Implementing a science curriculum reflecting an inquiry-based approach in the Upper Primary years

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primary science;
challenges

Abstract

There has been, for the past few years, a drive to implement inquiry-based learning as the main pedagogy to teach science at both primary and secondary level (Rocard et al., 2007). This approach has been advocated as a response to a European concern about economic decline, underachievement by students in international studies for science and mathematics, and the need to promote careers in science while also encouraging scientific literacy. This paper describes the outcomes of the implementation phase of an inquiry science curriculum in a primary classroom of 9-10 year old students, and its impact on the children's learning. The study shows that inquiry activities were received well by the students who were encouraged to carry out research and investigations to find answers to their questions, even if they needed practice and experience at inquiring. From the teacher's perspective, implementing inquiry posed a number of challenges such as finding the necessary resources and learning how to guide students to use their observations to draw conclusions as opposed to providing answers.

1. Introduction

There is a European need to promote careers in science and encourage more future scientists. At a national level, Malta did not compare favourably against the EU average for science and technology graduates (European Commission, 2007). In addition, Malta's underperformance in the TIMSS 2011 study accentuated the national concern with science education. This triggered a national review of the state of science education in Malta (Department of Information, 2008) leading to the publication of a national vision for science education (Ministry of Education, Employment and the Family, 2011) committed to promoting the inquiry-based learning approach at both primary and secondary level.

Despite education in Malta being well developed (Sultana, 1997; Bezzina & Grima, 2007), primary science still in practice struggles to be core to the primary curriculum, even if it is acknowledged in the main national educational policies (Education Act, 1988; Ministry of Education, 1999; Ministry of Education, 2001; Ministry of Education, Employment and the Family, 2011; Ministry of Education and Employment, 2012). The 'Vision for Science Education' policy document published has both given primary science more prominence, considering it one of the core subjects in the primary curriculum, as well as emphasised the importance that teachers need to implement inquiry-based learning approaches in classrooms (Ministry of Education, Employment and the Family, 2011).
This paper describes the result of the implementation of an inquiry-based learning curriculum designed for students of ages 9-10 years at primary level in Malta. The research reported forms part of a larger study which involved the development of an innovative format for writing a curriculum for inquiry, having it evaluated by teachers, and then implementing it to see how much the curriculum style used promotes inquiry. This paper will only report that part of the research referring to the curriculum’s implementation. It will not focus on the curriculum style of format, but on the impact that the implementation of this inquiry curriculum had on the teacher and the students involved.

2. Theoretical background

Inquiry-based learning is considered at European level as the main pedagogical approach through which to improve the quality of science teaching and consequently increase the number of scientific graduates (Rocard et al., 2007). Inquiry-based science education is an approach to teaching and learning science that has evolved from researchers’ understanding of how children learn, the nature of science inquiry, while also covering basic science content to be taught (Artigue et al., 2010).

Inquiry is not just about motivating children by engaging them in hands-on activities (Finley & Pocoví, 2000; Míñstrell & van Zee, 2000; Wheeler, 2000). Inquiry is a state of mind referred to as “inquisitiveness” the eagerness to know “how” and “why”; and in part a skill that must be acquired through experience (Alberts, 2000). The main reason for teaching inquiry is to equip children with the necessary skills for problem-solving, to communicate their findings and be proficient in facing the modern world (Alberts, 2000). The key element is to allow time for children to engage in dialogue with the material world by observing, questioning, predicting, debating and reflecting on data evidence and make logical sense of their observations in a structured manner (National Research Council, NRC, 1996; Alberts, 2000; Wheeler, 2000; Crawford, 2009; Artigue et al., 2010).

The main aim of inquiry-based education is to develop students in becoming independent learners. Teachers must facilitate each individual learner to develop, articulate and refine their own ideas (Harlen & Allende, 2009). Through scientific inquiry children develop cognitive skills such as problem-solving skills, skills to calculate and interpret data and investigative skills (Hanauer, Hatfull & Jacobs-Sera, 2009). Children inquire by engaging with scientific phenomena, posing questions to be investigated, hypothesising, planning and designing investigations, predicting experimental results, evaluating their findings, and then presenting results either visually, as in graphs or diagrams, or verbally or both. Children may then pose new questions to investigate other inquiries.

Different forms of inquiry can be organised in classrooms. Inquiry can be teacher-directed where the question is set by the teacher. The purpose is for the children to acquaint themselves with the process of inquiry rather than following their interests. Although teacher-led, children are expected to use problem-solving skills, as well as other skills to manage the investigation. On the other hand, inquiry can be more open, allowing children to identify what questions to ask and which phenomena to inquire about. Ideally this level of inquiry is to be approached following a guided approach so that children acquire an understanding of what doing scientific inquiry entails. Free inquiry is thus more directed towards authentic scientific inquiry (Chinn & Malhotra, 2002).

The key element of teaching science as inquiry is allowing the students time and space to dialogue and debate on data evidence, in order to make sense of their observations in a logical manner (National Research Council (NRC), 1996; Alberts, 2000; Crawford, 2009). The key to inquiry is for children to be engaged through minds-on
activities and engage in dialogue with the material world by observing, questioning, predicting, reflecting and devising the next step forward (Wheeler, 2000; Artigue et al., 2010).

Inquiry-based teaching and learning is not, however, without criticism in literature (Kirschner, Sweller & Clark, 2006; Santrock, 2001). It is argued that in inquiry-based learning children do not acquire adequate content-knowledge to carry out investigations; there is limited time for planning and carrying out investigations, as well as challenges related to classroom management (Witt & Ulmer, 2010). Despite the perceived advantage of inquiry-based learning, it still faces many challenges which need to be addressed if science education is to be reformed.

3. The aims of the research

As has already been highlighted, the study reported here makes part of a larger research. The curriculum that was designed had particular features in the way it was written which was believed to promote better the implementation of inquiry-based learning methods in primary science. The format and structure of the curriculum which was drawn up was different from the traditional approach. Instead of identifying the science content to be covered, this curriculum was described in terms of competencies that the children were to develop. These competencies were then characterized by learning outcomes in terms of skills and knowledge (an example provided in table 1 further on). This model follows the way in which occupational standards are described in Malta. The evaluation of this curriculum format by teachers will not be described here. This paper, instead, reports the results of the evaluation of the implementation of part of this curriculum with one particular primary class. This was the class taught by the researcher and involved 9-10 year old students. The aim of the study was to test how much this curriculum facilitated the implementation of inquiry as well as to identify what challenges the teacher and students had to face when doing inquiry. This paper focuses on insights obtained with respect to this latter aim. The research questions tackled were thus the following:

i. What was the impact of doing inquiry with children at primary level?
ii. What challenges did the teacher face in order to manage doing inquiry science?

4. The research methodology

The first part of the research methodology involves the description of the curriculum framework developed and which was then implemented and evaluated. The curriculum framework developed was based on the ‘meso’ and ‘micro’ levels of curriculum development (Thijs & van den Akker, 2009). The curriculum framework envisaged that children were to develop as inquirers and problem-solvers and thus nurtured the development of investigative skills. The content-knowledge and cognitive abilities included were determined by international benchmarks in science and mathematics studies (OECD, 2013). The inquiry approach used reflected the approach highlighted in the current Vision for Science Education in Malta (Ministry of Education, Employment and the Family, 2011). Finally, the curriculum also took into consideration the materials and resources needed; the teacher’s role adopted to facilitate learning; grouping arrangements; where learning should take place; the time required for each activity as well as assessment criteria.

The curriculum framework, seen in Table 1, was drawn up in terms of competencies to be acquired, which are understood as the intertwining and application of skills, with a particular focus on inquiry skills, and content knowledge, to a new situation. The curriculum is also written in a learning outcomes approach which reflects the European trend in teaching and learning.
The science curriculum designed was divided into three strands: Life Processes and Living Things; Materials and their Properties; and Physical Properties, aligning it with the scientific strands for Integrated Science at secondary school. Five themes were eventually developed and which included: Diversity, Cycles, Systems, Energy and Forces. Each topic included the development of a number of competencies which were further divided into a number of skills and content knowledge components. Suggested inquiry activities and resources were also drawn up to support teachers and educators when planning for inquiry-based science activities.

A qualitative approach was used. The main research tools involved a teacher’s reflective journal which were based on her own observations of the children’s behaviour and performance during the activities as well as on reflections as a teacher implementing a new curriculum. In addition to this a number of interviews were conducted with the children at post-implementation stage. In order to facilitate the children’s responses during the interviews photographs of the inquiry investigations (the experiments organized excluding the children) were used to help the children relate to the situations being discussed and to facilitate the interviewing process with the children. Reflecting on the process and outcomes of the research is a critical component of design research (van den Akker, 2010). The reflective journal was thus also kept as part of the research data collected in order to facilitate reflexivity and transparency in the research process. The interviews were conducted with a number of children whose parents consented to participating in the research study. The interviews with the children were

Table 1: An example from the proposed science curriculum showing competencies, knowledge and skills

<table>
<thead>
<tr>
<th>Science Strand:</th>
<th>Theme:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life Processes and Living Things</td>
<td>Diversity</td>
</tr>
</tbody>
</table>

**Main Topic:** Surviving in the Desert

**Competencies:**
Children can identify characteristics in plants and animals which make them adapt to their environment. Children can identify problems in the desert in the desert environment and identify ways in which plants and animals adapt to survive.

<table>
<thead>
<tr>
<th>Knowledge</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Explain verbally the diverse ways plants and animals adapt to survive in harsh environments such as a desert (both cold and warm deserts)</td>
<td>• Research information about a plant or animal that lives in the desert and identify how it adapts to its environment</td>
</tr>
<tr>
<td>• Identify physical features of plants and animals which make them adapt to their environment (e.g. having big ears, long roots, thick succulent leaves)</td>
<td>• Investigate how a particular feature helps the plant or animal survive in its environment (e.g. investigating the relation between the rate of evaporation and the thickness of leaves; the length or structure of roots to reach water)</td>
</tr>
<tr>
<td>• Identify behaviour patterns in plants and animals which make them adapt to their environment (e.g. being nocturnal, camouflage, special seeds that ‘sleep’ during dry periods)</td>
<td>• Represent and communicate the findings</td>
</tr>
</tbody>
</table>

* Link to Social Studies 5.1.3’Id-Deżert kiesah u d-deżert shun’
based on a set of inquiry-based activities carried out in class and the photographs were used. The questions set aimed at identifying how much the children enjoyed and learned science, as well as their awareness of the inquiry-skills which they developed as a direct consequence of these inquiry activities. The interviews with the children were directed with only a few open-ended questions which were included to capture the children's view on learning science and inquiring about science phenomena. 15 children participated in the interviewing process. The interviews were held at the school library which was available at the time. The children were interviewed in pairs. Photographs of the inquiry activities already done were shown to the children before the interview commenced. This helped refresh the children's memory on what had been done in class. The Assistant Head of School acted as a critical friend to ensure that no child is pressured to respond to any questions which they did not wish to answer.

This research was conducted following ethics clearance from the University Research Ethics Committee (UREC). Consent from the parents allowing their children to participate in the research study and to be interviewed was obtained.

5. The research findings

The implementation of the inquiry curriculum was evaluated in terms of a number of design principles that were used for the design of the framework. These design principles had been identified based on the work on curriculum design by Van Den Akker (2003, 2010) and included the following aspects related to inquiry: engagement; children asking questions; conducting research; materials and resources required; grouping; time; content knowledge; and assessment. The implementation of the curriculum was evaluated with respect to these aspects to inquiry.

5.1 Active Engagement

The children were actively engaged during most of the inquiry activities done. The children found most of the science topics presented appealing and raised their interest and curiosity. This was evident in the degree to which they were involved in planning and carrying out the inquiry activities. All children succeeded in completing the investigations and showed evidence of being engaged cognitively through the questions asked. In one interview, one child indicated that he would like to follow similar activities because it was easy to remember things done during the science lesson. Understanding is easier to acquire and knowledge can be better retained when children are actively engaged in learning.

5.2 Asking questions

Inquiry involves children asking questions and this was the primary focus of the inquiry activities presented. Children showed interest and asked questions during all the activities. They also acknowledged the value of asking questions in science as the quotations from the interviews highlight.

**Teacher:** Why do you think questions are important?

**Child D:** Miss, questions are important because...and there is an expression in Maltese...the question is the sister of knowledge [literal translation – meaning if you ask you will acquire knowledge]...

**Teacher:** True.

**Child D:** When you ask, you get to know something new and if you don't ask, you won't know.

**Teacher:** Do you think that the science activities encouraged you to ask more questions?
Child D: Yes because you learn a lot during the science activities and you become more curious.

Teacher: So the more you ask the more curious you are [smiles].

Child D: And the more you get to know the more curious you are. For example when you told us about the moon...first we ask questions, then we get to know more about the questions towards the end of the lesson...that's how you get curious. And I got to know many things from my book [referring to a science book].

Children were very curious and always wanted to know more. The inquiry activities encouraged them to ask more questions. During the inquiry activities children gained confidence in asking investigative questions. It has to be pointed out that when the children wanted to know more they extended the activity and rendered it time consuming. This is reflected in the researcher's reflection.

Researcher's reflective journal:

[Inquiry: Surviving in the Desert] Although the children were engaged, I could feel that the lesson dragged on quite a while since the children asked endless questions and the process of concluding the investigation took quite some time. Although the process was time consuming, I was very satisfied seeing the children discussing and planning in groups, observing and asking relevant questions, making predictions and feeling excited when they discovered something particular about their plant.

![Figure 1: Materials used during investigations](image-url)
5.3 Conducting research

Research is an important component of inquiry. Inquiry questions which could not be investigated through hands-on activities were researched and presented to the class. A number of the inquiry activities were designed such that inquiry could also be carried out through desk research and used to support evidence gathered. As their teacher observed, the children were very eager to get resources from home such as books, a globe of the world to locate the hot and cold deserts for example and other objects required for the investigations. Children also shared information with the class, and in one of the interviews one child actually mentioned the importance of sharing knowledge with others. When children obtained information, a variety of resources were consulted, to ensure that their findings were valid.

5.4 Materials and resources

Materials used for investigations seen in Figure 1 were mostly easily accessible or were recycled objects. Children were asked to bring most of the things required for the investigation. This facilitated the teacher’s work who did not need to find all the resources. Since the experiments were done in groups, less material was needed. During the interviews, some children claimed to have tried the experiments at home. This was plausible since the materials used during the investigations could be easily found. It was thus easy for the children to experiment at home and observe what happens. This effectively extended their learning time beyond school hours. During the interviews, some children claimed to have tried the experiments at home. This was plausible since the materials used during the investigations could be easily found. It was thus easy for the children to experiment at home and observe what happens. This effectively extended their learning time beyond school hours.

5.5 Grouping

Collaborative group work is an important aspect of inquiry-based learning and something which children appreciate most. The children stated that they enjoyed working as a group. Part of the science activities involved children working on an investigation with their friends as highlighted in the following quotation from the children’s interviews.

Child A: Yes, we had a pleasant experience and we worked as a team and when we work together we do things quicker and we enjoyed it more than if we work on our own.

Child B: Yes because we worked as a team and shared our opinions... and we get to know each other more.

Working with others was not always plain sailing and children had to deal with disagreements, tolerate different opinions and resolve differences. Children were assigned different roles such as ‘leader’, ‘in charge of apparatus’ etc. and this helped group members to work effectively as a team. Sharing of resources was also an important aspect of collaborative group work. Reflecting on how they worked as a group and how they could improve the way they worked together was very beneficial to the group. Their ability to reflect on how the group functioned made them aware of certain issues which could be avoided or better tackled another time.

5.6 Time doing science

Although most of the learning was initiated during the science lesson, children learnt a lot and acquired observation skills during educational outings such as doing fieldwork, visiting nature reserves and also during pottery sessions. Such outings did not always take on an inquiry-based approach. However, emphasis was made on observation which is the most important inquiry skill to determine what is important to observe. Children were also guided to learn about what to focus on. Learning was not restricted to the science lesson but children were ‘talking science’ outside the actual science lesson as they discussed the investigations carried out and looked up information or wrote about it during their free time.
Doing inquiry is time consuming. This was acknowledged in the researcher’s reflective journals.

**Researcher’s reflective journal:**

*[Inquiry: The Solar System]* Children showed interest and curiosity on the topic as seen from the questions asked. I also realised that I could not dedicate one lesson on this topic, but more time would be needed to talk about the moon and address their questions. It wasn’t something that could be hurried up if real learning was to take place.

*[Inquiry: Surviving in the Desert]* Although the process was time consuming, I was very satisfied seeing the children discussing and planning in groups, observing and asking relevant questions, making predictions and feeling excited when they discovered something particular about their plant.

*[Inquiry: Rocks, Minerals, Sand and Soil]* Due to time constraints, I decided to leave out the second activity on the use of rocks in everyday life since we were going on an outing to Alka Ceramics for a pottery session...Instead of doing the second activity on the use of rocks, I gave the children a few websites and asked them to browse through the websites with online games on the use of rocks. They could do this at their own leisure, either at home or at school. However, less time was taken to conduct investigations once the children got used to working collaboratively as a group and got more accustomed to the process of doing inquiry.

### 5.7 Content knowledge

When the children were asked about what they like about learning science, most children commented on the fact that science is part of their everyday life and that science teaches us things which we are not always aware of. This is seen in the following excerpts from the children's interviews.

**Child B:** The science activities are like...we don’t realise we’re doing science...they are everyday activities...like breathing...you must know how breathing takes place.

**Child A:** The solar system...how it works...we learned that through science.

**Teacher:** What do you like about learning science?

**Child D:** I learn a lot of different things which are important.

**Teacher:** Why?

**Child D:** They are linked to our life...rocks...there are different types of rocks and you wouldn’t know about them...I didn’t know this and all the things about the earth...I thought rocks come [from nowhere]...

Children’s active engagement in the inquiry process results in developing a deeper understanding of content knowledge and it is more likely that such knowledge is retained. Other children commented on the fact that asking questions is important to acquire knowledge. Although children cannot yet relate science to scientific literacy, one child stated that scientific knowledge is important to help us make decisions in the future.

### 5.8 Assessment

Assessment can take place in different forms during the inquiry process. Children were assessed when they planned a well-balanced three-day plan; during ‘Healthy Fridays’ when they talked about their well-balanced lunches; when they presented the conclusions of their investigations to the class; when they asked questions...
Implementing a science curriculum reflecting an inquiry-based approach in the Upper Primary years

during investigations and also while reflecting on their learning experience. An ‘Inquiry Process Checklist’ was also formulated to further assess how much children learned through inquiry. This proved to be beneficial for the teacher to keep focused on all the phases of doing inquiry. The inquiry checklist was also given to the children as success criteria at a later stage. If children are aware of the inquiry process, they are more likely to assess themselves and their peers against the identified learning outcomes. The aim of inquiry-based learning is to promote self-regulation and autonomy.

5.9 Preferred science activity

All children claimed that they enjoyed the inquiry activities during the science lessons from the topics covered during the implementation exercise. The topics covered were various and included: keeping healthy which included aspects such as healthy eating; the solar system considering the different planets and their properties; rocks, minerals, sand and soil and their properties; surviving in the desert which tackled issues such as water retention properties; as well as pushes and pulls and their application to everyday life. Children were asked which activity they preferred best from these topics as depicted in Figure 2.

It is evident that over half of the children claimed that they preferred inquiring most on forces by investigating parachutes. This was mainly due to the children relating and enjoying the parachute activity inquiring properties of air resistance. Table 2 summarises the children’s reasons for their preferred topic. However, it can be noted that all the reasons provided demonstrate the children’s involvement with the topic of the inquiries tackled. Data gathered from the implementation process showed that children were actively engaged in the learning process since the inquiry activities were authentic and relevant to their own experiences. Children acknowledged the fact that the activities aroused their curiosity on the topic. Knowledge and understanding were acquired, when children were engaged in hands-on and minds-on activities. These also tie in with the learning outcomes proposed in the vision document. Children’s acquisition of inquiry skills, as the ones in the proposed activities, encourages autonomy and independent learning. This is the key to progressing as lifelong learners.
6. Discussion

This study has shown the degree to which primary students can be engaged in inquiry. The students gradually became accustomed to asking questions and searching for answers through experiments and research which were then used to draw conclusion. This study provides yet another argument in favour of inquiry as the right tool for teaching and learning science even at primary level. The children were observed to gradually acquire both skills and content knowledge through authentic inquiry science activities. In turn, this slowly lead to the acquisition of competencies which hopefully will enable children to become scientifically literate citizens and mature into lifelong learners.

This study further supports educators’ emphasis that inquiry-based learning should be encouraged as from the early years of schooling and across the curriculum (Rorty, 1998; Johnston et al., 2010; Gatt et al., 2014). Like other similar research (Tytler, 2007; Gatt et al., 2014) this study has also shown that inquiry-based science education increases children's interest and attainment levels, while stimulating teacher motivation. Curiosity and inquisitiveness are skills which are very much valued in children. Primary science should therefore aim to encourage children to ask questions, observe and inquire about the world around them (Ministry of Education, Employment and the Family, 2011; Martin, 2012).

The students expressed how they enjoyed the activities while they concurrently developed a new attitude to learning: through asking questions and varying investigations to try and find answers to their questions. Besides enjoying themselves, inquiry-based learning can also have the potential of developing future scientists while at the same time be accessible to all children (Tytler, 2007; Harlen, 2012) since the competencies developed are relevant to scientists’ work as well as to normal citizens. The problem-solving skills observed also serve to equip children with the inquiry and problem-solving skills necessary to engage in a knowledge-based society (Alberts,

### Table 2: Children’s reasons for their preferred inquiry topic

<table>
<thead>
<tr>
<th>Main Topic</th>
<th>Reasons for preferred choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keeping Healthy</td>
<td>We learned how to keep healthy and fit</td>
</tr>
<tr>
<td>The Solar System</td>
<td>I found a lot of information</td>
</tr>
<tr>
<td>Rocks, Minerals, Sand and Soil</td>
<td>I liked using clay in the pottery session</td>
</tr>
<tr>
<td>Surviving in the Desert</td>
<td>Discovered new things I didn’t know (**)</td>
</tr>
<tr>
<td></td>
<td>Was interested to know the purpose of hair on plants</td>
</tr>
<tr>
<td></td>
<td>Liked how people survive in the cold desert</td>
</tr>
<tr>
<td>Pushes and Pulls</td>
<td>Learned new things about forces (**)</td>
</tr>
<tr>
<td></td>
<td>Made parachutes and tested them (****)</td>
</tr>
<tr>
<td></td>
<td>It was fun seeing the parachutes fall</td>
</tr>
<tr>
<td></td>
<td>I learnt how to make a parachute and tried it at home</td>
</tr>
<tr>
<td></td>
<td>All parachutes were different</td>
</tr>
<tr>
<td></td>
<td>Working together as a group</td>
</tr>
</tbody>
</table>

(*) indicates multiple frequency of choice
Implementing a science curriculum reflecting an inquiry-based approach in the Upper Primary years

Inquiry-based learning in science should be the cornerstone of doing science in the primary (Osborne & Dillon, 2008; Harlen, 2012; Mullis, Martin, Foy & Stanko, 2012; OECD, 2013). Inquiry-based learning is thus consistent with current views of how learning takes place since it involves children’s active engagement and promotes scientific literacy (Lane, 2011; Harlen, 2012).

The study has shown that the inquiry process requires time and should not be rushed if effective learning is to take place as the children still needed more practice and time to develop efficient inquiry skills. Children should be given enough time to pose questions, plan investigations as a group, carry out the investigation, collect data, discuss results and present their findings. Reflecting on the learning experience is also important in doing inquiry (NRC, 1996; Alberts, 2000; Crawford, 2009). Through scientific inquiry children can acquire skills and content knowledge to become competent learners and be able to apply such competencies to other problem-solving situations (Tytler, 2007; Säävälä, 2008; Georgescu, Male, & Stabback, 2011; NCFHE, 2013). In this light, it is evident that inquiry-based learning promotes lifelong learning (Harlen, 2012).

The study shows how inquiry poses challenges also to the teacher. One of the challenges involves access to adequate materials and pedagogical resources. These resources should be provided in addition to the basic curriculum to ensure its effectiveness in the implementation process (Van Den Akker, 2003, 2010). Another challenge experienced was of pedagogical nature. In implementing this new approach it is difficult to refrain from providing the correct answer and instead to promote further reflection on the evidence obtained in order to draw conclusions. Thus teachers too need time and practice to be able to fully adopt such a pedagogical approach and make it part of their everyday teaching.

The study has also shown how assessment measures with regards to primary science need to complement the pedagogy adopted for doing science (Pataray-Ching & Roberson, 2002; Burris & Garton, 2007). Formative assessment can guide scientific inquiry. Student portfolios depicting the child’s work during scientific investigations, self and peer-assessment and an inquiry checklist should constitute such formative assessment (Marsh, 2004; Ministry of Education, Employment and the Family, 2011).

7. Conclusion

The insights acquired from implementing the inquiry activities show that the proposed inquiry activities stimulate the development of problem-solving skills as inquiry skills are applied in the authentic activities (Krugly-Smolska & Taylor, 2004; Bybee, 2005). Children owned the inquiry question as they planned, gathered evidence, evaluated that evidence, discussed with peers and answered the inquiry question/s. Such active engagement in the inquiry process also led to a better understanding of scientific content knowledge, as was highlighted in the children’s interviews. Data gathered from the implementation process showed that children were actively engaged in the learning process since the inquiry activities were authentic and relevant to their own experiences. The choice of topic and inquiry pedagogy used appealed to the children as they acknowledged that the activities aroused their curiosity on the topic. Children may not have become proficient in inquiry skills due to the limited time available for the implementation phase. However, they achieved a lot during inquiry activities to clearly indicate that if such an approach is initiated from early years upwards and throughout the year, then children would make a leap forward in achieving autonomy and self-regulated learning - the key to progressing as lifelong learners.
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References


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