following which data collection can start.

The data collected in WP4 required the collection of data through interviews with children and teachers which are audiotaped. Photos were also to be taken in order to enhance the analysis of the data as well as for potential use when the research data is developed into teacher training material. The data which was to be collected required that ethics clearance be obtained. Following the identification of the case studies to be included in the research exercise, official permissions were obtained from the Directorate for Quality and Standards in Education for the case from the state school, the Catholic Diocese in the case of the Church School, and from the Head of school in the case of the Independent Schools. The ethics form was filled in with all the required documentation and submitted to FREC. The documentation needed included:

1. Official permission to conduct research from the Directorate for Quality and Standards in Education (DQSE) for State Schools, and from the Catholic Diocese for the Church school;

2. Official permission (signed document) from the Head of each school involved. There were four schools involved;

3. Official permission (signed document) from each teacher participating in the research;

4. Information sheet about the research for the children’s guardians;

5. Consent form for teachers and for guardians;

6. Interview questions to be used;
7. Detailed project methodology.

Permission was granted by FREC, stating that the copyright of the photos remains that of the parents and that permission was to be obtained for any use of the photos beyond to data analysis purposes. The application was then sent to UREC. UREC requested that a consent form for use to obtain permission for use of photos beyond research purposes be drawn up. When this was submitted, ethics clearance was finally obtained and data collection could start. Official clearance was obtained at the end of March 2013. Due to the closing of schools for Easter holidays, most of the data collection took place after Easter and all data was collected by the first week of May.

2.4 Data Analysis

This section provides details of the process through which the research has been applied to the context of Malta and the logistics for collecting the data. The second section refers provides some details of the final sample of teachers included in the study. The limitations encountered in implementing the study are also discussed.

2.4.1 Process

As already mentioned, the methodology agreed for the fieldwork specified that each partner would produce a minimum of six identified cases, with a minimum of three narrative episodes per case to fully explore the opportunities presented for the fostering of creativity in early years science and mathematics education. A narrative episode in this case was defined as a written narrative account that describes an observed event or series of connected events of science and mathematics teaching/learning with a creativity focus, which forms a coherent story by itself. These were to be drawn from observations selected for their relevance to the pre-identified project factors and supported by information gathered through a minimum of two types of core data. Where possible the views and thoughts of the children in addition to those of the teachers were sought; extracts from relevant transcripts, containing they key areas of interest specific to the focus of the episode are provided.

All data were coded using a set of deductive codes, based on the project factors (see Table 1), and were discussed in terms of Siraj-Blatchford et al.’s (2002) framework to explore pedagogy in terms of pedagogic framing and pedagogic interventions. Their opportunities for science or mathematics creativity were highlighted.

Finally, the episodes were combined in overall cases, which included information about the site, the setting and the teacher. These cases and related episodes are presented in this report.

More particularly in Malta, access to the classes was sought in different ways. The teachers who had initially offered to allow the research to be conducted in their classroom when completing the teachers’ questionnaire were identified. In addition, personal networks and
channels were used to try and identify teachers who are known to have recognized good practice and who are known to be creative and to promote creativity.

Eventually, a total of 6 teachers were identified in four different schools. Although there is only one teacher from pre-school level, care was taken to ensure that there was distribution in age range of the classes included from primary level. It was thus possible to gather data from children between the ages of 3 to 7 years, which covers most of the early years provision of education in Malta.

2.4.2 Final sample
As has been described in a previous section, the selection of the teachers aimed at providing a range of ages of practice as well as a distribution of teachers between pre-school and primary level. It has to be said that while a range across the three different school types was obtained, this was not the same with respect to the balance between pre-school and primary school level. The main reason was that pre-school teachers, due to not being qualified at a tertiary level, were reluctant to allow a researcher in their class, and so access to pre-school classes was difficult.

The total number of teachers included was 6, and a total of 20 episodes were identified and observed and documented as part of the research exercise. A balance between science and mathematics was obtained, with a few cases where the activity targeted mathematics and science simultaneously. Eventually, a total of 20 episodes from the 6 teachers were collected and write-ups for each of these episodes drawn up.

2.4.3 Limitations
There were a number of limitations that were experiences in conducting this research study. The main limitations encountered related to the choice of cases to visit. Although the number of cases required were few, it was still difficult to find the right range of ages and school types. The main obstacle was that of finding teachers who are willing to allow researchers in their classroom. The culture among teachers in Malta is that of not allowing as much as possible people into the classroom and have their activities with the children watched by others. In fact, this is rarely done even for inspection and accountability purposes. The second difficulty was that of ensuring that the teachers participating are actually creative and that they promote aspects of creativity during their practice. Creativity in science and mathematics was one of the main foci of this research exercise and it was thus important to manage to identify cases, which would eventually provide material and insights about the purpose of the research.

The end result was that while it was less difficult to find creative teachers, finding teachers at pre-school who are willing to participate in the research proved a major limitation. In fact, at the end, only one teacher was included at this level.
3. Case Studies
This section considers six cases, each representing one of the six teachers and provides both a summary of the observed practice as well as comments on the main outcomes and research findings concerning each.

3.1 Case 1 – "Natasha from Sunflower School': a case of creative skills development
The first teacher observed is referred to as Natasha, who is a pre-school teacher in an Independent school teaching children aged 3-4 years.

3.1.1 Context

a) School Setting
This school is an Independent school, which means that parents pay fees to attend the school. This is a co-educational school and offers education to children from the age of 2 up to primary level at age 10. The school promotes learning that is embedded within an enquiry-based, knowledge-rich and inclusive environment. The schools aims to create stimulating and active learning experiences that arouse curiosity and develop the imagination, emotional intelligence, encourage effective communication and critical thinking, help learners become responsible and autonomous. The school helps every member of the school community to become a collaborative and creative lifelong learner able to confidently face new challenges in a fast-changing world.

There is no specific geographical catchment since children from all over Malta attend this school. However, it is to be noted that since the school fees are relatively high, that this becomes a selective school, which is based on the parents’ income. Particular features which result include a high proportion of English speaking children. In Malta English and Maltese are both considered as the first language. However, there are some areas in Malta, particularly those where people are of higher socioeconomic status, where English is the preferred spoken language. One specific distinction between the different socioeconomic groups tends to be the proficiency of use of the English language. It thus indicates that this school has mainly children from higher socioeconomic backgrounds. The school is also characterized by a significant number of foreign students, of various nationalities from both within and outside the EU. This may mainly be due to the strong use of the English language throughout most of the school day. In fact, the main language used in this particular case is English. Maltese is used mainly when the activity is targeting the learning of the Maltese language. The details of the school context and the case, that is, the teacher included in this study are provided in the table below.
Table: Details of school and case context

<table>
<thead>
<tr>
<th>Where?</th>
<th>Country</th>
<th>Malta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting name</td>
<td>Natasha</td>
<td></td>
</tr>
<tr>
<td>Location within setting</td>
<td>Pre-school</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Who? (children)</th>
<th>Year group/age of children</th>
<th>3-4 years old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of children in class</td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Who? (adults)</th>
<th>Number of adults</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role of adults</td>
<td>1 teacher and 1 learning support assistant, at times an additional helper is present</td>
<td></td>
</tr>
<tr>
<td>Case teacher role</td>
<td>Co-ordinator</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>When?</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dates of visits</td>
<td>15/03/13</td>
<td>18/03/13</td>
<td>11/03/13</td>
<td>09/03/13</td>
</tr>
<tr>
<td>Times of visits</td>
<td>8:30-11:30</td>
<td>8:30-11:30</td>
<td>8:30-11:30</td>
<td>8:30-11:30</td>
</tr>
</tbody>
</table>

b) The teacher
The teacher in this case has been a pre-school teacher for 22 years. She does not have formal training in the early years but has a strong science background, as her subject specialization covered the sciences. In view of her background, the teacher feels that she uses many science contexts to organize activities for the children. She believes that science helps children learn more about the world around them and how it works, whilst also providing a good context to introduce and promote mathematical and other cognitive skills. She also feels that children are easily motivated and enjoy doing activities related to science and she tries to do this as often as possible. In fact, as the person in charge of coordinating the activities for the school’s year group, she proudly admits that the majority of the themes chosen are related to science. The teacher also feels that she is creative, and likes to look around through resources and pedagogical documents in order to obtain ideas for interesting and engaging ideas. This teacher is particularly aware of the cognitive skills that children need to develop from such a young age. She works to achieve this through many creative ideas.

c) Classroom
The children in this case study are mainly 4 years old, turning on to 4 as from January 1st. This is because the Maltese education system uses the 1st of January as the cut-off point. All children turning 4 from 1st of January will be in the second year of pre-school, known as Kinder Garden grade 2. There are 18 children in the class, one of which has learning difficulties and is assisted by a Learning Support Assistant. There are a number of foreign children in the class, with English being the main language spoken, even if there is one boy...
who is French/Italian speaking and is currently catching up with English. The teacher at times speaks to this child in his native language in order to communicate. The class consists of a group of lively children who are good at communicating, open and willing to talk about what they are doing.

3.1.2 Episodes

1) Measuring Robots
This activity involved having the children measuring the height of a robot that they had produced from recycled material in a previous activity. The children were to measure the height by counting how many blocks were needed to reach the height of their robot. The aims of the activity was thus to provide the children with basic skills in measurement. In the activity the teacher explained to the children what they had to do. She placed everybody’s robot on their tables, and gave them a number of blocks to use on a paper plate placed in the middle of the table. The children had time to build their blocks in a tower and to count how many blocks are needed in order to reach the total height of their robot. The robots were of different size and height besides being of different colours and slightly different shapes.

The activity focused on promoting the concept of measurement which involves measuring, in this case height, in terms of a unit value, in this case a robot’s height. The children also learnt that when measuring length, they have to be careful to where the object starts and where it finishes so that the object’s actual height is measured. This activity thus lays the foundation of measurement in mathematics using scales which are introduced later on in the compulsory education curriculum.

The creative aspect in this episode can be identified when children were involved in activities where they could touch and manipulate the objects that they were using. The children in these instances engaged in thinking up examples of high or ‘tall’ objects which they could measure as in the case of the robots. This episode specifically captured one particular boy who used his imagination to create representations of objects and situations, such as the Eiffel Tower, which was closely related to the concept of height which was being covered during the activity.

The element of creativity here referred to the different applications of height which the children made, and how they used their experience and imagination to create situations related to their activity.

2) Feet
This activity also involved the children in measuring length through the use of blocks. Cardboard feet had been cut and used in an activity on an earlier date. First the teacher, with the help and participation of the children, drew the outline of her own foot, and that of the researcher and cut out from cereal boxes. The teacher then distributed the children’s feet outlines, which had been cut and labeled with the students’ names. The teacher then
moved on to explaining the activity, indicating that they were going to measure how long their feet were. She told them that they were to use different things to measure this length. The children could use the different measuring tools – the blocks, measuring tape, or their ruler to measure the length of their feet. The activity then ended with the teacher doing a short counting activity where the children counted up to 20.

The activity here focuses on exploring the different tools and in some cases encouraging the children to decide on the best tool to use when taking measurements. The children had the opportunity to choose between using the blocks, the tape measure and a large paper version of a ruler to measure the length of their foot. The activity also lays the foundations for developing skills about how to measure that involve being careful where to place the starting point of your measuring instrument and how to read the final unit. This activity thus lays the foundation to measurement in mathematics using different measuring tools, which are introduced later on in the compulsory education curriculum.

The activity thus involved a combination of both science and mathematics. The first part of the activity that consisted of drawing the educators’ and researcher’s feet served as a warm up activity. This is common in mathematics activities in the primary curriculum and is intended to ‘loosen’ children’s brains to mental working of simple mathematical manipulations. In this case the mental manipulation involved counting, as this was the mathematical skill needed in the measuring activity. This activity also included an element of science where the children became aware of different tools, which they could use to make measurements.

The creative aspect of this episode can be identified in how the children interacted with the different measuring tools. While overall the children focused on measuring the length of their paper foot, and not other things, the children explored using the different tools. Some children expressed preference based on liking.

3) Feet 2
This activity also targeted measurement and was a continuation of the previous feet activity. The teacher started the activity by introducing the concept of spring as it was the first day of spring. The teacher then reminded the children of the work that they had done about feet and pointed at the decorated footprints that were hanging from the wall, and explained that they were going to measure them. The teacher distributed the blocks and the footprints and the children used the blocks to measure the length of the feet. Of interest here was the learning support assistant’s (LSA) support to the child with learning difficulties who had been absent on previous days. The LSA helped the child to decorate the different pieces of the coloured paper as well as use the bricks to measure the length of the foot.

When the children had finished the activity, they had moments where they could express their creativity. The children built models of what they considered as a robot, number one, swords etc. The teacher then attracted the children’s attention. They first talked again about
spring and trees and leaves. There was an interesting discussion related to leaves, anteaters etc. The teacher then focused on mathematics and started with warm up by asking the children first to count up to 11. They then used numicon resources that consist of plastic sheets with holes representing different numbers, so as the number two would be represented by two holes. The children needed to count the number of holes, and then to match the shape of the plastic sheet with a chart on the wall. This chart demonstrated both the shape of a specific plastic sheet and the number it represents beneath it. This was done as a class game. It is interesting to note that the teacher involved the boy with special learning difficulties to participate. The child, who has traits of autism, managed to count and identify the matching picture on the wall. The whole activity was about 45 minutes long.

The activity here focuses on consolidating the work on mathematical skills related to the measurement of length, in this case of the outline of a foot. The teacher had been working on the measurement during the whole term and this activity involved a form of formative assessment through which the teacher ensured that all the children in the class had developed the pre-skills needed for measuring.

The creative activity in this episode can be identified in the play which the children engaged in mainly at the end of the activity after they had done the measuring exercise. The children played around with the blocks and managed to create different things such as machines, swords etc.

3.1.3 Case summary and conclusions

The scientific background of this teacher can be identified both in the topics and themes used during the year as well as in the way which she approaches teaching and learning in the early years. The classroom had a number of artifacts such as dinosaurs, fossils made of salt dough etc., which shows that science is often used as a context for learning.

The learning activities usually focus on promoting both physical and cognitive skills. The activities observed all included instances where the children were involved in doing physical activities. The use of blocks provided the children with opportunities to manipulate small objects and improve their fine motor and coordination skills. However, of greater importance, most of this teacher’s activities were aimed at promoting cognitive skills: counting, measuring and how to measure. These pre-mathematical skills are considered very important to ensure that children are able to tackle more complex mathematical manipulation once they start compulsory education.

The teacher’s strategy for assessment is mainly through observing the children perform during activities. As the children are engaged in their activity, the teacher goes round the class to see what they are doing and how they are getting on, noting how much each of the students is able to perform the physical and cognitive skills.

There is space for creativity in this classroom, even if it often was not within the main activity. Creativity was observed most when the children were allowed extra time to play
around with their objects. The most creative instances were observed when the children were allowed to play around with pegs and blocks. These both form small entities that then could be built into bigger units as the children wish. In all instances, the children liked to share their creations.

The teacher focused more on promoting positive attitudes towards science. This could be noted from the number of references that the teacher made to scientific issues such as spring, butterflies, leaves, dinosaurs etc. The teacher likes to take advantage of opportunities, which arise to mention and refer to scientific aspects. The teacher is aware of her role in promoting science, reflecting her personal enthusiasm that she then tries to share with her students.
3.2 Case 2 – ‘Lydia at Sunflower School – A case of scaffolding through fun

This case refers to a primary school teacher, given the name of Lydia; teaching children aged 6 to 7 years in Grade 2. Lydia teaches at the same school as Natasha.

3.2.1 Context

This school is the same Independent school where Natasha teaches. Since case 1 and 2 share the same school context the school details will not be repeated. The class is housed in the same building as that for Natasha.

Table: Details of school and case context

<table>
<thead>
<tr>
<th>Where?</th>
<th>Country</th>
<th>Malta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting name</td>
<td>Lydia</td>
<td></td>
</tr>
<tr>
<td>Location within setting</td>
<td>Primary school</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Who? (children)</th>
<th>Year group/age of children</th>
<th>6 - 7 years old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of children in class</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Who? (adults)</th>
<th>Number of adults</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role of adults</td>
<td>1 teacher</td>
<td></td>
</tr>
<tr>
<td>Case teacher role</td>
<td>Primary Teacher</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>When?</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dates of visits</td>
<td>16/04/13</td>
<td>17/04/13</td>
<td>20/04/13</td>
<td>26/04/13</td>
</tr>
<tr>
<td>Times of visits</td>
<td>8:30-11:30</td>
<td>11:00-12:30</td>
<td>12:30-13:30</td>
<td>8:30-11:30</td>
</tr>
</tbody>
</table>

b) The teacher

The teacher in this case has just graduated from a Bachelor in Education (Hons) where she had specialization in early years. The teacher is small in size and of a very pleasant disposition. In view of her background, the teacher feels that she is creative and enjoys giving the children activities, which engage them. She also likes to use games to promote learning. In the case of science she likes to look up activities and experiments from various resources, as she believes that the children really enjoy science lessons, which involve hands on activities.

c) Classroom

The children in this case study are mainly 6-7 years old. They are in the second year of primary school, known as Grade 2. There are 20 children in the class. There are a number of foreign children in the class, with English being the main language spoken. The result is that most of the lessons are carried out in the English language. The class consists of a group of
lively children who are good at communicating, open and willing to talk about what they are doing. This was evident during the interviews with the children.

3.2.2 Episodes
Four separate episodes were observed in this case, two in science and two in mathematics. These will each be considered separately and the creative aspects considered each in turn.

1) Money
This was a mathematics lesson about money. The teacher started the lesson with a number of practical examples involving amounts of money. She used large paper pictures of euro coins and stuck the values on the board to help the children see how to be able to count totals and to distinguish between tens and units. She then moved to organizing a group work activity where she gave each group of children a small basket with plastic euro coins. The children had to play a small game where they had to decide the price for an object and then use the paper coins and their small portable board to organise the coins in tens and units as done with the teacher at the beginning of the year. The children enjoyed playing at shopkeepers and customers. One group pretended to buy an ice cream, as it was something that they liked to eat and thus were motivated to incorporate it in their pretend play. Following the group activity, the teacher called the children to attention and explained the classwork, which they had to do from their mathematics workbook. The rest of the lesson was then spent working out this classwork, which involves a page on counting money.

This was a mathematics lesson, which focused on coins and how to combine coin in order to obtain the total needed. The children had to learn to distinguish between the tens and units as this would help them add up the coins more easily. So, if for example they needed to add up to a total of 35 cents, first the children were required to add up the coins to a total of 30 cents using either 3 coins of 10c or 1 coin of 20c and 1 coin of 10c, and then add up the total of 6c by using any combination from 1c, 2c and 5c coins. The activity thus helped the children develop the necessary mental strategy required to put together a large total using smaller value coins.

There were two aspects of creativity in this activity. The first creative aspect relates to the way that the teacher presented the activity. She was creative in using a real context, which would help the children find the activity presented relevant. The other aspect of creativity is in the group work activity, which the teacher organised. When the teacher asked the children to imagine buying different things, it allowed the children to use their imagination to create different situations. The instance where one group engaged in pretending to bought ice cream is an example of children’s creativity as they used their imagination and previous experiences to guide this activity.

2) Minibeasts
This activity is a science activity where the children focused on minibeasts. The main activity involved the children going out in the schoolyard to look for minibeasts. The lesson started with the teacher introducing the topic of minibeasts. She asks the children if they can mention any minibeasts that they know. The children were enthusiastic and shared their knowledge. The teacher then distributed a worksheet among the children and explained that they had to go down to the schoolyard, look for any minibeasts and tick on the worksheet the minibeasts’ characteristics and frequency. The teacher then took the children down to the schoolyard where they were given time to roam around and to see if they can find any minibeasts and to note the surroundings in which they were found. The children excitedly roamed around the yard and made their observations. In one instance some of the children noted a pupa stuck to a tree and talked about the life cycle of butterflies and how it was previously a caterpillar. They also noticed a number of ants walking around the base of the tree. The children talked about their personal encounters with ants in their own homes. In another instance the children found a millipede and they also discussed their experiences.

The activity focused on science inquiry where children had to look for, find, and observed minibeasts in their natural habitat. The activity thus promoted the development of observation skills as well as knowledge about the surrounding conditions that different minibeasts prefer. The worksheet that was used also promoted skills in using tables to represent their observations. This skill is not just science but also has an element of mathematics.

The creativity in this activity is in the freedom that the teacher gave to the children when they went out to look for the different minibeasts. This was an opportunity for the children to express their own ideas with respect to where to look for minibeasts. The observations made were also to a degree creative as the children decided what to look at. In the case of the pupa, children commented about the size as well as to how it was stuck to the tree. There were also creative elements when the children talked about the other minibeasts and recounted in what areas of their own homes they had also seen them. These were opportunities where the children used their creativity to explore connections and develop meaning.

3) Eating Whales
This activity was a mathematics lesson where the teacher was trying to help the children learn how to add up from one number to another. She started off with some mathematics warm up activities using the small whiteboard and asks the children to work out simple calculations involving e.g. 63 + 10. The teacher explains the mental strategy needed to work these out mentally, indicating the importance to identify the tens in the number given, and if adding 10, then just adding one value to it. The teacher then distributes blocks to the children and they made towers consisting of 10 blocks. She asks them to build values e.g. 23 using these towers of 10 and then adding single blocks to add on the remaining units. The children found this example meaningful and it aided their understanding. Following this
activity, the teacher moved on to subtracting 10 from numbers. Instead of adding towers of 10, the children were now subtracting towers of 10. To explain this activity the teacher used the story of a big whale, which needs to eat smaller fish. She gave examples such as: if there were 35 fish swimming and the whale ate 10, then how many fish would remain. Another group activity follows. At the end of the lesson, the children work out examples of adding and subtracting 10 from their workbook. It has to be noted that more time was dedicated to helping the children learn how to subtract than adding 10.

This was a mathematical activity that helped the children to develop strategies to add and subtract 10 mentally. As the children used their blocks, they learnt how first to group their numbers in towers of 10. It was then easier to add and subtract by adding and/or taking away whole towers. The children needed to practice the strategy with the blocks before they moved on to doing the mathematical manipulations mentally.

The creative aspect in this activity involved mainly the example of the eating whale, which made the mathematical strategy relevant and easier for the children to grasp. There were also instances where the children mentioned and used the examples of the story in order to aid them with their calculations.

4) **Shooting balloons**
This activity was a science lesson related to forces where the children had to explore how air going out of a balloon exerts a force on the balloon and makes it move forward. The teacher started the lesson by drawing a balloon on the board and asking the children what they believed would happen if she would let the blown up (but untied) balloon go. The children were aware that the balloon would move forward, but not all realized that this was due to the force, which the air exiting the balloon was exerting on the balloon. The teacher then put forward a research question to the children and asked them whether they knew what would be different if they were to blow up the balloon to different volumes. One child expressed a prediction that the more a balloon is blown, the faster the balloon would move forward. The teacher then stated that this is what they were going to test. She took the children out on the wide terrace where she had prepared two chairs a distance apart with two string and a straw inserted in each running from each edge of one chair to the other. The teacher then asked the children to blow up two balloons, possibly to two different volumes. The children did this and the teacher temporarily sealed the balloons with paperclips while she stuck the balloons with tape to the straws. As the two balloons were placed at one end next to the chair, the teacher counted to three and the children released their balloons. The balloons sped forward but it could be observed by the children that the balloon with more air was faster and moved more than the smaller balloon. The children tried out the activity a number of times.

This activity was an example of inquiry in science, even if the activity was quite directed. The children were presented with a question at the beginning of the activity and then they carried out an experiment to find an answer to their question. The teacher directed the
activity well and helped the students to reflect on the observations made and to link the
evidence gathered to the original question set.

The element of creativity in this activity was limited as the inquiry activity was quite
structured. The creative element can be identified mainly when the children explored the
outcome of trying out balloons of different sizes so that they could observe what happened
when balloons of different sizes are used. This promoted creativity where the children used
their creative approach to explore the phenomenon being studied deeper and thus
understand it better.

3.2.3 Case summary and conclusions
This teacher is very creative in the activities that she prepares and how she presents them to
the children, often engaging them in activities that they enjoy but as the same time learning
strategies and enhancing their knowledge base. In the case of mathematics, the teacher
tends to pitch at a cognitive level where the children learn mental manipulations. In the case
of science, as the teacher herself admits, she likes to express herself and be more creative.
She enjoys looking for innovative activities online or in books. She likes to give the children a
sense of wonder about the world as well as encourage them to ask questions and to try and
find solutions and answers to their questions. The teacher is very lively and enthusiastic
about her work, loves the school she is working in and is eager to learn and try out new
approaches that enhance learning.

The teacher reflected on her approach to creativity. She defines herself as being quite
creative person and creative in the way that she prepares and presents the learning
activities. She was less sure on how much she promotes creative thinking among children.
She says that the group work that she prepares usually provides space for the children to
express things in their own way.

The teacher likes to organize activities where the children are actively involved themselves
in doing things. She believes that the children need to be stimulated to observe their
environment. The children are interested in the world around them and they are naturally
motivated to participate in activities which involve engaging directly with the natural world.
These direct activities serve to foster positive attitudes towards science. In the case of
mathematics, the teacher targets cognitive processes which are supported by manual
manipulation such as handling blocks. The teacher perceives herself as a facilitator of
learning, promoting children’s reflection and awareness of their own learning processes.
Assessment is carried out in various ways, both through following the children’s work during
the group work as well as assessing the children’s classwork, which is usually done at the
end of lessons.
3.3 Case 3 – ‘Sabrina at Marygold School’ – A case of creative inquiry-based learning

This teacher, Sabrina is a primary school teacher teaching first year primary to a group of boys of 5 years in a Catholic Church school.

Table: Details of school and case context

<table>
<thead>
<tr>
<th>Where?</th>
<th>Country</th>
<th>Malta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting name</td>
<td>Sabrina</td>
<td></td>
</tr>
<tr>
<td>Location within setting</td>
<td>Primary school</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Who? (children)</th>
<th>Year group/age of children</th>
<th>5-6 years old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of children in class</td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Who? (adults)</th>
<th>Number of adults</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role of adults</td>
<td>1 teacher and 1 Learning Support Assistant</td>
<td></td>
</tr>
<tr>
<td>Case teacher role</td>
<td>Primary Teacher (in training nearing Bachelor of Education(Hons) course)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>When?</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dates of visits</td>
<td>8/04/13</td>
<td>11/04/13</td>
<td>18/04/13</td>
<td>3/05/13</td>
</tr>
<tr>
<td>Times of visits</td>
<td>8:30-10:00</td>
<td>8:30-10:00</td>
<td>8:30-10:00</td>
<td>8:30-10:00</td>
</tr>
</tbody>
</table>

3.3.1 Context

a) School

The school at which Sabrina works in is a Catholic Church school, which caters for the education of boys from the age of 4 to 18 years. The school is divided into primary (4 years to 10 years), secondary (between 11 years and 15 years) and sixth form levels (between 16 and 18 years). The school is single-sex with an education for only boys. The Catholic Diocese manages selection for entry into the school, which oversee the entry of children through a ballot system. Only children who are considered special cases are admitted into the school outside the ballot system. This means that the catchment and background of the children admitted to the school will be various and can vary from one class to another and from one year to another. The school endorses Catholic principles and is managed under the direction of the Diocese in Malta. The school also has to fulfill the requirements as laid down by the National Curriculum, which is the regulatory role of the Ministry of Education.

The school caters for boys between the ages of 4 years (pre-school) to the sixth year of primary school. There are four classes of about 25 children in each grade.
b) Teacher
This is a teacher in the school who after some years of experience working at supporting children with special needs decided to upgrade her professional competences and become a qualified teacher. She is thus currently following an evening course in Bachelor of Education in the Early Years and is now in her fourth year of training. The teacher last year was very much motivated by the inquiry approach in science and has been trying out inquiry-based learning in science. She has been applying many of the pedagogical approaches that she came across and has establish herself as a creative teacher who is practicing inquiry-based learning in science with her class.

She has a class of five year old boys and is supported by one learning support assistant who assists a child with special needs. There is no grouping according to ability in the class and so it can be considered to be a mixed ability class.

c) Classroom
The class consists of a group of 24 boys who are grouped around four large tables. The classroom is large and the teacher has an interactive board as well as white board at the front and which she can use depending on what she would like to do. The teacher’s desk is on the side of the room, next to the desk of the Learning Support Assistant. There is a lot of light as one wall is full of large windows.

The boys are a group of lively children who are motivated to learn. There is a range of abilities, from very bright to weak students, who work together in mixed-ability groups.

3.3.2 Episodes
Three episodes were collected from Sabrina, two of which are in science inquiry, and one in mathematics. Each of these episodes will be presented separately and used to analyze the data to identify synergies between science and mathematics and creativity.

1) Senses
This episode is an example of an inquiry-based activity. The teacher first asks one of the students to go out in front of the whole class and uses a scarf to blindfold him. She then took a lemon cut in half and asked the boy to smell it. He guessed what it was. She then asked him to feel it with his hands and then to look at it (after removing the blindfold). The teacher then called out another student and repeated the same process with an odourless leaf. The teacher then reminded them that they had been talking about the senses and that they were going to study how best to study objects. She then turned to the board and wrote down the question of their investigation. She wrote down ‘Which one shows the most detail?’ She then explained that there were various ways of studying objects. They could use a mirror, a magnifying glass or their own eye. She then distributed a mirror and a magnifying glass to each group i.e. to each different table. She then gave each group a cut lemon, a stone and a leaf. She also presented each group with a worksheet where they had to tick, for
each of the items to be studied (half lemon, stone and leaf) and to decide which tool was best to study it in most detail.

The children spent some time working in groups where they used the mirror, magnifying glass as well as their eyes to look closely at each of the three specimens. At the end of the group work, the teacher collected the worksheets and went back to the inquiry question that she had written on the board. She drew up a table and used it to note down the frequency of the conclusions made by the children. The result was that out of a total of 12 chances, the children had on 11 occasions chosen the magnifying glass, and only in one occasions they chose their eye. The children, together with the teacher, concluded that the best tool to use to study things in more detail was the magnifying glass.

This activity is a good example of inquiry-based learning in science. The teacher created a context, choosing an authentic situation, which the children are familiar with. She then put forward a question for an investigation, which the children then needed to investigate in order to find an answer. The teacher thus promoted inquiry skills. The activity also worked well in providing an example of real science where answer and results in experiments are not absolute. The children’s answers reflect real life science where experiment results are not always exact and on many occasions scientists need to work with a degree of uncertainty.

The creative perspective in this activity is related to how the children went about testing the different tools (the mirror and the magnifying glass). There was a degree of discussion about how to use the mirror and the magnifying glass in order to best test them. They thus tried to manipulate the two apparatus to see how they can use them to observe the objects given closely. This provided space for the children to use their creativity to sort out how best they can manipulate the tools that they had to use.

2) Totals

This is a mathematical activity where children had to work out what number they needed to add on to a given number in order to make the total given. The teacher started the activity by doing a couple of easy examples with the children where, for example, she started with the number 7, and asked the children to help her work out how many more she needed in order to make a total, in this case of 9. As the children appeared to have grasped the strategy, the teacher moved on to the group work. She gave each group some blocks, straws, beans, small teddy bears and plastic cups. She also gave the children a small worksheet with examples that they had to work out. The teacher asked the children to find the missing number in examples like 4 + ____ = 9. The children were free to use any of the things provided to work out these examples as they could either use straws, blocks, small teddy bears, or else they could use beans with plastic cups. The children had to use these to first count the initial number, and then see how many more they needed to make the total indicated in the worksheet. The beans appeared to be the most popular among the children as they worked together in groups of 2 or 3. Others used the straws, the teddy bears or the
blocks. The teacher went round to see how the children were working out the examples and to see if they were working them correctly. After some time when most of the children had worked out the whole worksheet, the teacher called them to attention. She then proceeded to work some more examples on the interactive whiteboard. After a few examples, the teacher then asked the children to take out their workbooks and they did some classwork. On finishing, the lesson was over.

This activity was a mathematical activity where the teacher taught the children mathematical strategies. The teacher provided physical objects to help the children practice these mental manipulations and then to slowly internalize the strategy so that they eventually can do the calculations. It was evident on going round the groups that the children were using the strategy learnt slowly and becoming more proficient with practice.

The creative aspect of the activity was in the liberty that the children had in choosing which of the objects given they wanted to use to work out the examples. It was evident that the majority were intrigued with the kidney beans and preferred to use the method where they use the plastic cups to place the kidney beans that they had in the beginning and those that they needed in order to reach their total. It was interesting to note that the children used the cups differently: some used the cups to cover the beans; others kept the cups vertical and transferred beans into these cups. The teacher thus provided space for the children to be creative in the way they used the object to help them work out the examples given.

3) Drums
In this activity, the teacher presents another inquiry-based activity. This time the inquiry is about sound and drums that produce sound when they vibrate. The focus of the inquiry is on the vibrations. The teacher first presents the class with her bag, which is full. She slowly takes out different things from this bag such as containers of different sizes, slit balloons, stretch and seal plastic, tinfoil, as well as rubber bands. She tells the children that they are going to experiment with drums. She distributes containers, slit balloons and stretch plastic to the children who are for some time involved in building a drum, with the help of the researcher and the Learning Support Assistant. When most of the groups had managed to build the drums, the teacher then took out different sticks (markers, wooden spoons etc.) and asked the children for what they could use them. The children quickly noted that they could use these as sticks to play their drum. The teachers now introduced the inquiry activity. She presented the children with three things: marbles; large pasta tubes, and red kidney beans. She told them that she wanted to know which one of the three would bounce most on the drums and asked the children to make a prediction. Some indicated that the marbles will bounce the most and some indicated the red kidney beans. The teacher then asked the children whether they knew how they could test their predictions. The children, with some guidance, said that they had to try out the marbles, beans and the pasta on the drum and then see what happens to each. The teacher pointed out the sticks and the children realized that they needed to be careful to hit the surface of the drum with as much
as possible the same strength each time. The children had some difficulty in carrying out the inquiry in an organised way and at one point the teacher called all the students to attention and then they tried them out for each group one by one in a more orderly way. The teacher made the children keep note of their observations. The result was that out of a total of 12 trials (4 groups who had to try three different objects each) it resulted that the marbles were identified to have bounced most on 11 occasions while the kidney beans bounced the most only once. They thus together concluded that the marbles bounced most. The teacher asked the children to think about why this was the case. The children put forward several possible reasons, amongst which they mentioned that the marbles were round (they meant spherical). They also mentioned that the marbles were also heavy and thus they ‘jumped more’.

This activity is a typical science inquiry-based activity where the children were presented with a question and the children had to investigate and to search for an answer to their question from their observations. It appeared that the children were used to have science lessons where they were involved in testing things and they enjoyed doing this. They were able to propose methods on how to carry out investigations. The children seemed to have started developing inquiry skills as they experienced inquiry activities.

The creative aspects in this activity lie mainly with those instances where the teacher asks the children to propose ways in which they can carry out an investigation in order to find answers. The teacher is careful to allow the children to be creative and hears all the proposed ideas without expressing opinions on how good or not good an idea is, but rather directs the discussion to allow the children to build their methodology through exploring the different options proposed. The boys are not short of ideas and one can note that a minimum of three to four methods are usually proposed while other students commented on the viability or non-viability of the method proposed. Thus the teacher is promoting creativity with respect to problem solving techniques.

3.3.3 Case summary and conclusions

This teacher is a good example of a teacher who teaches science through inquiry-based learning. As indicated in the teacher profile and as the teacher herself admitted in the interview, she was intrigued by the inquiry-based learning approach in science during her teacher training. So much so, that this year she has tried a number of activities which are inquiry-based. The teacher stated that she has found herself slowly becoming accustomed to the approach and now can say that she can only manage to teach science by inquiry. She also stated that it has now become second nature to her to always ask the children why they say certain things and to ask them on how they can test what they are stating. This approach could be observed in the children’s interview when they talked about their experiences in science and kept mentioning how they testing this, that and the other.

It can also be said that the teacher also allowed an element of creativity in science and mathematics, particularly during group work. She is aware that it is important for the
children to develop the skill of devising methods to test what they want to learn. This means that they need to be creative in exploring possibilities. The teacher actually stated that when the children are making suggestions for investigations, she is careful not to judge the proposals put forward, and that she tries to be neutral in order to let the children develop their ideas in a non-threatening atmosphere in comparison to other approaches that emphasize on giving the correct answers that may risk promoting fear of failure.

The teacher assesses the children’s learning in different ways. During the group work activity she goes round to see how the children are getting on and whether they are managing to work out the activities. She also tried to include some examples on the interactive white board in order to ensure that all have understood. She also assesses the children’s learning through their work during classwork.
3.4 Case 4 – ‘Diane at Marigold School’ – A case of creative construction of knowledge

Diane is a primary teacher who teaches 5 year old children in the first year of primary school. She is a colleague of Sabrina and they often plan activities together during the year.

Table: Details of school and case context

<table>
<thead>
<tr>
<th>Where?</th>
<th>Country</th>
<th>Malta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting name</td>
<td>Diane</td>
<td></td>
</tr>
<tr>
<td>Location within setting</td>
<td>Primary school</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Who? (children)</th>
<th>Year group/age of children</th>
<th>5-6 years old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of children in class</td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Who? (adults)</th>
<th>Number of adults</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role of adults</td>
<td>1 teacher and 1 Learning Support Assistant</td>
<td></td>
</tr>
<tr>
<td>Case teacher role</td>
<td>Primary Teacher (in training nearing Bachelor of Education (Hons) course)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>When?</th>
<th>Dates of visits</th>
<th>Times of visits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>8/04/13</td>
<td>10:00-11:30</td>
</tr>
<tr>
<td></td>
<td>8/04/13</td>
<td>10:00-11:30</td>
</tr>
<tr>
<td></td>
<td>8/04/13</td>
<td>10:00-11:30</td>
</tr>
<tr>
<td></td>
<td>8/04/13</td>
<td>10:00-11:30</td>
</tr>
</tbody>
</table>

3.4.1 Context

a) School
The school is the same as that for Sabrina. The school context is thus the same as hers. The details of the school will thus not be repeated here. In fact Sabrina and Diane’s classrooms are two rooms apart.

b) Teacher
The teacher is a Bachelor of Education (Hons) graduate who graduated in 2005. She has always been teaching in this same school since. Diane likes to plan ahead as she wants to make sure that the children develop the desired skills and competences that are required from 5 year olds. She is supported by a Learning Support Assistant, which means that she has a student with learning difficulties. The teacher values the need for the children to have experiences, and while she is strict and organized, she also allows the boys to express their ideas and to participate actively in the lessons.

c) Classroom
The children in the class are a group of around 25 5 year old boys. They are a mixed ability group since they have been admitted to the school based mainly on drawing by lots (unless
they have older brothers at the school for which they will obtain preference). They are organized round a number of tables to form groups. The front of the class has an interactive board as well as a white board next to it. The teacher’s desk is on the side, as is the desk of the Learning Support Assistant.

The classroom is very bright and colourful. There are large windows on one side of the room, which overlook the schoolyard and allow a lot of light to enter the room. The other walls in the room are all covered with charts, which introduce a lot of colour. Copybooks and school bags are stacked in an organized way in their places in the classroom. This is a busy room but well organized.

3.4.2 Episodes

Three episodes were observed in this classroom. Two of these episodes included mathematics activities while the third one was a science lesson. Each of these activities will be described in the sections, which follow hereunder.

1) Teddies

This is a mathematics activity where the children have to find the missing number. The teacher switches on the interactive board and shows a number line made up of a number of bears, which she asks the children to count. She tells the children a story about papa bear that is taking some of the little bears for a walk. In one example she calls out 6 boys to go out with papa bear for a walk. The teacher asks, if there are 10 bears, how many have stayed home and are not going for a walk? The children together find the number of missing bears (4). The teacher repeats this exercise a couple of times and the children enjoy the activity. The teacher then asks the children to take out their paper bears, which they had to cut out of paper on previous occasions. The teacher gives the children a number of examples, which they have to work out, and in groups, they have to use their bears to find the missing number. Each time the total amounts to 10 but as the initial number varies, they have to find out how many other bears remain to make 10. It was interesting to see how the children distributed the bears round their papa bear, with some placing the baby bears in a straight line, others all round papa bear. Having worked out a number of examples, the teacher asks the children to put the bears back in their folders. She then moves on to ask the children to show their fingers and pretend as if their fingers were the baby bears. Together they worked out a number of examples this time using their fingers. Having worked out some examples, the teacher uses the interactive board for some more bear examples to make sure that the children have understood the mental manipulation.

This activity was a mathematics activity where the children had to learn a mathematical strategy about how to work out the number they need to add to another number to make up a specific total. The teacher first provided a physical context (bears) to help them get used to the mental manipulation. With practice, she then asked the children to start using their fingers. This would allow the children to work out similar examples when they encounter them without resorting to a specific physical prompt. The teacher has pitched her
lesson at the cognitive level and helped the children learn mental strategies, which they will eventually manage to do mentally without the need to use bears, fingers or anything else.

The creative aspect was observed with respect to the teddy bears. One could immediately notice that the children had coloured the teddy bears in different ways. Some had coloured the bears in the same colour, other had chosen to use different colours for the different bears. The children also distributed the bears in different ways: sometimes in a row, sometimes round papa bear. One particular boy managed to be particularly creative as he managed to fix the paper papa bear in such a way that he could place him vertically standing, unlike all the other children who kept their bears flat. He achieved this by placing one of the bear’s feet forward and the other backward so that his bear could balance vertically.

2) Balance
This was mainly a science activity where the teacher wanted to organise experiments related to the concepts of heavy and light. The teacher started the lesson by presenting the children with a situation of a seesaw on the interactive board. The children easily noted how the heavier objects went to the bottom while the light one went up. The teacher then gave the children a closed shoebox and said that they had objects inside it and that they were going to use them at a later stage in the lesson. She then took out a balance apparatus, which was built from a clothes hanger with strings hanging from each end that were connected to circular plastic container, held together by a peg. The children then had to use the balance by taking the objects, which were in the box and placing them on different sides of the balance. The children at first started to place one object on either side of the balance. They then added other objects on either side trying to balance the hanger. The image overleaf provides an image of the balance used in the lesson.
When the teacher was satisfied that the children had explored the use of the balance enough she asked the children to put the objects back in the shoebox. She collected the balances and called the children to attention. She then moved on to the interactive boards where she had further examples of marbles placed either side of a balance, tackling an issue where an object first weighed more than one marble, but balanced when a second weight was added. With this, the teacher ended the lesson.

This activity was identified as a science lesson as it involved the concept of balancing when different weights are placed on either side of a balance. Therefore, when achieving balance the objects at each side are demonstrated as having equal weight. Another scientific concept introduced involved the concept of moments as more than one weight was needed to balance another. However, one can also state that the activity had an element of mathematics, as the concepts of light and heavy are also part of the mathematics curriculum. It is possibly the experiment that categorized this activity as involving science.

The element of creativity in this activity was observed in that part of the lesson where the children were allowed to experiment with the balance and to try and balance the different objects that they found in the box. The children tried out the different objects in different ways, using their creativity in deciding which weights to place where in the balance.

3) Numbers
This is a mathematics activity where the teacher focuses on helping the children identify numbers when written in numerical way as well as when they are written in words. The lesson started with the teacher and children reciting the numbers together. The teacher started by doing a short exercise with numbers on the interactive board. In this activity the teacher covered the numbers both in numerical as well as in word format. The children appeared to be familiar with the numbers. After the interactive board activity, the teacher introduced the group work activity.

The teacher gave each different group a different game to do. One group was given flashcards with the numbers written in numerical form as well as in words, which they had to match. Another group were given papers where they had to colour in the numbers written in words. The third group wrote the numbers in words on their small whiteboards. The fourth group was involved in writing the numbers in the two different formats (words and numerical) using play dough. This latter group was involved in deciding which number to represent and how to write them.

This activity targeted one aspect of mathematics where the children learn how to write the numbers in both the numerical and word format. This is part of the mathematical curriculum. The lesson was mainly one of consolidation to ensure that the children had learnt the numbers in the different formats.
The creative aspect was evident mainly in the group work activity, which was asked to write the numbers in different ways using play dough. The children had to decide which numbers to write and also in what way. As can be noted in the photo below, the children also took the opportunity to try and create other designs while doing the activity.

3.4.3 Case summary and conclusions
This teacher is a good example of a constructivist teacher who creates situations and exercises which help the children to construct knowledge as they try to learn and understand what they are doing. This teacher does not present questions or challenges as in the case of Sabrina. However, on the other hand, she organizes activities for her students where they can do things and reflect on activities, which allow them to make sense of the situations presented. This could be observed in the science lesson where the children had to try out in order to understand better what the teacher had introduced at the beginning of the lesson. There was also a similar approach in the mathematics lessons where the group work focused on providing the children with opportunities to try out and familiarize themselves with the new learning. The teacher was aware of the cognitive processes involved in the learning process. She planned her lessons in advance and took into consideration the children’s abilities and what they need to learn.

The creative aspect of the teacher is related to the examples which the teacher plans. She likes to use the interactive board which reflects her planning. The activities are very attractive and reflect the teacher’s own creativity in finding interesting ways of motivating the children to learn. The elements of creativity with respect to promoting creativity among children was observed during the group work where the children were given space to express themselves and do things to a degree within their own perspective, thus allowing them to be creative. It is for this reason that this teacher is considered to be a creative constructivist.

The teacher assesses the children’s learning in different ways and at different points in the lesson. During the group work, the teacher goes round the different groups and oversees the
activities in order to assess how much the children were learning. The teacher also described how she also assesses the children’s learning by correcting their schoolwork.
3.5  Case 5 – ‘Gillian at Honeysuckle School’ – A case of creative exposure to the world around us

This case introduces Gillian, a teacher of grade 3 students (third year of compulsory school) at a primary state school.

Table: Details of school and case context

<table>
<thead>
<tr>
<th>Where?</th>
<th>Country</th>
<th>Malta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting name</td>
<td>Gillian</td>
<td></td>
</tr>
<tr>
<td>Location within setting</td>
<td>Primary school</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Who? (children)</th>
<th>Year group/age of children</th>
<th>7-8 years old</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of children in class</td>
<td>23</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Who? (adults)</th>
<th>Number of adults</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role of adults</td>
<td>1 teacher and 1 Learning Support Assistant</td>
<td></td>
</tr>
<tr>
<td>Case teacher role</td>
<td>Primary Teacher with Bachelor of Education(Hons)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>When?</th>
<th>Dates of visits</th>
<th>11/04/13</th>
<th>18/04/13</th>
<th>26/04/13</th>
<th>25/04/13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Times of visits</td>
<td>11:30-13:30</td>
<td>11:30-13:30</td>
<td>12:00-14:30</td>
<td>11:00-13:30</td>
<td></td>
</tr>
</tbody>
</table>

3.5.1  Context

a)  School

The school at which the teacher Gillian teaches is a State early years primary school. This school caters for children from the age of 3 where it offers two years of pre-school education, up to the third grade of primary education, which in Malta is still currently forming part of the early years in local schools. The school caters for the children in the village, and all children living in the locality can be registered to attend the school. The village is found in the southeastern part of Malta and is embedded in an area where there is a wide range of socioeconomic status.

The school’s mission is to enhance children’s interest towards areas of joy and fulfillment such as craft, drama, music, P.E, science, art, ICT where Peripatetic teachers are an asset. All the staff do their utmost to provide the pupils with an education of an assured quality within a caring community in which all individuals irrespective of circumstances and situations, are given opportunities to develop their full potential. The school, as a State school, offers education free of charge. Children in the school are educated in mixed classes and no grouping according to ability is made at any level, particularly also at the age range which Gillian teaches. Assessment up to this age is formative.
b) **Teacher**
The teacher has a Bachelor of Education (Hons) and has been teaching at the same school for the past 20 years. She has remained enthusiastic all these years and enjoys updating her knowledge, which can help her improve her pedagogical skills. She explained how she had attended training courses, which had helped her update her skills in the use of the interactive whiteboards. The teacher also prepares her lessons regularly and tries to provide as much as possible a meaningful experience to her students.

c) **Classroom**
The class is located on the first floor in the school. The desks are organized in about six groups. The teacher has a Learning Support Assistant who supports two children with learning difficulties in class. The class has an interactive board at the front. The rest of the walls are fitted with a number of charts, which make the room colourful. The teacher’s desk is on the side of the room, close to interactive board.

The children are overall well behaved and represent a normal mixed ability classroom.

### 3.5.2 Episodes

Three episodes were observed with Gillian, two of which focused on science and one on mathematics. These three episodes will be described in turn in the following subsections.

1) **Materials**
The teacher started the lesson by presenting a number of different objects to each group in the class. She asked the children to touch and manipulate the objects in order to obtain a feel of the objects as well as study how they were made, whether they were soft or hard etc. She then moved to the separate groups and started discussing with the children the different objects that she had brought to the classroom. For example, one object was made of glass. The teacher asked the children if they knew from which material glass is made from. The discussion revolved round the manufacture of glass, which is man-made from natural materials. The teacher spent a good percentage of the lesson discussing with the children the properties of the different materials, whether they were man-made or natural, and where the source of such materials could be found. The teacher took the opportunity to try and expand the children’s general knowledge as well as scientific knowledge about materials. This part of the activity took about 20 minutes in total. The teacher then moved to the interactive board where she uploaded a game. The game involved catching an object on the board and then moving it to the box according to its appropriate classification. The teacher used a number of objects including: pine cone, plastic bottle, coin, wooden puzzle, napkin, rubber dice, charcoal, hammer, bouncy ball, small ball, cloth apron, glass souvenir etc.

This activity was a science activity that involved the classification of objects into natural and man-made. It also promoted children’s observations skills as the children had to observe the
objects closely. The children became more aware of the world around them and observed objects, which they usually see but tend to be taken for granted.

The creative elements in this activity were mainly evident in the part where the children were allowed space to touch and manipulate the objects that they were given in the group. During this period of time, the children explored the objects. For example one student who had a plastic apron could not figure out what the object was. So he first spread it out, then he put it up and he at one point actually smelled it. It can be seen that the teacher was very creative in providing the wide range of items which created a lot of stimulation for thinking. To a lesser degree, creative approaches were promoted when manipulating the objects.

2) Capacity
This activity focused on the concept of capacity and obtaining an idea of the capacity of 1-5 litres for estimation. The teacher started off by presenting the class with many containers which she placed on the table. She then revised the concept of 1 litre and how it was equivalent to 1000ml. The teacher then switched on the interactive board to show a table with different values of volumes in different columns. The teacher called out a number of children and asked them to make predictions about the volume of the different containers that she had on the table. The teacher then explained that they had to test their estimations. The children first filled a container of 1 litre with water. Then they had to pour the 1 litre volume of water into the one of the new containers. They had to repeat the procedure a number of times so that they can get an idea of the volume of the container. Having completed this exercise, the teacher then referred the students’ attention to the table on the board and the children reflected on whether their estimated capacity for the container was corrected or if they needed to change the estimation from one column to another.

The teacher repeated the exercise a number of times with different groups of children. The teacher highlighted the meaning of the symbol >1l. The teacher started to pose additional questions as the children gained confidence. Examples of questions set included ‘how much capacity do you think would half of the container contain?’ At the end of the lesson, the teacher looked at the board and with the children reviewed the volumes that they had measured. The teacher then asked the children to look at the volume of containers that they have at home and to note their volumes.

The activity was designed to fulfill part of the mathematics curriculum which at this grade includes the concept of capacity. However, capacity, that is the measurement of volume, is also one type of measurement, which is used in science. The activity is thus a combination of mathematical and scientific skills relating to capacity. In addition, the children also developed the mathematical skill of estimation as with experience they gained an idea of capacity of 1 litre.
There is also a degree of creativity promoted in this activity, particularly with respect to how the children estimate the capacity of a container. The children used several strategies to try and decide how much volume the dishwashing liquid container and other containers could hold. The children looked at the size of the container, held it in their hand, tried to compare the container to others they had already used. It was up to the children to decide how to go about making their estimation and this is where they used and expressed their creativity.

3) Waterproofing
The teacher started the lesson by showing the children a video about some monkeys who wanted to build a house but could not decide what to do and how to go about choosing which material to use. The lazy animals used different materials to build a house, which were not appropriate. They eventually got wet and had to go to their friend’s house, which could protect them from the rain. The teacher then moved to another activity on the interactive board. The game presented the children with materials such as glass, wool, brick and plastic which can be classified as transparent, or used to keep warm, to build for waterproofing. This activity served to make the children aware of the different usage of materials. The teacher then moved to the investigation. She distributed a questionnaire to the children and explained that they were going to test which of the materials indicated would be best to use to keep a boy, which she showed on the board, from getting wet in the rain. The materials that were presented to the children included paper, kitchen roll paper, a sock, cotton cloth and tin foil. The teacher showed the children a container with plastic and asked them how they would test which material was the best for waterproofing.

The lesson then moved on to doing an experiment where the different materials were tested for their properties of permeability. The children eventually concluded that the best material was tinfoil, as the water did not pass through it.

This was a science activity that probed how the properties of materials can be used for purposes useful to humans. The case considered was that of waterproofing used to protect a boy from getting wet in the rain. This activity built on the previous science activity on materials where the children moved from identifying properties of materials to using the properties of these materials.

There was an element of creativity when the children were trying to identify the properties and use of materials to build a house and used their own experiences and ideas in order to try and come up with options. The investigation was less creative but the children also explored other possible materials than those that they were presented with. Some examples mentioned included marble, bricks and glass.

3.5.3 Case summary and conclusions
This teacher works to try and help the children gain understanding of situations and concepts that they are presented with. She tries to provide as many practical examples as possible in order to widen the children’s experiences and general knowledge. She guides the
children a lot as there is a variety of abilities in the class. When teaching science the teacher likes to provide children with many examples, and to expose them to different things, in this case materials, which they can feel directly. The teacher states that it is important to her to see that the children can relate the content covered during lessons to the children’s everyday world. In the case of mathematics, the teacher also tries to give relevance to the mathematical strategies that she teaches the students. In the case of the activity on capacity, the teacher tried to provide the children with an understanding of 1 litre so that children can make realistic estimates of volume.

The teacher admits that she tries hard to come up with examples of activities which engage the children, and in fact, as the observation of the episodes have shown, she is very creative in the type of activities which she provides to the children. She was less sure of how much she focuses on promoting creativity among the children, even if she believes that the group work is one main way to achieve this as it allows the children to express themselves.

With respect to assessment, the teacher stated that she is continually following the children’s development informally through the children’s participation in their lesson. The classwork and homework are other forms of assessment which the teacher uses to track the children’s learning.
3.6 Case 6 – ‘Fleur at Daisy School’– A case of creative scaffolding
This case introduces Fleur, a teacher of grade 3 students (third year of compulsory school) at a girls’ Church school.

**Table: Details of school and case context**

<table>
<thead>
<tr>
<th>Where?</th>
<th>Country</th>
<th>Malta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting name</td>
<td>Fleur</td>
<td></td>
</tr>
<tr>
<td>Location within setting</td>
<td>Primary school</td>
<td></td>
</tr>
<tr>
<td>Who? (children)</td>
<td>Year group/age of children</td>
<td>7-8 years old</td>
</tr>
<tr>
<td></td>
<td>Number of children in class</td>
<td>25</td>
</tr>
<tr>
<td>Who? (adults)</td>
<td>Number of adults</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Role of adults</td>
<td>1 teacher and 1 Learning Support Assistant</td>
</tr>
<tr>
<td></td>
<td>Case teacher role</td>
<td>Primary Teacher with Bachelor of Education(Hons)</td>
</tr>
<tr>
<td>When?</td>
<td>Dates of visits</td>
<td>9/04/13 17/04/13 23/04/13 26/04/13</td>
</tr>
<tr>
<td></td>
<td>Times of visits</td>
<td>8:30-11:30 8:30-11:30 9:00-10:30 8:30-10:30</td>
</tr>
</tbody>
</table>

3.6.1 Context

a) School
This school is a Catholic Church school which caters for girls between the ages of 4 years to end of compulsory education at the age of 16. The school, however, is run mainly as two separate schools, one primary and one secondary school. The entry to the school is through ballots among those parents who apply for their children to attend Church schools. The result is that the school caters for mixed-abilities. The school is supported by the State and there are no official school fees, even if parents are asked to give the school a yearly donation of hundred euros.

The school aims to provide the students with a holistic educational experience catering for the children’s academic, social, physical, psychological and spiritual needs. The school is committed to doing this without distinction of ability, socio-economic class or race. An education is offered in a safe, loving and Catholic environment aimed at helping each girl develop the gifts and good qualities she is endowed with to her fullest potential.

b) Teacher
The teacher in this school is a Bachelor of Education (Hons) graduate with 8 years of experience. In her Bachelor studies she has specialized in early years teaching. She considers herself as an open and creative teacher, whose colleagues see her as a strict teacher with a
good grasp of discipline over the students. She loves teaching and is continually looking for new ideas to try out and to help the children in her care to learn more while enjoying themselves as they learn. Apart from taking care of one particular student the Learning Support Assistant also helps the teacher in the activities she organises for the class.

The classroom is big and is supplied with an interactive whiteboard. There is a lot of space at the back of the classroom and one corner has been converted into a reading area full of shelves with books that the teacher herself has supplied. The space at the back of the classroom allows the teacher to organise activities, which need more space. The teacher’s desk is located at the front on the class next to one of the sides of the interactive whiteboard, while the Learning Support Assistant sits at the other side of the class. The classroom walls are full of displays and make the room very colourful. One wall is full of windows overlooking the yard. These windows provide the class with a lot of light and the result is a bright and colourful classroom. The students’ desks are organised in groups with a total of six groups in total. This allows the teacher to organise group work without any need for the children to move their desks.

c) Classroom
The class is a grade 3 class of 25 girls of ages 7-8 years. These girls are a group of lively girls who can be quite difficult to control at times. The teacher is constantly strict but often has to deal with strong characters that tend to be bossy, particularly during group work.

The teacher admits that the girls are a handful and that this year she has found it very hard to maintain discipline at all times during the school day. On the other hand, she stated that they overall worked hard and there were quite a number of clever girls. However, the need to continually discipline the children has exhausted the teacher.

3.6.2 Episodes
Four episodes, two in science and two in mathematics were observed in this case. Each of these episodes is described in the sections that follow.

1) Counting Caterpillar
This is a mathematics activity. The teacher starts by reminding the children of the story of 10. She asks two girls at the front to provide two examples e.g. 4+6 and 5+5, both of which add up to 10. The teacher then switched on the interactive whiteboard and showed the children the number 4 as well as a caterpillar with four segments in its body. With the use of a caterpillar on the screen, she turns segments in different colour so that the children could see values such as 1+3 and 2+2. After exhausting this example, she then moved to total number 5. Again she worked the example with the children using the caterpillar. When the teacher felt that the children appeared to have understood the task, she moved on to the group work. For the group work the teacher gave a caterpillar (made of a basic long strip with Velcro to which the segments of the caterpillar could be attached). The children had to work similar examples of finding different combinations of addition for the same total using
the caterpillar, which they had on each table. It was interesting to see how the girls used the caterpillar. Some used the method shown by the teacher. However, a number of other groups used the caterpillar in a different way. One particular group decided to take away the caterpillar’s head as they felt that the head, since it was round like the segments, was confusing them in their working. They thus were creative in deciding how to use the caterpillar given to help them with the mental manipulations. The teacher went round the groups. When she was satisfied that the students had grasped the activity which they needed to learn, she called the whole class to attention. The next five minutes were used for the different groups to share their strategies with the others. It emerged that the different groups had used different ways to find the totals. Two of the groups removing the caterpillars’ head whilst the rest starting of by representing the total number with segments of the same colour and then removing one segment at a time and replacing it with segments of another colour in order to experiment with the possible combinations. The teacher then moved on to explain the classwork from the workbook, after which the children started working additional examples.

This activity was mainly a mathematical activity where the children had to devise a strategy to break down a total number into different pairs of the numbers. The teacher presented the children with the caterpillar, which promoted the use of strategies. It can be noted that this teacher pitched her learning and understanding in mathematics at a cognitive level and wanted the children to understand the mental manipulations that they were making.

The elements of creativity were noted with respect to the way in which the teacher presented the caterpillar and used it to promote mental strategies. However, the element of activity where the children’s creativity was promoted was evident during group work when the children had to use the caterpillar themselves. It appears that the children did not use the caterpillar in the same way as the teacher but developed their own ways. One significant example was the group who took off the caterpillar’s head and decided that it was easier and less confusing to just use the caterpillar’s body. To them, having another circle attached to the strip was not relevant and only served as a distraction. They thus did away with the caterpillar image and just used the segments.

2) Fruits
This was a science activity focused on fruits. The teacher started the lesson by referring to the food pyramid, of which there was a large chart on the classroom wall and asked the children to remind her what they had talked about when they had done it. The children were quick to identify the need to eat some food in moderation and others more frequently. From this, the teacher moved to the interactive whiteboard and showed the children a video about fruit and how important it is to wash them properly before eating them. The teacher then moved to the back of the class where she had prepared a table and had placed different fruits. She said that they were going to look at fruits and that they were going to take a close look at their seeds. She went round and gave a plate with some fruit to each
group. Each group had a different fruit. The fruit to be observed included: strawberries, bananas, kiwi, apple and grapes. She also gave each group a picture of the plant/tree on which the fruit had grown on. She also gave each group a magnifying glass so that they could look at the seeds in the fruit closely. The girls had to fill in a worksheet in order to finish their task. The worksheet had questions that directed the children’s observations of the fruit. The fruit’s seeds particularly intrigued the children. The most interesting fruit proved to be the banana where the children were not able initially to identify its seeds. The teacher offered to look it up on the internet through the interactive whiteboard. However, one of the children managed to see the seeds by cutting a bit off the banana and noticing a number of small black spots with her magnifying glass. While the children were doing their observation activity, the teacher continued to peel the fruit and at the end of the lesson, the children ate fruit salad.

This activity concerned science and promoted mainly observations skills. The teacher combined scientific knowledge about healthy diets and the need to eat fruit as part of a healthy diet. However, she also targeted observation skills that form an important aspect of doing science. The children were really interested in observing their fruit and many contributions about the seeds and fruit were included in their worksheets.

The creative aspect of the lesson was again related to the group work where they noted additional things about their fruit. The teacher also asked the children to draw the fruit and the drawings of some of the children showed a degree of talent, which some of the girls had and how well they managed to represent the fruit that they were observing through their creative expression of drawing. These images below provide examples of the students’ particularly artistic contribution.
3) Least money
This activity was a mathematics activity where the children had to identify the least number of coins they need in order to put together a certain amount of money. The teacher started the activity by using the interactive whiteboard. The teacher introduced an activity where she introduced the strategy used to identify the least number of coins to reach a certain total. After doing a number of examples as a whole class, the teacher moved on to the group work. She had prepared different tasks for each group related to least coins needed and then asked the children to start working. Some children had a basket full of different toys with a price tag and they had to play shopkeeper and find the least number of coins to pay for the toys. Another group had a game similar to monopoly but in order to throw the dice and move forward they had to be able to make up the least coins for total given. In order to help them with their working, the teacher gave each group a sheet, which showed what were the least coins necessary in order to make up totals. The sheet covered total up to 1 euro.

The group work took quite some time to complete as the children needed time in order to work out the least coins correctly. With the help and support of the adults in the classroom, along with the researcher, the children eventually finished their activity. The teacher then called the girls to attention and moved on to giving them classwork related to the topic covered from their school workbook. The girls were involved in completing the examples from the workbook until at the end of which, the activity was over.

This activity focused on mathematics and required children to find the smallest number of coins necessary to add up to a particular total. It has to be said that a number of students struggles with the concept, but eventually, all the children had grasped what they needed to know. The mental strategy required was quite difficult and the teacher needed to support a number of the students during the group work in order for most of the class to manage to complete the task.

The creative element was mainly observed during group work, particularly with the group who had the shopping activity. When acting out this situation the children did not just work out the values but were observed as taking on different roles and deciding on which items to buy. This instance allowed the children to be creative in how they tackle a situation and how they imagine that situation as taking place.

4) Planting seeds
This activity was a science lesson which built on the previous week’s activity on fruit. The teacher started by reminding the children of the activity of the previous week and how they had cut open fruit in order to identify the seeds inside. She then said that she had brought some more seeds that day, but unlike the dry seeds used in the previous week, she presented them with seeds, which had been soaked, and in the case of the butter beans they also have been cooked. She asked the children to use the magnifying glass that she had given them and look again at the seeds and compare them to the seeds that they had used
the previous week. This exercise set off the group work activity where the children were studying the seeds provided in detail. Among the things that they noticed, there was the skin of the butter bean, which they had not really noticed the week before. The teacher, some time into the group work asked the children to take off the bean’s skin and to eat the seed if they wished. The children particularly enjoyed this part of the activity.

The teacher then moved to the second part of the activity, and after collecting the remaining butter beans, she gave each group a tin foil plate full of peat. She then distributed small plastic cups, recycled from the fruit system which is used in all primary schools, to sow a bean which the teacher provided. The teacher asked the girls to write their name on a piece of paper placed in the cup so that everybody could test and observe their own plants as they grew. Indeed, on visiting the class one week after this activity, most of the beans had started growing and had already produced two leaves.

This activity was a science lesson that brought to the girls’ attention the beans’ properties of absorbing water when placed in water. The function of the seed was later explored and, as the teacher commented, the students were very eager to note how the plants were growing, even if they could not name the plant in the pot. Besides the knowledge about seeds and that they absorb water, the teacher again promoted observations skills as the girls had to look again at the bean, not only more closely, but also to note if it was different and/or similar to other beans they knew of.

The aspect of creativity within this lesson was not particularly great. However, there were instances of creativity mainly when the children were looking at the beans in groups. What resulted was that for some time, the topic of discussion during group work focused on the beans. The children were particularly intrigued by the size of the bean. In trying to make sense of the situations in front of them, they tried to propose reasons for which these had absorbed water. Here creativity soared as various reasons and options were mentioned. While there is only one specific scientific question, it was surprising how aware these young children were of different reasons. They somehow knew that seeds needed water to grow, but then speculated about other aspects such as the seeds being boiled and good to eat, or that it had been left in the water for too long. These speculations would have been very interesting by the teacher to pursue.

3.6.3 Case summary and conclusions
This teacher is very creative in what she organises for her students. She designs games and activities, which besides their educational value to help the children learn the target concept also produce something that the children enjoy. She is thus a creative teacher. It could also be observed that she pitches her learning mainly at the cognitive level and that she promotes learning through deep understanding rather than through memorization. In the case of science, she likes to give the students the possibility of holding and touching things themselves so that they can experience things first hand. These direct experiences in investigations in science serve as a strong motivator for learning among the children. The
teacher expressed how she sees the children as more engaged when she gives them tasks to work in groups, even if their behavior is often challenging. The children like to try things out for themselves and enjoy participating actively in activities.

The teacher reflected on the role of creativity and could pin point parts of the lessons observed where there was space for the children to be creative. She also admitted that she realized that being creative herself in her teaching does not necessarily mean that the children have opportunities to be creative themselves. Catering for the development of the children’s creativity is a challenge in itself and must be planned as part of the learning activity. Having said this, the teacher was of the opinion that the group work allowed the children space to be creative.

The teacher assesses the children’s development in different ways. She monitors their work and progress during the group work activities, allowing her space to provide additional attention to those children who need additional support to understand the new material being covered. She also uses the children’s classwork to assess their performance and level of understanding.
4. Discussion of findings

This section includes a discussion of the main findings from the research exercise and draws results and conclusions with respect to teaching science and mathematics in the early years as well as probes to how creativity is included and promoted when doing mathematics and science.

4.1 Enabling Factors or Barriers at Contextual Level

There were several different contextual aspects which have to be taken into consideration in framing the research results. It has to be said that the amount of science that is actually done in primary schools in Malta is limited. This is not because official curricular documents do not acknowledge the need to include science in the primary curriculum, but since there is no formal assessment of science at primary level, it ends up being the first subject, which is neglected when there are time constraints in the school day. In addition, there is little official accountability for teachers to cover the whole curriculum besides through assessment. This is particularly so in the case of state schools. The resulting situation is that in State primary schools, science is mainly done only when the science peripatetic teachers are in schools. This means that children at most participate in one science activity once a fortnight. In the case of Church and Independent schools, this depends very much on the school’s outlook towards science. The result is that in Church schools there tends to be a science curriculum and textbook, and in some cases a special science teacher is present. However, in many cases the approach tends to be traditional, with mostly teacher-centred teaching and children engaged in working out tasks in their workbooks. In the case of Independent schools, there is greater probability that children have science lessons regularly. However, this does not necessarily mean that children are engaged regularly in inquiry-based learning in science.

The result is that those few teachers who do science tend to be the ones who are really enthusiastic about it and many times also enjoy organising activities which provide children with opportunities to try things out. The pool of teachers who could be included in this study belong to this group of teachers, which increased the probability of observing good practice and the chances of observing inquiry science at its best. The situation is not the same in the case of mathematics, as this is assessed formally as from the age of 9 and teachers thus dedicate a lot of time and energy to the learning of mathematical concepts and strategies. There are thus regular mathematics lessons in the primary schools.

The requirement of having a sample of teachers who promote creativity and are creative themselves was not difficult to achieve. It appeared that teachers, who are good at their work and try to offer an effective learning experience to children in the early years, tend to be creative and enthusiastic about their work, giving children the chance to explore and learn. The resulting situation is that those teachers considered to be most creative also enjoy teaching science.
4.1.1 Differences between preschool and primary school

There were differences between the pre-schools and primary schools observed. As the children grow older, the schooling format becomes more formal. In addition, one could also see the greater impact and use of literacy, with the older students engaging more in writing tasks than younger students. It has to be noted that one aspect, which appeared to remain constant throughout the different years was group work, involving children working together on a particular task.

Another difference that was noted referred to the duration of the activity, where at pre-school level, the activities tended to be very short and often requiring less than half an hour. On the other hand, in the case of primary school level, the activities were always at least of 40 minutes duration. Many times, the activities were longer because a writing task was often included at the end of the lesson and this usually took about quarter of an hour to complete.

The main differences identified thus relate to the following:

- Activities become of longer duration with age;
- Activities become more structured as the children are older; and
- The primary children always have a writing activity at the end of the lesson.

4.1.2 Differences between science and mathematics

There were a number of differences identified between mathematics and science, even if in some instances there was great overlap between the two and it was difficult to identify the activity since it tackled both mathematics and science.

The main differences identified included the following:

- **Science involved investigations where children had to manipulate natural objects and see how they behave:** It was evident that in all the science activities observed, the children were at some point involved in a form of experiment where they had to try out how something works. This form of experiment, which is a feature of doing science, was not observed in the same way in mathematics. Although the group work in mathematics involved the children using tools and/or games in order to fulfill a task, it was not necessarily a reflection of real world situations but involved games intended to help the children with their mental strategies.

- **There was less emphasis on writing tasks in the case of science:** Most of the mathematics activities, particularly those with the older children in the early years had an increased element of writing in the form of class work at the end of the lesson. This was a distinct feature in mathematics. So while in mathematics many times the students had to complete a page from their workbook by the end of the lesson, this is often not the case in science. On the contrary, in the case of science, the teachers often used worksheets, which the children had to fill in as they completed the group work activity.
There were more references to the real word in science than in mathematics: The activities in science were characterized by direct references to the world. Many of the activities involved studying fruits, drums, lemons, materials etc. The outcome of doing science was thus directly linked to learning more about the world and how it works. On the contrary, the focus in mathematics was mainly on developing mental strategies where the outcome of the group activity tended to be the development of a particular mental strategy to carry out a particular mathematical procedure.

Although science and mathematics are considered to be closely related and there is a tendency for those who are good in mathematics to be also good in science (Li et al., 2002) they still have distinct characteristics, which differentiates them from each other.

4.1.3 Opportunities and challenges for creative learning and teaching
The identification of the role of creativity in science and mathematics is still a challenge, as the observations of the lessons highlighted. It could be easily noted that the teachers observed are creative teachers. They created attractive and interactive learning resources. The result of such creative approaches resulted in the students enjoying their lessons as well as increasing their motivation to learn. In addition, it has to be also noted that learning was also effective. However, being a creative teacher does not necessarily translate into teaching creativity. When interviewed the teachers did reflect on this issue and admitted that they could have reflected more on how to promote creativity among their students, and that they could have organised more open activities where the children could express themselves freely as well as have the opportunity to come up with their own personal solution.

It could be noted that the most common instances where creativity was promoted occurred during group work where the children had the opportunity to discuss and tackle tasks together. During this period, there was more freedom for the children to express their ideas and do things their own way. It was most probably due to this element of freedom that creativity was promoted. The teachers admitted that in many cases, they had not planned the group work in order to promote creativity, but on reflection on the activities, admitted that they could have provided the students with more space.

4.2 Revisiting the CLS Mapping and Comparison Factors: A summary of findings
This section revisits the various factors that have been identified in the previous work packages in the project and which have identified factors that are worth considering when analyzing the teaching and learning of science and mathematics in the early years and in identifying the role of creativity within these two subjects.

4.2.1 Aims and Objectives
This section tackles the outcomes of the findings with respect to the aims and objectives of the early years education curriculum in terms of mathematics and science and the role of creativity within these two subject areas. The first aspect to be considered refers to the
aims and objectives set for science and mathematics. The comparison between these is tackled in the sections below.

**Differences between preschool and primary school**

There were differences in the mathematics and science organized in the pre-school levels and those at primary levels. It can be said that as the children grew older, the activities became more complex, but also more structured, possibly limiting the space for creativity. It could be noted that at pre-school level ample time was allowed for the children to explore materials and to manipulate the objects that they were using in the activities. This reflects a practice at pre-school level, which focuses on the development of skills more than an accumulation of concepts. At primary level, there is a greater emphasis on content acquisition, although in some of the practice, the adoption of inquiry-skills was also noted. This showed a greater emphasis on cognitive skills, whether they are mathematical strategies or else processes in science.

These observations to a good degree reflect the official policies for the different age levels in Malta. Official educational aims and objectives at pre-school level focus mainly on the development of skills. The curricula at primary level also include content matter and increased cognitive and mathematical skills, as well as greater understanding of how the world works. The practices observed thus fit within the official aims for educating young children in Malta.

**Differences between science and mathematics**

There were differences in most of the mathematical and science activities observed. The main difference was reflected in the type of group activity that the children engaged in. In the case of mathematics, many times the children were given tasks where they had to use games and/or aids prepared by the teacher. The activity presented was often context-free and rarely embedded in any context. This was mainly due to the target of the activity being that of developing mental strategies that form part of the official mathematical curriculum. It can thus be noted that such activities still fulfilled the official aims and objectives of mathematics in Malta.

The group work activities in science was different in that the activities which the children were engaged in often represented an actual context and thus the children were engaged in exploring the real world around them while at the same time developing scientific processes and concepts. This approach also falls within the aims and objectives of the national curriculum with respect to science.

**Opportunities and challenges for creative learning and teaching**

The latest documentation on creativity relates mainly to innovation, which is to be promoted at a cross-curricular level. It has to be said that less attention was paid to the need to promote creativity among young children, even when learning science and mathematics. The main opportunities lay on the level of open-endedness in the activities organised such as
group work. This activity offered the main creative opportunities, where teachers promoted creativity.

4.2.2 Learning Activities
This section looks at the type of learning activities organized at the different levels and in the different subjects and noting their similarities and differences. These are tackled in the sections below. As in the case of the previous sections, differences between pre-school and primary, between science and mathematics, as well as opportunities for creativity are each tackled in turn.

Differences between preschool and primary school
There were few differences in the learning activities organised in terms of type of activities. Group work was used as main pedagogical approach both at pre-school as well as primary level. This translated into a large percentage of time students were involved in discussing together the tasks assigned. The main differences identified have already been highlighted in the previous section and show an increase in complexity, as the children grew older.

Differences between science and mathematics
One difference identified between mathematics and science, which has already been highlighted, related to the different type of group work assigned in mathematics and science where experiments in science were related to a context relevant to the children’s everyday lives, while in mathematics the tasks were context free.

Another difference noted was that more classwork was assigned in the case of mathematics than science, with children, especially at primary level, spending about 15 minutes of the mathematics activity doing exercises from their mathematics textbooks. There was less demand on such exercises in science and any writing done usually involved filling in observations made during the activity, often at a group level.

Opportunities and challenges for creative learning and teaching
Space for creativity was mainly identified during the group activities as it provides students with the opportunity to express themselves. The challenges lay at two levels: first in making teachers aware that they can and should promote creativity even through subjects such as science and mathematics; secondly that it is mainly through open-ended activities, often through group work that it is best to promote children’s creativity.

There are thus many unexplored opportunities for promoting creativity in the early years within mathematics and science learning. The potential that these two subject areas have should be considered and taken advantage of.

4.2.3 Pedagogy
This section is very close to that of learning, but focuses more on the teaching rather than a learning perspective. Comments included in this section thus complement observations
already made and conclusions drawn in the previous section, and build further on the discussion so far with respect to the three different perspectives taken.

**Differences between preschool and primary school**

It can be said that there is a degree of difference in the pedagogy observed at pre-school level and at primary level. However, it is also to be noted that there were also pedagogical differences also between the different ages across the primary ages between the first and third year of primary education. While in the first year of compulsory schooling, learning tends to be informal and involve little written tasks due to the children’s limited literacy competences, one finds that by the third year of schooling teaching is more structured and formal and many times children are involved in a written task.

All the teachers tend to pitch their learning at a cognitive level, promoting thinking, reflection and the development of mental strategies. This could be an aspect of their pedagogy, which makes them good and effective teachers compared to other teachers. They also allow space for the children to work together and to share ideas and construct knowledge in a social setting, whether at pre-school or primary level. The activities were also longer in duration as the children were older, reflecting the children’s ability to concentrate and stay on task for longer periods of time.

**Differences between science and mathematics**

There was less science activities observed at pre-school level and thus it is difficult to compare the differences between pedagogy in mathematics and science at pre-school. This comparison however can be made for the primary years. It can be noted that the pedagogy in science was more inquiry-based in many cases than in mathematics. Thus the group activities organized in mathematics involved mainly the need to practice mental manipulations and using strategies, which have already been learnt. In the case of science, many times, the activity was different in that the task assigned often engaged children in challenges where they either needed to test how something works or to verify a phenomenon which they were exploring. The nature of the tasks in science and mathematics were thus different.

**Opportunities and challenges for creative learning and teaching**

There were more creative opportunities in science than in mathematics as often in science the children were engaged in trying to find solutions or to think up ways of testing ideas which they had put forward. It has to be noted that in the case of the teacher who had taken up inquiry activities, the children demonstrated a much more developed and complex way of thinking and reflecting than children in other classes who did not regularly participate in inquiry. When discussing science these children spoke about testing different things, while other children talked about the knowledge gained. The inquiry-based learning approach’s potential in promoting creativity has not yet been explored in enough detail and must be explored further for the benefit of having more creative generations.
4.2.4 Assessment
Children’s learning and development is measured through different forms of assessment. Although it is common within the early years to have formative assessment across the board, teachers utilized different forms of assessment in order to follow their children’s learning.

Differences between preschool and primary school
Assessment procedures are not that different between the pre-school and primary years. The main differences in assessment are a result of the children having greater literacy skills in the older years than at younger ages. The results of the increased literacy skills lead teachers to assess older children through their written work, which includes either classwork or homework. On the other hand, in the case of the pre-school children, the teacher kept an activity book for each and every child in order to be able to record as many of the activities, which the children were engaged in.

Differences between science and mathematics
The processes of assessment were also different in the case of mathematics compared to those used in science. The need to assess individual performance was more important for mathematics than in science. In mathematics there were many instances where the children were asked to work out examples and the teacher then corrects them to assess how much the children learnt. In the case of science, this emphasis was much less and in many cases the children produced joined outputs, often involving one output among a number of children.

Opportunities and challenges for creative learning and teaching
Since teachers were not that aware of creativity when teaching science and mathematics, they were less aware of the need to assess creative aspects when doing science and mathematics. Elements of creativity are often considered as subjective and intangible and thus this makes it harder for creativity to be assessed. However, if one were to assess how original and innovative children are in the responses that they give, assessment in itself can motivate children to try and come up with different answers than the traditional accepted one.

4.2.5 Materials and Resources
This section tackles the range of materials and resources used in the early years when doing science and mathematics and to compare and contrast their use with respect to pre-school and primary education, science and mathematics, as well as with respect to promoting creativity.

Differences between preschool and primary school
It has to be noted that the blocks were used across the different ages, particularly when doing mathematics. Blocks are versatile and they intrigue children as they can construct

The project CREATIVE LITTLE SCIENTISTS has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 289081.
different things and be used in different ways. The use of blocks was observed from pre-
school to the third year of primary school.

On the other hand, one could see that thin workbooks were used more in the case of
primary school than at pre-school level. No specific textbooks, however, were noted in any
of the activities observed.

**Differences between science and mathematics**

The nature of the experiments, which the students engaged in science called for the use of
everyday things which one finds easily at children’s homes or in familiar surroundings.
Resources used included stones, lemons, clothes hangers, plastic containers, books, fruit,
things made of different materials etc. The only specifically scientific equipment used was
the magnifying glass, which was used in two activities organized by two different teachers in
two different schools.

The resources for mathematics were of different nature since they had to serve a different
purpose. Resources used in mathematics included official resources which one purchases for
education purposes such as blocks, marbles, numicon etc. In the case of other resources,
these were often made by teachers through the use of cardboard, lamination etc, and had a
specific use only for mathematics. It was only in the case of the activity on capacity that the
teacher used everyday things one finds at home, but as argued, this activity was considered
as both science and mathematics.

**Opportunities and challenges for creative learning and teaching**

The creativity in the use of materials was often evident as the teachers observed were
creative teachers. In science there were instances where the teachers were creative in how
they put together the required apparatus. One good example was the balance that was built
from a clothes hanger, a peg and two containers tied to each end.

The teachers were also creative in the resources they made use of in mathematics, even if in
a different way. It could be seen that often the teachers made resources out of cardboard
and laminations, where they developed games, learning aids, and other resources that often
were used during group work. There was also an element of creativity in the way through
which the teachers developed and used resources for the interactive whiteboard. This new
technology has recently been implemented in schools across Malta and many are those
teachers who are still learning how to exploit the full potential of this resource.

**4.2.6 Grouping**

This section looks at how children are grouped within the year as well as in class for the
different subjects of science and mathematics as well as between pre-school and primary
school.
Differences between preschool and primary school

In the case of early years, children are usually organized according to their date of birth. This is usually done in order to have children of similar age together. A difference of few months is a great difference in age at the age of 2, 4 or 5 years.

There is no grouping of children according to ability. In fact, all the schools practice inclusion where children with learning difficulties are integrated in the classroom. So there is no particular grouping in the primary school. It is to be noted, however, that in Church schools, children are educated in a single-sex environment. In fact, in two of the Church schools observed, one was a girls’ school and one a boys’ school.

Differences between science and mathematics

There is difference in grouping in either mathematics or science. No distinction is made at any point between children based on their ability or some other form of classification. Usually group work is organised in mixed-ability groups where the children sitting next to each other at a table are grouped together.

Opportunities and challenges for creative learning and teaching

It has to be noted that having mixed ability grouping can in itself be a configuration, which promotes creativity. Mixing children will provide opportunities for different ideas and contributions, which promotes creativity. While this is a vital opportunity, there still remains the challenge of ensuring that all contributions made to group work should be considered that children learn to respect others’ opinions and to take them into consideration when working together. It has to be noted that it is not easy for children to engage in effective group work and that they need time and training to work together while also engaging in creative processes.

4.2.7 Location

This section looks at the location where the science and mathematics activities are carried out within an early years setting.

Differences between preschool and primary school

There was no particular difference in the location for delivering activities between pre-school and primary level. In both pre-school level as well as at primary level, learning activities were organised both inside the classroom as well as in other open spaces within the school. In pre-school, the children went out in the corridor to stretch out the cloth representing a dinosaur’s length to see how long a Tyrannosaurus Rex is (although this was not captured in an episode, it was still observed taking place). At primary, one class went out in the school garden to look for minibeasts while the activity on shooting balloons was carried out on the terrace. This shows that teachers at both levels are versatile in using the different spaces within the school.

If there were some slight differences in location, this could be identified mainly within the classroom. It was noted that at pre-school level the children were given more freedom to
wander about. In particular, at pre-school level, the children were allowed to spend time in the play area. It was customary to spend some time in the morning playing until the children settle down for an activity. This was not the case for primary education, where children’s location was mainly fixed to the classroom. The only change in location that was mainly allowed related to the children visiting the library corner to get books. However, even where space for reading was allocated, the children never used these spaces but went back to their place to read their book.

Differences between science and mathematics
Some differences in the use of location were identified between mathematics and science. It was noted that all the activities that took place outside the classroom were mainly science activities. These involved looking around the yard, but also carrying out experiments that need space not available in a normal classroom.

Opportunities and challenges for creative learning and teaching
There are opportunities for creativity in both activities that took place outside as well as inside the classroom. However, since the teachers in this research demonstrated how one could use different spaces to promote learning, teachers should be encouraged to use spaces in schools better in order to promote more creativity. It has to be noted that the activities, which took place outside the classroom, reflected a degree of creativity in the provision of education because the children were working outside their normal tradition classroom.
5. Implications
There are various implications that can be drawn out of this research study. It definitely shows how creativity is often evident in situations where children are mainly engaged in open-ended activities, which involve group work. It also shows how the teachers are very creative in the way that they present material, but need to give more attention to creating more opportunities where the children can be free to provide answers.

5.1 Implications for teacher training
There is a lot of potential for teacher training. Teachers in training need to be made aware of what type of creative thinking can be promoted in the early years as well as what types of activities e.g. group work provides space for creativity.

There is usually a lot of emphasis on being a creative teacher, but less so on the need to teach for creativity. The examples of good practice observed in this research project can be used to exemplify situations, which can be used to go beyond teaching specific subject areas but also promote creativity.

5.2 Implications for policy development
There is one main implication to teacher training. It is evident from the teachers observed that teacher-training tends to provide more emphasis on teachers being creative in finding ways to present new material to children, but less attention is given to children who have to be given time and space to be creative. Initial teacher training should highlight the following aspects as they are not given the attention they deserve.

- Children need to be stimulated and provided with space to express their ideas as well as try them out where possible;
- The children should be given open-ended tasks which allow them to come up with different answers and options and that the assessment does not rely on providing the expected answer, but that putting forward original responses which still answer the question set should be appreciated for its uniqueness.

There is also the need to promote pedagogies for creativity as part of policy documents. It is very important to go beyond just committing to creativity and innovation, but to go further and highlight the need for teachers to be responsible also for promoting creativity as well as the pedagogies that encourage it.