Using Discovery Learning Pedagogies to Develop Science Capabilities in New Entrant and Year One Students

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CHRISTIE ORR
School of Education
Auckland University of Technology

ABSTRACT

This inquiry explored the use of discovery pedagogies inspired by the Reggio Emilia philosophy to evaluate their ability to develop science capabilities in new entrant and year one students, and the influence of these pedagogies on the engagement of priority learners. The study followed the teaching as inquiry model. The chosen intervention for this inquiry was allocation for Discovery Time which involved the implementation of a 15-20 minute session with the whole class using the 'I see, I think, I wonder' technique, and specific teacher questioning to encourage students to make careful observations and thoughtful interpretations and stimulate curiosity to set the stage for inquiry. It was found that for this procedure to develop student's science capabilities, their questions and inquiries of interest needed to be taken into a deeper context of learning beyond the Discovery Time intervention if students were to fully engage with science and the science capabilities. The research found that discovery learning pedagogies complement the development of science capabilities in new entrant and year one students, and have a positive corresponding impact on the behavioural, emotional and cognitive engagement of priority learners.

FOCUSING THE INQUIRY

The science component of the New Zealand Curriculum (Ministry of Education, 2007) has recently undergone reform to represent a future-oriented school science curriculum. With this shift in focus, the Nature of Science has been developed as the core strand. Thus, experienced practitioners are still learning the pedagogical content knowledge of this curriculum I saw an opportunity to generate deeper understandings of this curriculum, and to consider how discovery pedagogies inspired by Reggio Emilia philosophy could contribute to deeper learning in science education. This would enable me to implement a coherent science curriculum and discovery inquiry pedagogies in my classroom, to meet the needs of my students and uphold the vision of developing "confident, connected and lifelong learners" (2007, p. 8).

There is value in engaging students with science in the early stages of education, and learning about natural science is crucial to early education (Conezio & French, 2002). Additionally, an effective science curriculum can develop young children's understandings about the world alongside their cognitive, social, emotional and language development (2002). As inquiry is embedded in Reggio pedagogies, these pedagogies will be harmonious with science curriculum goals.

The Nature of Science (NOS) strand aims to develop ideas about what science *is* and what it can and cannot do (Bull, Joyce, Spiller & Hipkins, 2010). With this shift in the focus from a content based curriculum, five basic science capabilities have been developed from the NOS research. These describe what capabilities contribute to a functional knowledge of science (Ministry of Education, 2016). As these are recent changes to the curriculum, there is still little research that supports practitioners to understand why the capabilities were developed, what they are supposed to do in terms of teaching and learning, how they are put into practice and how they fit in with the current New Zealand Curriculum key competencies. Thus, my inquiry intends to fit into this gap in research.

TEACHING INQUIRY: LITERATURE REVIEW

Scientifically Literate Citizens

The science learning area in the New Zealand Curriculum promotes the idea of developing citizenship capabilities: “In science, students explore how both the natural physical world and science itself work so that they can participate as critical, informed and responsible citizens in a society in which science plays a significant role” (Ministry of Education, 2007, p.17). Hipkins (2014) has explained how the science capabilities are vital to achieving this goal. For students to engage critically with science, requires them to have functional knowledge of science, to be able to say what science is, its strengths and weaknesses, and ask questions about science issues (Ministry of Education, 2016). Through the science capabilities, students can practice these types of thinking, questioning, and actions that are needed to become informed citizens.

Vygotskian theory suggests that young children be given opportunities to theorise on natural phenomena in order to develop scientific thinking skills (Inan, Trundle, & Kantor, 2010). This entails children generating explanations of phenomena which are consistent with their observations. If given the appropriate set of conditions, children’s reasoning skills can be developed to a high level (Murphy, Bianchi, Mcullagh & Kerr, 2013). The call to develop the science capabilities does not mean knowledge is no longer important. Capabilities combine knowledge with skills, and values with attitudes (Bull, Joyce & Hipkins, 2014). Research in cognitive science shows that skills and knowledge are bound together: you need something to think with, and knowing things makes it easier to learn new things (2014). The concept of the capabilities starts from the premise that there are fundamental things that people need, in order to be able to access to make the most of new opportunities (2014).

A few unrelated experiences in school science experiments will not be enough to critically engage with science. Capability-building requires several related experiences over time that make a powerful impression on students (Hipkins, 2014).

Reggio and Discovery Learning Pedagogies

Discovery learning most commonly refers to a way of learning in which students are exposed to questions and experiences (provocations) in such a way that they ‘discover’ for themselves the predetermined concepts (Hammer, 1997). Cook, Goodman & Schulz (2011) suggested that learners discover action possibilities in the environment through exploration and discovery learning. For instance, toddlers inspect the length and ends of rakes when they need a tool to reach a distant object, and the rigidity of handrails when they need to cross narrow bridges. Preschoolers can draw accurate inferences not only from observed evidence, but also from evidence they generate (by chance) in exploratory play.

The school in which this inquiry is situated is inspired by Reggio Emilia philosophy. In Reggio, there is no predetermined curriculum. Children’s learning is developed through their involvement in long-and short term projects which develop out of first hand experiences and their theories about the world (Thornton & Bruton, 2015).

All teaching, like all learning, involves discovery. What distinguishes these practices is a stance of inquiry whereby teacher discovery plays a central, essential role in shaping the substance and form of the course. Curriculum is thus not pre-determined; it is largely discovered and emergent (Hammer, 1997). In relation to the curriculum area of science, teaching must be flexible and responsive to addressing diversity in all children. Different culture groups have different learning experiences. The Reggio Emilia philosophy is grounded in inquiry, encourages learning through play and supports a social-constructivist approach to teaching and learning, embracing Vygotskian theories. Reggio has many connections with the early childhood curriculum which advises against uniform strategies. Thus, science in a Reggio context will adapt to students’ interests, inquiry and culture (Inan et al., 2010).

Through exploration, children learn useful and appropriate ways to find out what they want to know and begin to understand their own individual ways of learning and being creative. These experiences enhance the child’s sense of self-worth, identity, confidence and enjoyment. Exploration involves actively learning with others as well as independently, and helps to extend children’s purposeful and enjoyable relationships (Ministry of Education, 1996).

From a view of teaching as discovery, the class is an arena for teacher exploration of students' participation, knowledge, and reasoning, and what the teacher finds in that exploration informs her or his sense of the objectives and how they might be achieved (Hammer, 1997). Rather than keeping students on track and making appropriate discoveries on a designated schedule, the teacher's responsibility is to ascertain what they are discovering and to judge how to proceed (Hammer, 1997).

Increasing Engagement for Higher Achievement

Engagement in learning is an important theoretical and practical foundation for the promotion of academic achievement (Chase, Hilliard, Geldof, Warren & Lerner, 2014). Dotterer & Lowe (2011) found that classroom engagement is an important component of students’ school experience because of the correlation with achievement. Student involvement theory claims that engaged students will have increased learning over students that are less engaged (Lewis, Freed, Heller & Burch, 2015). Astin (1999) characterised the theory as “referring to the quantity and quality of the physical and psychological energy that students invest in the classroom experience” (p. 518). In other words, the greater the student's involvement, or engagement, the greater the amount of learning and personal development (Lewis et al., 2015).

Fredricks, Blumenfeld and Paris (2004) identified three discrete dimensions: behavioural engagement, emotional engagement and cognitive engagement. Each exists as a continuum of possible responses from compliance in response to extrinsic factors, to deep intrinsic engagement with learning for its own sake: students show they are behaviourally engaged by being involved and participating. This engagement is more likely to be extrinsically motivated when the student is mainly responding to input (e.g. from the teacher or a ‘fun’ activity).

Behavioural signs of more intrinsic engagement include autonomous and self-regulated participation. Evident interest and enjoyment are indicators of emotional engagement. Again this can be in response to extrinsic factors but becomes more internally motivated when the learning is valued by the student as worthwhile and/or challenging and therefore worthy of their personal effort and attention. Cognitive engagement at a surface level occurs when students show what they have learned, when requested to do so, via a task shaped by someone else (i.e. learning as a performance). As cognitive engagement deepens, they are more likely to want to demonstrate deeper thinking and they may choose to use metacognitive strategies such as goal setting, study strategies, setting and solving own problems and challenges (Hipkins, 2014).

THE INQUIRY APPROACH, THE INTERVENTION AND DATA COLLECTION METHODS

My research follows the teaching as inquiry model which is a process that involves teachers identifying the goals they want their students to achieve and then determining the knowledge or skills students require. Next, teachers evaluate the impact of their current teaching strategies and determine alternative interventions which may have a positive effect on both the students' learning and their own teaching practice. Following the implementation of the chosen intervention, teachers complete the inquiry process by gathering evidence on how beneficial these interventions were for students' learning (Ministry of Education, 2009).

The data collection approach of this research is qualitative (observations and documentation), as I believe this was the best method to use to gather an in-depth understanding of student behaviour. I also followed a reflective process in which:

- reflections were consistently made throughout the duration of the inquiry process,
- students were formatively assessed against the dimensions of engagement (Fredricks et al., 2004. See [Figure 2])

- and against the Criteria for developing Science Capabilities [Figure 1].

This intervention provided an opportunity for students to be able to show what they know, can do and are willing to be engaged with (Bull et al., 2014). During the intervention, my role was to carefully listen to what students said, watch what they did, and monitor their ability to use their science knowledge and skills.

DEVELOPING THE INTERVENTION

Intervention: Discovery Time.

For the purpose of this inquiry, I selected a group of priority students because they were identified as students least engaged with their learning, who would often lose focus and go off task. Therefore, in this inquiry I looked specifically at four students with these characteristics to see if their engagement with learning improved through the use of discovery pedagogies. I intended to report on the development of science capabilities of all learners in the classroom. My rationale for this is that in a new entrant/year one mixed class, students are still being classified as to whether they are below, at, or above standard, thus they are all priority learners.

I implemented a 15-20 minute 'Discovery time' session with the whole class using the *'I see, I think, I wonder'* technique. Teacher questioning encouraged students to make careful observations and thoughtful interpretations and stimulated their curiosity to set the stage for inquiry. Using '*I see, I think, I wonder'* enabled students to explain their inferences and to express their imaginative thoughts or *wonderings* they had about the subject matter, which prompted further inquiries. It also set the stage for students to exemplify the science capabilities of *gathering and interpreting data, using evidence to support ideas* and *engaging with science*.

To begin these sessions, a randomly chosen student would select an object from the classroom's discovery table. Choice engages the willingness of students, encouraging them to fully endorse what they are doing, drawing them into the activity and allowing them to feel a greater sense of purpose (Llewllyn, 2011). As students participated in the intervention, I observed and documented the engagement of the identified priority learners during the sessions. This engagement was assessed against the dimensions of student engagement (Fredricks, et al., 2004) and changes in behaviour were analysed over the duration of the intervention. In addition, all students in the class were formatively assessed against the Criteria for developing Science Capabilities.

From the original discovery time interventions, there was the opportunity to further explore the object or phenomena observed in discovery time through a more scientific lens in classroom experiments to answer some of the questions that arose from students' observations and inferences. These opportunities allowed for the observation of students exemplifying aspects of the deeper science capabilities including *critiquing evidence* and *making sense of representations about scientific ideas.*

DATA COLLECTION

For this research, qualitative methods (observations, documentation) were used. During the sessions, I noted students' observations, inferences, predictions, hypotheses and questions they had, for subsequent analysis after the sessions. Recorded student behaviour and interaction was evaluated against the Science Capability Development Criteria (Bull et al., 2014), to analyse how students were evidencing aspects of the science capabilities.

On a weekly basis, I observed and recorded the priority students engagement behaviours during discovery sessions to be able to reflect on their changes in engagement from before intervention implementation and post intervention implementation. These observations were compared against the dimensions of student engagement (Fredricks et al., 2004). Each of these exist as a continuum of possible responses.

	Student Behaviour
Gathering and interpreting data	● Makes careful observations ● Describes observations using objective language
Using evidence to support ideas	● Proposes explanations (I think because…) ● Understands that explanations can change when new evidence comes to light
Critiquing evidence	● Asks other students about what they think/found ● Suggests ways to strengthen investigations
Making sense of representations about scientific ideas	● Uses specific language to describe their observations and communicate ideas ● Makes sense of representations such as text types, models, diagrams etc.
Engaging with science	● Initiates discussions with 'wondering questions' ● Builds on others ideas ● Makes connections

Fig. 1:Discovery Time: Science Capability Development Criteria

ETHICAL CONSIDERATIONS

The first step was to inform my partnership school in which the inquiry was to be undertaken, and my Professional Learning Mentor, whose classroom would provide the environment for my inquiry. Informing the appropriate parties is important as I cannot conduct research in a school without permission.

The Principal and Professional Learning Mentor were provided with an information sheet which provided the purpose of the research, the process of the inquiry, and risks and benefits for the school. The names of the school, teachers or children would not be revealed. Pictures and videos of students were not be included in the reporting of my inquiry, however I was to gather qualitative data on student behaviours, and use examples of student questions and speech, in the context of the inquiry.

Behavioural Engagement	Emotional Engagement	Cognitive Engagement
● Participating and involved ● Responding to input from teacher or activity (extrinsic motivation) ● Self-regulated participation (intrinsic motivation)	● Evident interest and enjoyment (response to extrinsic motivation) ● Student puts in personal effort and attention	● Can show what they have learnt when asked to do so ● Show a *want* to demonstrate what they have learnt. ● Set themselves challenges for deeper thinking

Fig. 2: Dimensions of student engagement

As the participants are children, their vulnerability makes ethical consideration especially important. All practicable steps were taken to achieve informed consent.

THE LEARNING INQUIRY: FINDINGS AND DISCUSSION

The implementation of the discovery time intervention outlined above resulted in evidence of students showing considerable development of science capabilities, and subsidiary improvements in priority learners' behavioural, cognitive and emotional engagement in the classroom. The discussion of the development of science capabilities is relevant to whole class observations. Throughout this discussion, I have made links to how Reggio philosophy and Vygotskian theories are pillars in the development of the science capabilities with reference to experiences from the intervention. Levels of engagement as a result of this intervention are specific to the chosen priority learners who were identified as showing low levels of engagement in classroom activity.

Development of Science Capabilities

Gathering and interpreting data

Students showed evidence of gathering and interpreting data by making careful observations and describing them, and subsequently being able to make specific inferences from these observations. The discovery time intervention required students to engage in the act of observing and making meaning by using "*I see, I think, I wonder*". The *Gathering and Interpreting* capability reflects the idea that science knowledge is based on data derived from direct, or indirect, observations of the natural physical world (Ministry of Education, 2016). Students used a range of senses in their observations, which were also influenced by their prior knowledge.

Being able to interpret these observations allowed students to articulate their observations. For example, observations made from looking at a praying mantis by students included: "I can see body, legs and grass". This student was able to observe how the praying mantis was structured, as well as see that there was still some grass stuck to the insect, which could influence the student's inference of the praying mantis' habitat. Other observations recorded by students were similar in that the students could identify the different parts of the insect: "I can see legs, eyes and wings"; "I can see little eyes that look like a clear stick and wings that look like a spider's web."

To clearly state observations and understand the triggers that influence their thinking allows the student at this level to gain a minor insight about the logical processes of reasoning and thinking critically, which supports them on their journey to becoming scientifically literate and aligns with the purpose of the science curriculum vision. indicates that Reforms in science education that are influenced by Reggio philosophy emphasise science process skills such as observing and inference (Huffman, 2002). In this intervention, students are provided opportunities to enhance their science capabilities, while simultaneously learning about science content and concepts that apply to the subject matter of the specific discovery time intervention.

Using evidence to support ideas

Students they could use evidence to support ideas by making meaning and drawing inferences from their observations. In a particular discovery time intervention, the subject matter was inspired when a student's front tooth fell out. As a classroom, we decided use the tooth as the subject matter for the lesson. Having the students choose what object was to be investigated during discovery time interventions reflects the philosophy of Reggio Emilia in which teachers need to consider interests and questions that are personally relevant to the students as well as developmentally appropriate (Inan et al., 2010). Thus, in contrast to the more structured science curriculum, the Reggio approach focuses on students selecting the content for their own science education (2010).

During this intervention, students showed signs of using evidence to support ides. For example, when looking at the tooth, a student had observed the colour of the tooth, but also supported her idea by saying "I think teeth are made out of the same stuff as bones and that is why they are white." Using evidence to support ideas relates to science being empirical and measurable, meaning that scientific explanations are supported by hard data. Some students showed a better ability to use evidence to support their ideas than others. It was noticeable that some students were still reliant on their prior knowledge and what they already believed to be true to support their ideas. For example "I think if we don't brush our teeth they will go yellow" but this student was unable to explain what it was that had given him that idea.

Overall, I found that framing the task using "I see, I think, I wonder" was an effective way to get students beginning to explain the thinking behind their ideas and begin to develop their metacognitive awareness by getting them to think about their thinking. Developing an appreciation of what counts as evidence in science supports students to become scientifically literate.

Critiquing evidence

By encouraging students to think about their own ideas and discuss them with another student, supports the criteria key competencies of relating to others and participating and contributing. In Reggio-inspired classrooms that incorporate discovery learning pedagogies, teachers support and facilitate children to co-construct their knowledge through personal relationships with other students and teachers (Rinaldi, 1993). Critiquing evidence requires students to ask questions and discuss ideas with others, representing the Vygotskian theme of social-constructivism in the classroom.

Making sense of representations about scientific ideas

Throughout the implementation of the intervention, students developed their ability to be able to make clear statements of their observations and began to use more scientific language. Furthermore, over the duration of the intervention, students became more coherent in communicating their inferences from their observations. Vygotsky was interested in the relationship between language and cognitive development (Thornton & Brunton, 2015). Malaguzzi (1998) also stressed the importance of language stating, ‘‘Vygotsky reminds us how thought and language are operative together to form ideas and to make a plan for action, and then for executing, controlling, describing, and discussing that action. This is a precious insight for education’’ (p. 83). Conflict, discussion, and negotiation are frequent and supported in Reggio-inspired classrooms because these are considered driving forces for growth (Rinaldi, 1993).

Students had different ideas about various experiments which were discussed and the way the experiment were conducted were negotiated Vygotsky’s focus on social interaction suggests that students should be encouraged to interact, discuss, and argue with each other and with adults (Inan et al., 2010). This is represented in Reggio classes when strong relationships between students and teachers are established. Furthermore, being able to interpret results of experiments showed that students were capable of making sense of representations about scientific ideas. Students build their scientific literacy when they can understand the role that models can play in conveying science explanations.

Engaging with science

Engaging with science requires students to use all their capabilities together to engage with science in real life contexts. This requires students to develop the ability to carefully observe information and draw on prior knowledge and beliefs to make their own judgements and interpretations. They will also learn to be critical of information to make informed decisions. Beginning by developing the science capabilities at this level sets students up to be able to participate in discussions about science and at times, take action. As students were observing, making inferences, discussing ideas with others, making predictions and checking results and discussing those results in the various experiences initiated by the discovery time intervention, they were all showing a developing capability of *engaging with science*.

Behavioural, emotional and cognitive engagement

Prior to the implementation of the intervention, I observed the engagement behaviours of four identified priority students against the dimensions of student engagement (Fredricks et al., 2004). During the interventions I observed how each of these students showed aspects of behavioural, emotional and cognitive engagement. The purpose of looking for how engaged and involved priority students were in the discovery time interventions was based on the rationale that the greater the student's involvement, or engagement, the greater the amount of learning and personal development (Lewis et al., 2015). In a new entrant and year one classroom, teachers are putting in place the building blocks and groundwork to support students' later learning and personal development.

Overall, priority students' behavioural engagement showed slight increases. Behavioural engagement refers to students' participating and being involved in the classroom. Student A displayed high behavioural engagement when the object of interest in the discovery time intervention was personally relevant to him, for example, the human tooth we inquired into belonged to this student. In every intervention the student was eager to share ideas and contribute to discussions. The student showed enjoyment in the learning, but often went off on a tangent into unrelated topics when asked to articulate learning, which reflects a low level of cognitive engagement.

This student showed an increase in emotional engagement when sharing his own ideas but lacked the ability to listen to others or to be engaged when others were sharing. When asked to complete a reflection exercise on a science experiment in which the student was behaviourally and emotionally engaged, the student did not want to participate in writing down what he had learnt, but he could articulate orally what he had taken away from the experience. I found this interesting as the student showed high aspects of science capabilities and higher levels of engagement during science based and hands-on learning, but became less engaged in literacy-based activities.

Prior to the intervention, I observed that student B, C and D were all easily distracted either by other students, or objects around them, and would easily lose focus, especially when on the mat. Student B shows low emotional engagement to tasks but will participate when told to, and in some discovery time interventions, this student showed enthusiasm to contribute and participate in the learning with his peers. He shared ideas and showed aspects of developing science capabilities, namely gathering and interpreting data. Unlike Student A, Student B shows higher engagement in literacy activities and therefore showed cognitive engagement when being able to complete the reflection task on the science experiment and was somewhat able to clearly articulate learning from the inquiry.

Student C was a concern because he showed signs of very low emotional engagement and low willingness to interact with his own learning. This student is one of the youngest in the class (new entrant) and is easily distracted on the mat, meaning that as the facilitator in these interventions I needed to be aware of this student and to probe him to share ideas. The student however often replied with a shrug of the shoulders or a simple "I don't know". The student did show minor improvements in engagement. At the beginning of the discovery time interventions, Student C was behaviourally engaged and was observant of the subject matter in each intervention, however this did not always last long. The student shared some ideas of wondering questions and inferences from observations when probed, showing small developments of science capabilities which set the foundation for capabilities to be further developed as the student progresses in his learning.

Finally, Student D was an interesting student to observe as he was an EAL student fully immersed in an English classroom. Again at the beginning of discovery time interventions the student would carefully observe the subject matter but due to lack of English vocabulary, had difficulty articulating inferences from his observations. During the interventions I did notice improved behavioural engagement as he listened to other students' contributions to the discussions which I believe have been beneficial to his developing English vocabulary. His language barriers could also influence his low engagement in usual classroom behaviour, as the lack of understanding when others are talking could mean that he chooses to not involve himself so much.

The use of think, pair, share was useful to combat this during the interventions as the student responds better to 1:1 interaction as opposed to sharing with the whole class. The student could reflect on his learning through drawings in the reflection task and talk to the drawing to explain what he had learnt which showed an indication of improved cognitive engagement.

IMPLICATIONS OF THE INQUIRY FOR PRACTICE: BENEFITS & LIMITATIONS

Limitations to this intervention are that the outcomes cannot be conclusive as science capabilities are continuously developing, especially in new entrant and year one students. What has been a beneficial outcome of the intervention is the affirmation that science capabilities can begin to be developed in the early years of school. In fact, students naturally show aspects of science capabilities such as observing and gathering information.

The classroom culture in which this intervention was situated in already had a Reggio Emilia philosophy, however I believe this intervention, using discovery learning pedagogies, could have been successful in any school in a junior classroom. There may, however, be limitations to how deep the students go with their inquiries in terms of how these can be integrated into other curriculum areas in a more structured school. For the development of science capabilities, I learnt that the intervention need not stop after the *discovery time* session using '*I see, I think, I wonder*'. For students to truly engage in all the capabilities, their inquiries and questions developed in the original discovery time intervention needed to be followed up for students to experiment and find answers to some of their questions. This meant that aspects of what students wanted to inquire or learn more about were integrated in other curriculum areas and extended into science experiments.

Additional benefits of the discovery time interventions were the increase of metacognitive awareness in students, as they began to think about their thinking they became able to carefully articulate their inferences and be able to state what made them think certain things. Secondly, students developed more confidence in their own ideas and being able to state their own thoughts and not just copy what others have said, or assimilate to thinking what they believe the teacher wants them to say or think. This creates true individuals who can have the confidence to question and draw their own informed conclusions to make decisions. Finally, it was noted that the intervention had a positive impact on priority learners' behavioural engagement and was inclusive of all learners.

CONCLUSION

The results of the implementation of this intervention showed that the development of science capabilities can happen anywhere in the classroom, so long as there is the allocation of time and opportunities for learners to explore and be discoverers and the nurturing of their natural curiosity about the world around them.

The learning that stemmed from the intervention was not planned, but found by the students and then integrated into the curriculum, thus the knowledge was co-constructed between the students and the teacher. The Reggio Emilia philosophy supports this learning and the results of this inquiry are indicative of how discovery pedagogies are effective tools in developing science capabilities in new entrant and year one students, and subsequently increasing engagement in priority learners. Discovery learning pedagogies generate science rich contexts of social constructivist and inquiry based learning where the students' prior knowledge and natural skills can be nourished. The discovery time intervention provided a domain where students could seek answers to their wondering questions and interests and learn about related content, as well as use science skills to simultaneously develop aspects of the science capabilities.

The discovery time interventions engaged children behaviourally, emotionally and cognitively as it created contexts in which students could conduct hands-on work using all their senses to observe subject matter and explore its characteristics, as well as engage their minds through asking questions and proposing theories. Thus, this intervention constitutes the learning of the whole child. Moreover, the intervention provided the students with a context in which their understandings could be developed and curiosity nurtured in a socially constructed classroom. I have learnt that scientific discoveries occur as part of children's everyday experiences and need to be encouraged. Student's interests were taken into consideration for the subject matter of the interventions, which led to more meaningful and engaging learning for all students.

The outcome of this intervention confirmed that discovery learning pedagogies, inspired by the Reggio Emilia philosophy, are grounded in inquiry and therefore evidently compatible with the goals of the New Zealand science curriculum of developing citizenship capabilities: "In science, students explore how both the natural physical world and science itself work so that they can participate as critical, informed and responsible citizens in a society in which science plays a significant role' (Ministry of Education, 2007, p. 17).

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