TE IHUWAKA | Education Evaluation Centre

Shining a Light on Science: Good Practice in Early Childhood Services

REPORT

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Introduction

Science matters in early childhood education

Children are curious by nature and demonstrate this through how they engage with the world. They are eager to explore, question, experiment, and learn about science through the play-based curriculum provided in early childhood contexts. A play-based approach builds on children's motivation to learn and provides opportunities for them to explore ideas, experiment, and express new ideas. When this occurs, benefits include children becoming better problem solvers and critical thinkers.[1]

Te Whāriki: He whāriki mātauranga mo ngā mokopuna o Aotearoa Early Childhood Curriculum *(Te Whāriki)*[2] informs and guides kaiako to develop their own emphases and priorities to reflect the prescribed curriculum framework.

Learning dispositions are tendencies to respond to a situation in a particular way. They are the result of knowledge, skills and attitudes combining, which develop over time.[3]

Working theories are constantly evolving ideas we hold about the world, formed through our experiences. As children's experiences of the world increase, their working theories become more sophisticated and informed.[4]

Science is integrated throughout Te Whāriki and is embedded in the concepts of learning dispositions and working theories. Kaiako draw on these early childhood curriculum considerations as they 'respond to the full breadth of each child's learning' inclusive of science.[5]

Choosing and sharing examples of good practice

This report is the companion report to: *Science in the Early Years: Early Childhood and Years 1-4*.[6] In the initial report, ERO explored how kaiako and teachers promoted children's development of the foundations for learning in science. The report highlighted the wide variety of understanding of science and accompanying teaching practice occurring across children's formative years.

To collect the data for this report, we:

- spoke to leaders and kaiako/teachers[a]
- analysed documents
- spoke with children, where possible, to understand how they were being prepared to be ongoing science learners.

The intent of this report is to gain a deeper insight and understanding of good practice in science teaching and learning in English-Medium early childhood education. It presents examples of good practice of science in the curriculum, from eight services identified during their ERO reviews. They were drawn from a range of service types in both rural and urban areas. ERO revisited these services in Term 1, 2020 and is grateful for the time and knowledge kaiako, parents/whānau and children shared so willingly. We anticipate that these practices and ideas could be used by other services.

There are five sections in this report, which consider science in early childhood through a range of perspectives. These include:

- leadership that encourages collaboration and improvement
- kaiako who are deliberate in their approach to supporting children
- bicultural practice
- learner-focused partnerships with parents, whānau and the community.

Under each section, case studies are used to illustrate science teaching and learning in the early childhood context.

As children's science interests deepen from focusing on the activity to engaging more in an inquiry or project-based focus, we have suggested how science teaching and learning can be extended, and complexity added over time.

> *A rich curriculum is one that provides opportunities for children to learn and experience a curriculum that extends and promotes their learning across the breadth and depth of Te Whāriki.*[7]

This report also reflects many of the conditions that contribute to high quality early childhood education. These include: leadership that fosters collaboration and improvement; partnership with parents and whānau; building a localised curriculum; and kaiako who are deliberate in their approach to supporting children to:

> *Learn how to learn, so they can engage with new contexts, opportunities and challenges with optimism and resourcefulness.*[8]

Deliberate teaching would include a focus on providing learning environments where inquiry is modelled, supporting children's oral language and encouraging children to revisit and reflect on their learning.

a *Te Whāriki* uses the term 'kaiako' to refer to all teachers, educators and other adults who have a responsibility for the care and education of children in an ECE setting (Ministry of Education, 2017. p. 7). In this report, we use 'kaiako' to refer to these adults in an early childhood setting, and 'teacher' to refer to educators in schools.

We have included a theoretical example of effective internal evaluation focused on science. Leaders and kaiako may like to use this to help frame up their own service's evaluation looking at how well they provide rich and responsive science curriculum.

Using this report

The examples of good practice show how science teaching and learning can build on children's motivation to explore, experiment, and learn. They shine a light on how science teaching and learning can be successfully integrated through a child-centred, play-based curriculum.

Across the case studies the following common points have emerged as contributing to good practice in science. These include leaders who:

- identify what learning is valued, supporting kaiako to promote that learning, and monitor that it is happening
- are knowledgeable and/or enthusiastic about science
- successfully lead evaluation for improvement

and kaiako who:

- actively encourage parent and whānau relationships focused on their child's learning
- are responsive to children's interests and, through intentional teaching practice, extend children's learning
- notice children's interests, recognise the significance, and respond to the learning opportunity
- provide a curriculum that has a breadth and depth of learning experiences that support and challenge learning
- offer a curriculum that increasingly includes te reo, tikanga and mātauranga Māori
- respond to children's questions and assist them to articulate and extend ideas
- draw on community expertise and resources to enrich the curriculum.

We encourage you to use the examples of practice to help you consider how you can apply these principles in your own service.

Teaching principles and examples of practice

Leadership good practice

Strategic leadership in early childhood education is about the ability to influence and mobilise others to strengthen their practice. Leaders are important in setting a clear direction to enhance medium and long-term success. A strategic leader aims to transform practice by developing a shared vision and purpose, planning for continuous improvement, and managing change effectively.

The following case study shows how strategic leadership led to a shared understanding about 'what matters here'[9] and guided the negotiation of local curriculum priorities related to science, within the *Te Whāriki* framework. The example also shows how this commitment is reflected 'in long-and medium-term planning as well as in day-to-day practice.'[10]

Clear direction and focus

Key actions

Setting the strategic direction

Providing professional learning opportunities for kaiako

Valuing evaluation for improvement

Establishing expectations to guide teaching practice

Case study 1: Strategic leadership

This education and care service has identified a strong commitment to integrating science throughout the curriculum. Their strategic plan sets a clear direction in continuing to build teacher knowledge and understanding of science in the curriculum. This clearly articulates a focus on enhancing the learning environment and providing provocation for science learning. Evaluating the effectiveness of science in the curriculum and using this to make ongoing improvements is an important part of the plan.

The centre's philosophy identifies what is important and what the service wants to achieve. Their centre philosophy states this about science:

> *Kaiako provide a science curriculum intentionally that is responsive to ngā tamariki's deep interest and promotes the learning of skills, knowledge and dispositions that enable ngā tamariki to think and investigate scientifically.*

Leaders developed a policy to foster an agreed approach to implementing science teaching and learning in the curriculum. The policy identifies how the environment, routines, intentional teaching, parents and whānau involvement, community resources, and a bicultural approach will be considered as the curriculum implement the agreed curriculum.

Supporting and monitoring expected practice	The enactment of the policy is monitored by the curriculum leader. This is done through observation and discussion. Professional readings and guidance are regularly shared with kaiako to build their knowledge and ongoing understanding of science in a play-based curriculum. Assessment documentation confirms how children's interest in science is observed and appropriately responded to over time.

What do we value here?

This example shows how the service set a clear direction and focus to achieve the organisational goal of promoting science teaching and learning. The best approach to achieving this goal and resource allocation was carefully considered.

Science is valued by this service and its community. The policy document outlines its value and puts into writing the expectations of kaiako in terms of science teaching and learning. Kaiako are supported to build their capability in noticing children's interest in science, recognising its significance, and responding to this learning to meet the intent of the policy.

The team shares the belief that working in this way contributes positively to the quality of the curriculum and is evident in how it builds their capability.

Leadership of teaching and learning

The role of the pedagogical leader is to build a cohesive team with a shared direction for improving outcomes for children. Pedagogical leadership is leadership 'focused on curriculum and pedagogy, rather than on management and administration'.[11] This involves supporting others to build and develop their professional knowledge and expertise to design and implement a responsive and rich curriculum for all children.[12]

The example below is from a national home-based education and care service where the visiting teachers are the pedagogical leaders. They provide professional guidance and feedback to the educators, supporting them in offering a learning programme that reflects *Te Whāriki* and is responsive to children's strengths, interests, and needs.[13] At times, the visiting teachers work alongside children and liaise with parents. The example below highlights the role of that pedagogical leader in promoting science in the curriculum.

Pedagogical leadership

Key actions

Working collaboratively to support the child's learning

Pedagogical leadership included modelling, drawing connections to science learning, and providing new curriculum content knowledge

Case study 2: Leadership focused on teaching and learning

During a visit to an educator's home, the visiting teacher observed a toddler using gloop. As the child explored the texture of the gloop the visiting teacher worked alongside her, modelling the use of rich language to describe how the gloop felt and the actions the child was making as she engaged in this sensory experience. As the gloop dried and hardened the visiting teacher then shared with the educator the connection between this experience and science.

In the assessment documentation that followed this visit, the visiting teacher wrote about the value of messy play and highlighted the link to science. She provided information about how and why the mixture solidified as it is squeezed and then seems to melt when released, introducing new scientific language.

What do we value here?

The visiting teacher noticed the teachable moment to deepen the child's learning in science. Through her teaching practice, and the resulting documentation, she has supported the educator to see how science can be integrated through the learning experience.

Teachers make a photographic record of assessment which is then used with children to discuss and reflect on their learning.

Kaiako good practice

The primary responsibility of the kaiako is to 'facilitate children's learning and development through thoughtful and intentional pedagogy'.[14] In a play-based curriculum and pedagogy, kaiako need to be able to integrate domain knowledge, such as science, and facilitate learning and development through a rich, responsive curriculum that all learners can experience.

The role of the kaiako in offering science in the curriculum is multifaceted. Provocation is often a starting point for science learning.[15] However, unless kaiako purposefully incorporate a science lens in their conversation that follows with children, science learning may not happen.[16]

Kaiako also use children's interests as a starting point to engage them and build on to deepen science learning. In early childhood the main science focus is on the natural world, including the environment and sustainability.[17] While these are appropriate areas for children to be learning through, this focus has the potential to narrow the view of science in the curriculum.

There are many opportunities in children's play and everyday experiences to explore the physical and material worlds.

What is important is that kaiako achieve 'a balance between teacher-led planned activities and child-initiated play activities in which teachers participate to extend children's learning'.[18]

Intentional teaching

The following case studies show kaiako demonstrating a range of intentional teaching strategies to engage children in science-based learning. They also show how learning can be enhanced when kaiako: notice children's interests that can link to science; recognise the significant science learning; and are deliberate in their response to broadening and deepening that learning. As a kaiako shared with ERO:

> *It is important to have educators who are enthusiastic about children's science-related learning and recognise the teachable moment.*

Exploring Bubbles

Key actions

- Beginning with a provocation
- Modelling and support
- Experimentation
- Encouraging observation

Case study 3: Exploring speed, force, and motion

During a home-based visit the visiting teacher observed Fran (a toddler) exploring some bubble mixture. Fran began by looking closely at how the wand held the bubble mixture. The educator then modelled how to blow gently through the eye of the bubble wand to create lots of tiny bubbles.

Fran, with the support of the educator, experimented with blowing bubbles and was delighted with the results. She enjoyed chasing and popping the bubbles and observing them as gravity made each bubble fall to the ground.

The resulting documentation from this visit identified the value of children engaging in science learning through exploration.

Adding further complexity to learning using a scientific lens could include:

- observing which surfaces bubbles are more likely to pop on, versus settle on, and investigating why
- exploring surface tension and properties by thinking about why bubble mixtures make bubbles and discovering other products that can be used to make bubbles
- identifying and experimenting with different kinds of force and motion to move an object e.g. a force that repels or attracts, gravity, pushing and pulling, friction, and acceleration.

Floating and sinking

Key actions	**Case study 4: Exploring floating, sinking density, and weight**
Following the child's interest	Objects that float or sink had been a topic of conversation in the kindergarten. Ana decided to bring her own objects to test. Sharing these rocks at 'show and tell', she explained the differences between them, one being heavy and the other light. Ana explained that the heavy rock would probably sink and after some further questioning about size, she decided the second rock would probably sink as well.
Questioning, hypothesising and testing ideas. Researching and reaching a conclusion	The kaiako suggested that they test out these hypotheses. They began by filling a large container with water and then lowered in the rocks. Down went the heavy rock and up went the lighter one. This was not what Ana thought would happen, so it was tested again. The same thing happened so they took a closer look at the light rock. They began to consider why that rock floated.
Encouraging observation	Lydia, who had been watching, suggested that this happened because when you scraped the floating rock it was like sand. Ana was not convinced and said, "but sand doesn't float". Testing this theory, some sand was put in the water which slowly sank to the bottom. It was clear this was not the answer.
Responding to questions and modelling curiosity	Taking a closer look at the rock, which they learnt was pumice, they found it had lots of tiny holes. Questioning if this might be why it floated, the kaiako engaged in further research with the girls to investigate why the pumice floated.
	They found that pumice was formed via volcanoes and starts out very hot but cools quickly. This means that lots of holes form which trap the air, and this helps to keep the pumice afloat.

Adding further complexity to learning using a scientific lens could include:

- exploring the concept of density by considering other objects that float or sink and why this occurs e.g. talking about volume and mass
- changing the surface area of an item to make heavier items float e.g. shaping a raft out of clay
- exploring the density of liquids and investigating why some objects float in some liquids and not others and why some liquids will float on others e.g. oil on water.

Using the language of science

The following examples show how kaiako used scientific language with children. We know that with good oral language skills children are more engaged in their learning. As a kaiako shared with ERO:

> *It's the richness of the language that is used which just pushes children a little bit further in their learning.*

Velocity and friction

Key actions	**Case study 5: Exploring velocity and friction**
Noticing children's interest and drawing on prior knowledge	A conversation about ramps occurred with a group of children in this education and care service. The kaiako explained that a ramp goes from one level to another and asked children if they knew of any ramps. Children offered suggestions drawing on their own knowledge such as skateboard ramps. This led to identifying the various ramps in the centre environment.
Testing out a theory	Finding a block shaped as a wedge they decided to test out if it went from one level to another by rolling a marble down the block, which went very well. They then tested a pen, and the children discovered that this did not work so well. They wondered why this had happened. They decided the "tab on the lid of the pen made it cranky".
Rich oral language based on scientific concepts	The group then tested how far the marble would roll using three then four wedged blocks. The kaiako introduced new terminology, such as velocity and hypothesis, explaining to children what these words meant. They carried out further testing of other ramps with different sized balls. Each member of the group hypothesised how far each ball would roll and they tested their hypotheses. There was some concern that the softball did not roll as far as they thought, and the children decided this was "because the softball was bumpy".
Revisiting the learning episode	This interest in ramps was extended a few days later by investigating friction and ramps. The children tested a range of objects and saw how easily they moved down the ramp. The kaiako then wrapped the ramp first in a blanket and then with a sheet of plastic. Children again sent their objects down the ramp. They found that the objects moved more easily on the smooth plastic surface. This led to a discussion about friction and force.

Adding further complexity to learning using a scientific lens could include:

- exploring velocity by experimenting how fast / far a heavy object travels in comparison to a light one
- climbing the slide with different types of shoes on to test friction. Reflect on which was easier and which was more difficult and why?
- investigating the connection between friction, wood and fire through ngā pūrākau (the legend), Mahuika the Fire-Goddess.

In addition to highlighting the use of scientific language, this example shows how following a child's interest can be extended when kaiako deliberately interpret what they notice using a science lens.

Capillary action

Key actions

Noticing a child's interest and extending into science

Rich oral language based on scientific concepts

Observation skills encouraged

Hypothesising and drawing conclusions

Case study 6: Exploring surface tension and capillary action

In this kindergarten, Eden displayed a strong interest in art and colour mixing. The kaiako extended this interest by introducing a colour experiment where water was made to 'walk' across a paper bridge. The kaiako explained that this was called capillary action, occurring when liquids move through a paper towel. The kaiako explained that this happened because of the forces of cohesion, adhesion, and surface tension.

Together the child and kaiako considered the equipment they might need to see if they could make water go from one glass to another without pouring it. Each glass had a different colour of water in it. They talked about what might happen and how they thought the coloured water was going to move from one glass to another. Their hypothesis was recorded.

The experiment was set up and Eden returned to it many times throughout the day to see how it had progressed. She carefully observed what was happening and excitedly pointed out the changes that were occurring. Eden and the kaiako drew their conclusions and decided if their hypothesis was right based on their observation.

Adding further complexity to learning using a scientific lens could include:

- exploring where capillary action happens e.g. in nature, plants use it to access water, or when part of a towel is in water, after time, the whole towel will get wet
- investigating other ways water can be moved around e.g. Archimedes screw or through straws
- extending the interest in colour by exploring the nature of light e.g. making a rainbow by shining white light through a prism.

A contextually responsive approach

These examples reflect authentic contexts for learning and show how kaiako have reflected this in the curriculum. The following rural education and care service has a strong focus on gardening. It involves children's whānau who contribute soil and seedlings. In this example, kaiako helped to highlight how seeds sprout, a process normally hidden underneath the soil. This learning experience extended to planting the garden, tending and harvesting the crop to enjoy the proceeds.

Gardening

Key actions

- Beginning with a provocation
- Trial and error
- Modelling
- Scientific language
- Problem solving
- Encouraging observation skills

Case study 7: Plant anatomy and basic requirements for life

Children and kaiako planted five beany bags. These were small bags which have a damp paper towel and bean seeds added, which were placed around the service to sprout. Several were put in the sun and one bag was placed in the shade.

Over the next few days, children saw the beans sprouting. The beans in the full sunshine had sprouted well, growing roots and shoots. Only one bean had started to sprout in the area that got little sun. Children drew the conclusion that not only did the seeds need water and air to germinate, they also need warmth and light to grow. Kaiako explained that the leaves absorb energy from light by a process called photosynthesis and plants need the light to continue growing after sprouting.

A few weeks later the children and kaiako planted the garden with the bean shoots, tomatoes, silverbeet, and strawberry plants. They helped to dig the soil over, plant the different plants, and regularly water them. Kaiako talked with children about the importance of protecting their crops from the birds. Together they made bird-scarers to keep the birds away from the garden.

Asking children to draw on prior learning Following children's lead	As the children observed the changes the plants were undergoing, they noticed that they were being eaten and wondered how this was happening. Children drew on their existing knowledge of living in a rural area and decided that there must be a rabbit in the garden. A few of the children decided the best way to see if their hypothesis was true was to lie very quietly in the grass to see if the centre did in fact have a visiting rabbit. Sure enough, not one but two rabbits were spotted coming through a hole in the fence. With the rabbits rehomed, and the hole in the fence fixed, the garden was able to flourish.

Adding further complexity to learning using a scientific lens could include:

- experimenting with companion planting to attract beneficial insects
- following the moon gardening calendar and exploring tikanga Māori around this
- monitor how much water the garden gets and the effect on the plants.

In this next example the education and care service had a strong focus on environmental sustainability. This was woven throughout their curriculum and evident in everyday practice. Kaiako used this approach as a provocation. Children considered how they might have an effect on the living world and how to measure the impact.

Scientific thinking and reasoning

Key actions

- Beginning with a provocation
- Modelling
- Observation and categorising
- Communicating a scientific finding
- Monitoring impact of actions
- Testing a hypothesis
- Drawing a conclusion

Case study 8: Thinking like a scientist

Children noticed a kaiako had a clipboard and was watching the birds and writing things down. They were very interested in what she was doing. The kaiako explained that she was looking to see which birds were coming into their playground and showed the children her check sheet. This had pictures of birds on one side and the days of the week listed alongside each of them. The kaiako put a tick next to one of the birds when she saw it in the playground. She shared the check sheet and the names of the birds with the children. The kaiako pointed out similarities and differences between the birds on the sheet which included fantail, blackbird and sparrow.

Some children chose to work alongside the kaiako, observing the birds in the playground. They put a mark on their own clipboards beside each bird on the day they saw it. They returned to this activity over the course of the week.

Together they looked at the results, noting that not many birds were coming into the playground. They wondered what would happen if they put some food out for them and decided to give it a try to see if this might increase the number of bird visitors. Observations began again for another week and children kept a record of the birds they saw.

When the information was reviewed, they were able to see that a greater number of birds had visited their playground. Children decided that this was because they had put food out for them; their hypothesis was correct, – putting food out increased the number of birds in the playground.

Adding further complexity to learning using a scientific lens could include:

- researching native and exotic birds in New Zealand
- observing and categorising other species
- reflecting on ngā manu ō Aotearoa and what te ao Māori have to tell us about the different native birds.

Capitalising on the teachable moment

Cooking with children has many benefits.[19] This includes encouraging children's thinking and problem-solving skills. It can provide opportunities for children to further develop their language skills, to work alongside others, to count, measure and to follow a sequence. The kindergarten in the following example has been using cooking to promote thinking about science.

Precipitation

Key actions	**Case study 9: Condensation and precipitation**
Capitalising on the teachable moment to extend science learning Linking learning experiences	A small group of children were cooking with the kaiako. They had decided to make waffles. After helping to make the mixture they watched as the kaiako poured the mixture into the waffle maker. As she put the batter in the pan, steam rose out of the sides of the waffle maker. The children said, "smoke, smoke!". The kaiako explained that this was in fact steam and not smoke. This led to a conversation about how cold the morning was and how, when we are outside, we see steam coming out of our mouths. The group went outside to test this.
Noticing non-verbal cues	The children were very interested in what was happening and the kaiako shared with them that steam always rises. Adding to the conversation, the kaiako explained steam eventually forms clouds and when it cools down it rains. The kaiako could see by the children's reactions that they had not all understood. In response, the kaiako suggested they carry out a rain-making experiment.
Experimenting Testing a theory Encouraging observation	Returning to the kitchen they boiled the jug, noting that the water was rising, and steam was forming. The kaiako then filled a glass jar about a third and placed a plate with ice on top. The experiment did not work properly and the kaiako suggested this could be because the jar was too big. After changing to a smaller jar, and repeating the process, the children could see that the steam was rising in the jar. Once the steam hit the plate with ice it started to come back down the sides of the glass as 'rain'. The kaiako explained that this was condensation.
Science vocabulary	The experiment enabled the children to see visually what was discussed. This was then related back to the discussion about weather and the cycle of rain.

Adding further complexity to learning using a scientific lens could include:

- investigating how clouds are formed and evaporation
- exploring climate science by considering what happens if we get too much or not enough rain and why it is important that rain is clean
- thinking about weather patterns and what causes them e.g. lightning and static electricity.

Integrating science in a play-based curriculum

The case study below shows a clear example of how science learning is part of everyday play and learning. The kaiako was able to recognise this experience and link it to a scientific concept. In doing so, she provided a possible learning pathway to promote wonder and curiosity to deepen learning.

Exploring gravity

Key actions

Beginning with a provocation

Extending the experience through offering additional resources

Modelling

Allowing time for trial and error

Case study 10: Exploring force, motion and trajectory

In this playcentre a pulley system has been set up between the second level of the fort and the sandpit. Sam was focused on trying to move this pulley mechanism along the rope with two long flax sticks. He had concentrated for some time on this very challenging task he had set for himself.

The kaiako then attached a bucket to the pulley system and modelled how to use it. Sam watched intently and explored different approaches to pulling the bucket up and moving the bucket along the rope. Two of his friends joined him and through trial and error they worked out the best approach to filling the bucket and transporting it along the rope.

Assessment documentation identified Sam's learning and highlighted his disposition of perseverance. It recognised his problem-solving skills in working to understand how this pulley system worked and identified how he was exploring gravity and physics as he investigated the pulley system.

Adding further complexity to learning using a scientific lens could include:

- discovering how additional pulleys impact on the amount of energy exerted
- measuring distance and exploring force, motion and trajectory by throwing a ball at a target
- investigating gravity through a parachute or observing how different objects react as they are dropped.

In the following education and care centre, kaiako drew on children's prior knowledge. Kaiako used this intentional teaching strategy to focus and adapt their teaching to best meet children's needs. It provided a starting place for children to make connections between what they already know and new learning.

Energy travel

Key actions

Drawing on children's prior knowledge

Research

Discussing key points and new knowledge

Linking learning experiences

Modelling

Thinking about cause and effect

Case study 11: Exploring energy

A group of children and a kaiako were discussing how energy is transferred. Children initially shared their own knowledge for example, how they eat to give their bodies energy to "run, jump, use the monkey bars and slide for climbing". They noted that energy is also used by anything that makes a sound, such as the radio or their voice. Following this discussion, children watched a short video which highlighted the presence of energy in everything that moves. Brainstorming this idea further, children deepened their understanding that energy is used by "rabbits, cars and children".

The kaiako drew children's attention to the laptop, which was using energy to power it. They noticed one side of the laptop was warm and the other cooler. This led to a discussion about how energy can make things warm.

The group decided to carry out an experiment to explore how energy moves from one object to another. This was done by setting up a dominoes run that transferred energy from the first push right through to when the last block fell. The kaiako modelled this and then children enthusiastically experimented with their own designs.

Adding further complexity to learning using a scientific lens could include:

- thinking about the different types of energy such as mechanical, electrical and kinetic
- exploring the transfer of energy when balls bounce off other objects
- investigating ways of storing energy e.g. batteries, energy in food, from the sun, etc.

Developing working theories

Children develop their dispositions as they learn and develop an understanding of how to use them in different contexts.[20] Dispositions such as curiosity and perseverance can influence the way children approach learning and these have been linked to later educational success.[21]

These dispositions have previously been identified as crucial to children's early learning experiences in mathematics,[22] which is closely aligned to science and are reflected in the examples below.

Dispositions influence how a child might approach learning opportunities. For example, being curious will encourage a child to take an interest and ask questions. This supports them to develop and refine their own ideas of how things work (working theories). They continually adapt these ideas over time as they learn new knowledge.

> *Children's development of these theories is likely to flourish in an environment where 'uncertainty is valued, inquiry is modelled, and making meaning is the goal'.*[23]

The following kindergarten examples show how kaiako worked alongside children, drawing on their knowledge of them as learners, to support the children's developing working theories. Kaiako stressed to ERO:

> *We do not give tamariki the answers, we allow time for them to think.*

The rain inquiry

Key actions

- Stimulated thinking through the questions posed
- Active listening
- Challenging children to think more deeply about their theories

Case study 12: Sustainability and understanding the interconnectedness of systems and natural processes

A conversation occurred with a group of children about why we need water. The kaiako began by asking a question.

Kaiako:	Papatūanuku says we need rain, why do we need rain?
Liam:	To collect and feed the plants and for everyone to drink.
Kaiako:	How do we collect water?
Liam:	You just grab a bucket and collect the rain.
Nikau:	You can hold your hands and collect it and drink it from your hands.
Kaiako:	Are there other ways of collecting water?
Liam:	I learnt on TV you have to spray water on a tree and put your bucket under the tree and the water drips off the leaves and then goes in the bucket.

Allowing time for children to share their own working theories	Kaiako: That sounds like raining, what if it is not raining? Liam: You can get it from the tap. Kaiako: Yes, we can do that, but I wonder where the tap water comes from? Liam: From the tank under the ground. Kaiako: Oh, a tank, I wonder where the water comes from that goes into the tank? Liam: The tank under the swimming pool and the little tank pipe and little lines and the water goes through the tank and into the tap in the house. Kaiako: Does anybody have any ideas where the water from the tank comes from? Liam: Maybe a shop? Isabella: The beach? We go to the beach and there is a cave and water. Liam: From the fish's home in the ocean.
Modelling research	The kaiako and children explored this question further by searching on the internet. The question they asked was: • Where does the water for our homes in Christchurch come from? They learnt that much of the water comes from a local river and the rest from rainfall.
Reflecting on prior learning	The kaiako recapped what they already knew about where water came from and what they have learnt so far with the children. The group thought there was further exploration and inquiry required as they still did not know how the water gets into the tank. Kaiako also planned to relate this back to why Papatūānuku says water is important and how children can practice being kaitiakitanga, guardians of water at kindergarten.

Adding further complexity to learning using a scientific lens could include:

- considering erosion and investigating what happens to the land when there is too much rain
- discussing what happens when the environment gets too dry and why we need to be careful when things are dry
- investigating traditional Māori weather and climate forecasting.[24]

Outer Space

Key actions

Extending the curriculum

Encouraging children to articulate their working theories

Engaging in research

Representing their new knowledge

Drawing on resources in the local community

A rich curriculum was available

Kaiako provided time for children to explore their own working

Identifying the science related learning in assessment

Case study 13: Learning about space and its connectedness to earth

The group plan in this kindergarten was focused on exploring the concept of outer space. This began with children sharing their own knowledge about space.

Rishaan: The sun keeps us happy because rain is cold, and the sun is not.

Daisy: The sun is not in outer space. The sun is here, and it follows you.

Elijah: Yes, the sun goes into outer space at night and the moon comes here. In the morning, the moon goes into the outer space, and the sun comes back. That's why it is dark at night because the sun goes into outer space.

Grayson: The sun is not in the outer space. The sun is here, and it follows you.

Kaiako considered children's working theories as they provided a range of opportunities for children's learning to be extended. This included visiting the local library to look for books and resources that would support them to further develop their knowledge around space. Using these resources, the children learnt about the planets in the solar system and represented them through a range of visual art experiences.

This interest extended into dramatic play. Children used pipes as telescopes to look at the sky and outer space. While doing so they shared their working theories and understanding of outer space.

Elijah: (Looking through the telescope) I can see the outer space. There are planets, moon and stars in outer space.

Daisy: Planets are round like a circle and they move on a course in outer space.

Rishaan: (Holding a blade of grass) Grass is connected to the planet. This planet is Earth, world.

As children learnt new information their working theories continued to evolve. This was recorded through a series of assessments, which when linked, showed that children's understanding of space had developed over time. Kaiako also identified children's science-related learning dispositions through assessment documentation. They regularly considered the dispositions of curiosity, collaboration, imagination, and investigation.

Adding further complexity to learning using a scientific lens could include:

- investigating where the sun, moon, and stars are when we cannot see them
- thinking about earth's location in relation to the sun and how that gives us night and day
- exploring Māori astronomy.

Bicultural practice

Children's learning is enhanced when their home languages and cultures are acknowledged and respected.[25] In all the case study services, kaiako have demonstrated bicultural practice and this included in science. Initially, they draw on their established relationship with parents and whānau to learn about their children's strengths and interests to plan a responsive curriculum. A range of ways bicultural approaches have been incorporated into teaching and learning as children engage in science learning, are in the case studies below.

Kaitiakitanga

Key actions

Noticing the child's interest and extending into science

Building on prior knowledge

Engaging in research

Case study 14: Environmental sustainability

Kaiako and parents and whānau have collaboratively identified the learning that is valued in this service. Curriculum priorities informed by tikanga Māori values guides kaiako practice and the learning programme provided. The values of kaitiakitanga, rangatiratanga and manaakitanga are strongly reflected through this example.

Ahu had brought a snail to the kindergarten and this sparked the curiosity of tamariki. They began by sharing their working theories and existing knowledge of snails. Tamariki were interested in finding out what snails like to drink. The kaiako worked alongside of tamariki, researching the answer to this question. They found out that snails like to drink water and that snails are a good source of calcium for other creatures such as birds, hedgehogs, and lizards, who might eat them.

Encouraging observation and discussion Rangatiratanga is valued, children lead their learning Tuakana-teina relationship is promoted Manaakitanga is practised, children are respectful of other views Extending science learning across the curriculum Kaitiakitanga is valued, children are encouraged to care for the living world	The investigation about the snail created an interest in other living creatures in the garden. The next day Lucas found an earthworm in the garden and asked a kaiako to help him learn more about it. Initially, they went to have a closer look at the kindergarten's worm farm. Tamariki are aware of the special tiger worms that are kept there, and it helped to make links with the role of the earthworm in relation to decomposition of food and adding nutrition to the soil. Once again, the children learnt some interesting facts about worms, including that they have a big muscle which pushes and pulls them forward. Ahu confidently shared what he had learnt with his friends and gave them time to explore the snail and share their own thoughts. Lucas and Ahu then decided to draw the earthworm using the reference from a video shared. They added the segments on the body, the mouth in the front, and remembered to draw the tiny 'hairs' that give them traction on the soil. Both boys then asked to feed the worms. The food scraps were gathered, and the boys poured them into the worm farm. At the same time, they had a good look at the worms and talked about the worm castings and how they would eventually be used as compost on the garden. Other tamariki joined them and Lucas happily explained what we were doing. A worm escaped. Ahu carefully picked it up, replacing it in the worm farm. The planning documentation reflected the values of kaitiakitanga and manaakitanga and rangatiratanga and celebrated children's learning.

Adding further complexity to learning using a scientific lens could include:

- thinking about what material decomposes and what does not
- investigating animals' preferred habits and diet
- exploring a food chain.

Kaitiakitanga

Key actions	**Case study 15: Understanding the process of life and appreciating the diversity of living things**
Beginning with a provocation	Lauren and her mother had recently taken an interest in the mokamoka* at the kindergarten. There have been lots of mokamoka over the past month slowly munching their way through the swan plants and changing into a chrysalis. Every morning on arrival, Lauren would take her mother to check on the mokamoka to see if anymore had turned into a chrysalis.
Promoting whānau involvement	Lauren observed a tiny hēki,* which was small and hard to see. Lauren and the kaiako discussed how small the mokamoka would be and together they measured it out to get a sense of its likely actual size.
Encouraging observation and discussion	The next day the hēki had hatched and Lauren named it iti*. On careful inspection, two more tiny mokamoka were found. Lauren was very interested and engaged in lots of korero about the mokamoka as her friends visited the plants. She also spent time observing the progress of the mokamoka noting where they had been eating, how they were growing and the many aphids on the plant.
Encouraging manaakitanga	The following day there was lots of excitement as the first kahuku* hatched. Tamariki spent time observing the kahuku as it pushed out of the chrysalis and stretched its wings.
Providing opportunities for Lauren to lead and share her own knowledge	Assessment documentation reflects Lauren's science learning, such as engaging in observation, asking questions, listening to others' ideas, describing te mataora o te pūrererehua, and sharing newly-found knowledge with her peers. Lauren builds on her existing knowledge of te mataora o te pūrererehua, practices her te reo Māori and was able to demonstrate rangatiratanga in learning.
Valuing te reo me ngā tikanga Māori	A whakatauākī* is used to reflect on Lauren's learning journey. *Tirohia kia mārama, whāwhāngia kia rangona te hā.* *Observe to gain enlightenment, participate to feel the essence.*

**Translation*

Mokamoka
Caterpillar

Pūrererehua
Butterfly

Hēki
Egg

Whakatauākī
Proverb

Kahuku
Monarch butterfly

Iti
Small

Adding further complexity to learning using a scientific lens could include:

- exploring the growth and development of other animals
- looking at what other creatures live in the garden, what do they do, where do they live e.g. butterflies and bees pollinate; worms are in the soil but come out when it rains
- exploring te whakapapa pepeke: the genealogy of bugs from a Māori cultural perspective.[b]

Children's learning in science has been enriched through experiencing a curriculum that incorporates te reo me ngā tikanga Māori. Deepening children's learning further could include considering how traditional Māori knowledge is shared.

Mātauranga Māori is a modern term referring to 'Māori knowledge, Māori ways of knowing and associated practice'.[26] This involves a valuing of knowledge Māori passed from one generation to the next. Using this approach, kaiako draw on Māori expertise to reflect a localised curriculum. This supports children to be able to navigate their way between a Māori and Western world.

Opportunities to deepen learning in pūtaiao mātauranga Māori could include:

- finding out about local tikanga, when is best to harvest crops or fish, and exploring associated spiritual aspects
- investigating New Zealand's 'natural resources that Māori use to cook with, for example volcanic rocks for hangi, geothermal cooking methods, ngāwhā (steam boxes), hot water pools, clay ovens.'[27]
- exploring Māori astronomy and the influences of te whānau mārama.[c]

Learner-focused partnerships

Children's learning and development is enhanced when kaiako, parents and whānau work in partnership to develop the curriculum provided.[28] In all of the case-study services, parents and whānau are welcomed and encouraged to actively contribute to the science curriculum. They do so in several ways. They:

- bring science provocations to share with others based on their child's interest
- share their cultural expertise related to science with kaiako
- share their expertise in gardening, sustainable practices, marine biology, farming or bee keeping
- spend time in the service and work alongside children
- inform kaiako of community events that may extend the science curriculum further.

b Bug Lab Learning resource, designed for older children, is a useful resource for kaiako to draw on. It provides guidance around te whakapapa pepeke: a genealogy of bugs from a Māori cultural perspective.

c Te Whānau Mārama includes considering the way the light from the stars has influenced and guided Māori agricultural, fishing, hunting and building.

Children's interests and learning are shared in regular discussions between kaiako, parents and whānau. This is then reflected through assessment documentation which values the relationship between the home setting and the early childhood service. The narrative below was initiated by a parent celebrating their child's learning.

Learning Partnerships

Key actions	**Case study 16: Learning partnerships**
Children's science related learning is shared with parents and whānau	Children in this education and care service have been talking about pollution in the ocean and how it impacts on sea creatures. Children carried out an experiment by filling the water trough with clean water and talking about how nice it would be for the sea creatures to swim in. The water was then made to look dirty and a few drops of oil were added. Discussion focused on what would happen to the animals if the ocean was like this. Children shared their own working theories. For example, one that was popular with all was that the animals would "move out of the ocean". This led to a discussion about why this could not happen. **This information was shared with parents on a digital platform.**
The parent response to this new learning	"James has been talking a lot lately about water and pollution and obviously this has been raised a lot in the centre, which is great. We were talking last night (when James was brushing his teeth) about how water gets into the tap and where it goes after it hits the plug hole. James was concerned that if it went straight out to the sea then it might harm the fish. **Thanks for stoking his curiosity.**"
Kaiako respond with intentionality	The kaiako responded to the parent, indicating the child's question could be a provocation for further research in the service. James and other interested children then explored: "Where does waste water go?" Children shared their own understandings and there was a consensus that water goes down the pipe and out to sea. Kaiako used this as a starting place to further investigate what happens to the water in-between leaving the drain and reaching the ocean.

Adding further complexity to learning using a scientific lens could include:

- thinking about the different types of energy such as mechanical, electrical and kinetic
- exploring the transfer of energy when balls bounce off other objects
- investigating ways of storing energy e.g. Batteries, energy in food, from the sun etc.

Using community expertise and resources

Science learning is enhanced through engaging in meaningful interactions with the local community and its resources, inclusive of people, places, and things.[29] Children's learning is deepened when kaiako take them into the community and connect with experts about areas of interest.

Caring for the living world, and promoting sustainable practices, was found to be a strong focus in many services.[30] These practices often included gardening with children, recycling, composting, and managing worm farms. In the following education and care service, kaiako developed this by building on children's interest in the living world and extending this to conservation. They focused on teaching children about the fragility of the earth and how they can play a role in caring for it and its creatures.

Conservation

Key actions

- Beginning with a provocation
- Extending children's learning
- Experimenting
- Making comparisons
- Questioning to provoke deeper thinking
- Problem solving

Case study 17: Developing an ecological mindset

Children had listened to a story about a bird caught in a fishing net. This sparked a great deal of interest about the sea and what might be in it. Kaiako drew on this interest to foster a connection and sense of responsibility between people, places and things. They introduced children to ideas around waste and pollution, particularly looking at its impact on their coastline.

Initially the group started with clean water in the water trough and added some plastic marine life. They then took a sample of this clean water and set it to one side. Then kaiako added sand, plastic bags, bottles and plastic rings to the water.

A second sample of the water was taken, and the children quickly noticed the difference in the colour of the water. Kaiako asked children to consider what they thought would happen to the sea life if rubbish was left on our beaches.

Jenny: They would drown.

Elijah: How would they see?

William: They might eat it.

Kayla: They can't swim.

Airini: They might die (many children agreed with this).

Enriching the curriculum & using a community resource	Kaiako then asked how this problem could be fixed. Children suggested they needed to pick up the rubbish and take it home when they go to the beach. The conversation continued throughout the week. This interest was further extended by drawing on a community resource, the seaside, and an excursion was planned. The intention was that children and kaiako would take some responsibility for the wellbeing of the coastline with a beach clean-up.
Visiting places of significance in the community	Arriving at the seaside they began by meeting with a kaiako from ECO Educate who shared a puppet story about how the animals felt living in a dirty environment and how sick they can get if rubbish is not put in the bin.
Identifying with the feelings of others Promoting child agency	Afterwards everyone participated in picking up rubbish off the beach.

Adding further complexity to learning using a scientific lens could include:

- examining what was collected to see if some of it is recyclable and, if so, what makes it recycling instead of rubbish?
- experimenting with leaving different rubbish items in the open and buried
- considering what decomposes and what does not and why
- exploring conservation from a Māori perspective and incorporating the concept of kaitiakitanga (guardians/caretakers of the land).

In this example, the kaiako drew on expertise in the local community as a strategy in this kindergarten to further children's learning.

Community expertise

Key actions

Following the child's interest

Modelling curiosity

Asking questions to elicit children's thoughts

Researching

Drawing on community expertise

Observation

Case study 18: Thinking like a scientist

Shelby brought in a large bone to show her friends at mat time. She explained that she and her mother had found it as they were walking along the beach. The kaiako asked, "I wonder what this bone might be from?" Many of the children offered their own suggestions. These included a hammerhead shark, a crocodile, a pig, and a Tyrannosaurus rex.

The kaiako looked closely at the bone but was unable to identify it. The kaiako suggested that they take a photo of the bone and send to the vet to ask if they could help to identify it. Shelby thought that was a good idea and dictated the message. This included where she had found the bone, how heavy the bone was, and what animals her friends thought the bone might be from. This was accompanied with an email from the kaiako explaining how curious all the children were to find out the answer to their question.

The local vet gave a quick response and indicated that she thought the bone was a sacrum of a cattle beast and attached a photograph. The vet explained that this was part of the spine that attaches to the hip, just before the tail starts. She also explained that the changes in the appearance of the bone would be due to weathering. Looking carefully at the photograph, Shelby agreed it was a cow bone.

Shelby and the kaiako sent a response thanking the vet for helping them to answer their question. Shelby confidently shared her findings at mat time.

Adding further complexity to learning using a scientific lens could include:

- exploring which animals have bones, which do not, and those that have exoskeletons
- investigating what makes bones strong
- exploring the use of whalebones by Māori.

Improving practice through internal evaluation

Evaluation is important as it 'supports the development of new knowledge and understanding about what works well and what makes the biggest difference to support valued learning for all children'.[31] ERO has developed a theoretical example of internal evaluation relating to science to demonstrate how a service might use evaluation to improve the quality of science teaching and learning in their own curriculum.

The example follows the five key steps[32] and has used the evidence collected for ERO's initial report *Science in the Early Years: Early Childhood and Years 1-4.*

Step 1: Noticing – what is happening for children?

The recently published ERO report, *Science in the Early Years: Early Childhood and Years 1-4,* was discussed at a service's team meeting. It triggered a discussion about the extent to which science was evident in their curriculum. A finding in this report was that many kaiako believed that 'science is everywhere'.[33] While the team agreed with the statement, kaiako were unsure how deliberate they were in taking the 'scientific lens to these learning opportunities'.[34] This statement, and the resulting discussion, acted as a provocation for kaiako to engage in further reading to deepen their knowledge and to collectively determine what good practice looked like.

Step 2: Investigating – obtaining a more complete picture

The team brainstormed what they already knew about science in their curriculum. They listed all the experiences they offered that could be related to science. For example, working with playdough, gloop, the worm farm, gardening, and cooking, to name a few. The team agreed there were also many opportunities for children to actively explore the environment, engage in learning experiences that fostered their curiosity, and learn about the living world through the curriculum.[35]

The pedagogical leader then asked kaiako to think about:

a) How intentional are/were kaiako in adding breadth, depth, and complexity to children's science learning?

b) How does their assessment for learning documentation reflect a focus on science?

Through the course of this discussion, kaiako agreed they needed to take a closer look at what was happening in their curriculum. They agreed that the overall evaluative question to guide their internal evaluation would be:

- **To what extent is science related teaching and learning promoted in our curriculum?**

The kaiako also agreed that they would use questions a) and b) as sub-questions to guide their information gathering. They thought carefully about what information they already had available that would be useful in answering these questions.

The kaiako identified their assessment for learning documentation was valuable in providing an insight into the curriculum experienced by children over time. They agreed that they needed further clarification of the sub-questions to ensure they were all using the same indicators of quality to make consistent judgements in the analysis process.

The following section outlines the evaluation plan kaiako used to direct the investigation. They used indicators drawn from professional readings and ERO resources to unpack what success might look like and determine if the service was implementing the science curriculum as expected. The choice of the indicators also informed the data gathering process, analysis and reporting. This plan enabled useful data to be collected.

Question a)	**How intentional are/were kaiako in adding breadth, depth and complexity to children's science learning?**
Indicators[d]	Kaiako: • notice children's science related interests and use the teachable moment to extend these • use science specific vocabulary with children to enhance their learning experience • use a range of strategies to encourage children to express and explore their working theories, problem-solving endeavours, and experimentation • recognise and extend children's understanding of science concepts in different contexts, including those with particular cultural relevance • encourage critical thought, wondering and creativity.
Information gathering includes:	To find out when and how well science related vocabulary is being used kaiako would: • complete event recordings at different times, three times per week over two weeks for twenty minutes • ask parents and whānau about their child's use of scientific language outside the service To show science related teaching and learning the pedagogical leader would: • make anecdotal observations over two weeks • review one-third of assessment documentation to identify if and how the indicators above were evident. Kaiako decided that selecting one-third ensures the process is manageable.

d Many of the indictors are drawn from ERO's 2020, early childhood methodology Te Ara Poutama, Pike Ake, Kake Ake – For those who aspire to seek excellence: Indicators of quality for early childhood education: What matters most. Wellington: New Zealand. Author.

Question b)	How does assessment for learning documentation reflect a focus on science?
Indicators	Assessment information shows: • children's strengths, interests, dispositions and working theories • the intentionality of kaiako in identifying science learning and planned and enacted next steps over time to deepen and add complexity to learning • how children's interest in science is progressing and continuity of learning over time is evident • how consideration has been given to te ao Māori in how science is reflected in the curriculum.
Information gathering includes:	Kaiako would ask: • parents and whānau if the records of children's learning make their child's learning and progress in science clear to them The leaders will review: • the same one third of assessment documentation to identify if and how well the indicators above were evident • meeting minutes related to planning and/or group planning evaluations for the last twelve months to identify how science and children's learning has been discussed and planned for.

The kaiako engaged in further reading about science in the early years to inform their next steps. They also revisited the section in *Te Whāriki* focused on pathways to school and kura.

The team considered how *The New Zealand Curriculum (The NZC)*[36] learning area of science builds on the learning outcomes from *Te Whāriki*. Reviewing the *Science Capabilities*[e] enabled kaiako to draw close links to their current practice. They were unsure how well they focused on all possible contexts for science in the curriculum they provided. This prompted them to include an additional sub-question:

e The five science capabilities are: gather and interpret data, use evidence, critique evidence, interpret representations and engage with science. Ministry of Education (n.d.). Introducing five science capabilities. Available from scienceonline.tki.org.nz/science-capabilities-for-citizenship/Introducing-five-science-capabilities

Question c)	**What contextual strands of science and science capabilities are reflected in their teaching and children's learning?**
Indicators	Planning shows that: • kaiako pay attention to supporting children to think like a scientist • kaiako provide opportunities to learn in science that go beyond the natural world to include, for example, planet Earth and beyond, the physical world and the material world.
Information gathering includes:	The anecdotal observations undertaken by the pedagogical leader and the review of assessment documentation will provide information about this area of investigation.

Step 3: Collaborative sense making – analysing and scrutinising data

After six weeks, the team met and shared their initial analysis of the work they had taken responsibility for. The discussion (and documentation process) promoted a deeper level of understanding about science in their curriculum. Kaiako moved the discussion from focusing on describing what is happening, to thinking about what this practice means for teaching and learning of science. This led to discussing the overall question: 'is this good enough?'[37]

They agreed on the strengths that were evident and decided on areas for improvement. They noted there was considerable variability of science teaching and learning practice within the team. Areas for ongoing improvement included kaiako:

- intentionally using relevant rich descriptive language with children to identify science related learning
- considering science from a te ao Māori perspective and further integrating the use of te reo Māori
- furthering their knowledge of the science contextual strands[38] so to better notice children's science related interests, recognise their significance and respond in a way that builds complexity to learning. This included deepening their own knowledge of children's developing working theories.

Step 4: **Prioritising to take action –** what do we need to do and why?

Kaiako collective efficacy is the belief that through their collective actions they can influence the success for every child[39] and this is strongly reflected in this teaching team. Kaiako collaboratively developed an action plan that outlined the improvement steps they would take to improve the quality of the curriculum and outcomes for children. This plan:

- identified what was to be done
- what success looked like
- the kaiako who would lead the action
- the expected timeline
- how they would report back on progress made.

Kaiako identified their first priority was build the whole teams' knowledge of science teaching and learning. The pedagogical leader agreed to make available a range of professional readings that reflected science in a range of different contexts, reflective of all strands in science. They would then have a facilitated discussion focused on how kaiako could use this knowledge to better support children's learning and progress.

The team was confident that by using these strategies, and working together, their knowledge of science teaching and learning would be developed further. This demonstrates the power of collective efficacy.

Step 5: **Monitoring and evaluating the impact –** what is happening as a result of the improvement actions

Kaiako were clear about what they wanted to achieve and how they would recognise progress.[f] Ongoing monitoring enabled kaiako to identify what was working and what was not. They used this information to make real-time adjustments to practice as necessary and to judge the impact of these changes on improving outcomes for children.

The table below identifies kaiako current practice and their intended practice; this is the shift they want to make to enhance teaching and learning. The impact for learners is the outcome that will be measured as they evaluate the effect of the changes to their practice.

f Effective internal evaluation for improvement.

TABLE 1. *Provides examples of the kinds of shifts in practice kaiako identified to improve outcomes for all children.*

Current practice[g]	Intended practice[h]	Impact for learners[i]
Practice is variable. Children hear rich, descriptive language, but scientific terms are often not used. Opportunities to extend language were missed. This was evident in observations.	All kaiako make use of science-specific vocabulary with children to enhance their learning experience.	Children's vocabulary widens as they hear science specific language. They begin to understand how they can use it and apply it to everyday conversations.
Some Māori values are referred to focused on the living world and basic te reo Māori is used with children.	Kaiako give deeper thought about how they can integrate further aspects of a Māori world view through the science curriculum. For example, traditional, cultural, and spiritual values.	Children are confident in their identity, language and culture, and understand and use te reo Māori words easily in conversations.
Children are encouraged to think like a scientist. Natural science features strongly in the curriculum, but there are many missed opportunities to follow up on other contextual strands of science.	Kaiako provide opportunities for learning in science using many different contexts.	Children experience a broad and rich curriculum that enables them to grow their knowledge and understanding of all aspects of the world around them.

g Findings from the analysis phase.
h Based on the quality indicators used to inform this evaluation.
i Based on the intent of *Te Whāriki* and the learning outcomes, p. 24-25.

Current practice[g]	Intended practice[h]	Impact for learners[i]
Kaiako notice and listen to children's working theories, as they are shared. Assessment documentation identifies this as a moment in time, continuity of learning is not shown, and there is no planning to extend learning.	Kaiako use a range of strategies to encourage children to express and explore their working theories, problem-solving endeavours, and experimentation. The development of working theories is celebrated and reflected in assessment.	Children make sense of their world by generating and refining working theories.

The team continued to monitor growth in kaiako practice and evaluated the impact for children. For example, on completing additional observations, the pedagogical leader noticed an increase in the use of rich, descriptive science-related language both by kaiako and children.

Parents and whānau also began commenting about the new science-related language their children were using. These early findings were evidence of how effective the teams' collective response was on improving science-related outcomes for children.

Kaiako shared with parents the recent evaluation focused on science and the work they had been doing. Realising how interested parents and whānau were, kaiako sent out a newsletter to the parent community, sharing information about the focus on science.

Kaiako were pleased with the response they received from parents and whānau and the new learning they identified in their own children. This prompted kaiako to reflect that it may have been beneficial to involve parents and whānau earlier in this work. It led them to question how effectively they were working in partnership with parents and whānau to promote children's learning. This reflection has now become a focus for their next internal evaluation.

This theoretical example of internal evaluation has been used to demonstrate the process and the evaluative thinking that contributes to ongoing improvement focused on science. It also demonstrates how one internal evaluation can prompt exploration in additional areas.

Summary

This is a companion report to *Science in the early years: Early childhood and Years 1-4*. This report describes principles of good practice for science teaching and learning in early childhood services, and gives examples of these principles of practice.

The examples provided in this report highlight the collective efficacy of kaiako. They show how kaiako working together have overcome challenges and ensured that science is a deliberate focus in the curriculum. ERO's example of internal evaluation also shows the outcome that this collective approach can have on enabling the learning success of all children.

This good practice report has provided an insight into science in an early childhood context. It shows how science can be successfully integrated into a play-based curriculum to enrich children's learning. The practices and ideas shared through these case studies may be something that your service may like to refer to as you consider how science is actively promoted through the curriculum provided.

Useful resources

Te Whāriki online is a Ministry of Education website that is designed to support kaiako as they work with tamariki. It includes a focus on science in the curriculum.

It's a Bug's Life science resource is developed by Te Papa in collaboration with several early childhood services. It is a practical resource that has activity ideas that could be used to informed science teaching.

Interactive science in a sociocultural environment in early childhood provides a practical overview of science in early childhood education is provided it explores science learning areas and pedagogy.

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