EDUCATION REVIEW OFFICE
TE TARI AROTAKE MATAURANGA

Science in The New Zealand Curriculum: Years 5 to 8

May 2012

Foreword

The whakataukī of the Education Review Office (ERO) demonstrates the importance we place on the educational achievement of our children and young people:

Ko te Tamaiti te Pūtake o te Kaupapa
The Child – the Heart of the Matter

In our daily work we have the privilege of going into early childhood services and schools, giving us a current picture of what is happening throughout the country. We collate and analyse this information so that it can be used to benefit the education sector and, therefore, the children in our education system. ERO's reports contribute sound information for work undertaken to support the Government's policies.

As we operate in an economy focused on knowledge and innovation, we need children to have access to high quality science education. This is not the case at present. School leaders and teachers need support to build the capability and capacity to deliver quality science programmes.

Successful education relies on many people and organisations across the community working together for the benefit of children and young people. We trust the information in ERO's evaluations will help them in their task.

Graham Stoop
Chief Review Officer
May 2012

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Overview

ERO's 2010 report, *Science in Years 5 to 8: Capable and Competent Teaching,* identified models of good practice in 13 selected schools and also found that most schools faced some challenges in developing high quality science programmes. The report stated its intention to undertake a large scale national evaluation of science education to provide a more detailed picture of the overall quality of primary school science across the country.

This 2012 report, *Science in the New Zealand Curriculum: Years 5 to 8*, provides an overview of science education in Years 5 to 8 in 100 schools reviewed[1] during Terms 1 and 2, 2011. ERO evaluated the quality of science teaching and learning, its place within the curriculum and its relationship to literacy and numeracy teaching.

Effective practice in science teaching and learning in Years 5 to 8 was evident in less than a third of the 100 schools. The wide variability of practices between highly effective and ineffective practices was found across all school types.

The quality of leadership was a significant contributor to the quality of science teaching and learning. In schools with effective science teaching and learning, principals actively promoted this learning area. Lead teachers had a strong interest in, and a passion for, science and worked proactively, in partnership with the principal, to foster staff knowledge and confidence with this learning area.

Teachers in these schools planned programmes that ensured students learnt concepts from all strands of the science curriculum. Students regularly focused on the Nature of Science strand, with particular emphasis on the process of investigation and the language of science. Carefully designed science programmes provided opportunities for students to investigate, understand, explain and apply their learning in meaningful and relevant contexts.

Effective teachers acted as facilitators as students influenced the direction of their own learning. Students in these classrooms were independent thinkers and could talk about their learning confidently using scientific language. Lessons were engaging and students were positive about science.

In effective primary school science programmes, teachers successfully integrated science teaching with literacy and mathematics teaching that provided students with the specialist language and mathematics skills that supported their science learning. These teachers were able to successfully use an inquiry learning approach that maintained the integrity of the science.

Few principals and teachers demonstrated an understanding of how they could integrate the National Standards in reading, writing and mathematics into their science programmes. In the less effective schools principals saw science learning as a low priority. They struggled to maintain a balance between effective literacy and numeracy teaching, and providing sufficient time for teaching other curriculum areas, but particularly science. An integrated approach resulted in the science learning being lost. These principals often had little knowledge as to what extent science was included in classroom programmes in their schools.

[1] These included primary, intermediate, composite and years 7 – 13 secondary schools.

Students did not benefit from a useful framework for science teaching and learning that included the science curriculum knowledge strands, and the overarching Nature of Science strand. Knowledge-based programmes were evident rather than interactive thinking, talking and experimenting approaches.

Science programmes in the less effective schools lacked coherence and continuity. The science component was often not made explicit to students. Teachers provided flawed investigative approaches or stand-alone lessons that were not clearly linked to the science curriculum. Student involvement in experimental work was variable.

Teachers had little useful data on student achievement in science and boards had little information about the quality of teaching and learning in science. Self review of science programmes was a low priority in over 80 percent of schools.

A lack of knowledge and understanding of the science curriculum requirements, and of what constitutes effective science teaching, was evident in many schools. Many teachers do not appear to be confident or well prepared for teaching science. They have generally had limited ongoing professional learning development opportunities in science. This has contributed to the low priority many teachers place on it.

Next steps

ERO recommends that the New Zealand Teachers Council investigate:

- how well the nature and quality of pre-service training for teaching science in primary schools is enabling teachers to confidently and effectively teach science.

ERO recommends that the Ministry of Education investigate opportunities for support and ongoing professional learning development for teachers in:

- integrating literacy and numeracy into science teaching and learning
- considering the place of National Standards for achievement in reading, writing and mathematics across all learning areas, including science
- developing an approach to inquiry learning that maintains the integrity of different learning areas, including science.

On the basis of this report ERO recommends that schools review the:

- priority given to science teaching and learning in their curriculum
- quality of science teaching and learning, using the indicators of capable teaching and learning in ERO’s 2010 good practice report.

Introduction

Science and The New Zealand Curriculum

Science is a compulsory learning area of *The New Zealand Curriculum.*[2] The curriculum states that students should experience learning during their time at school from Year 1 to Year 10 in all four context strands: the Living World, the Material World, the Physical World, and Planet Earth and Beyond. The extent to which any one of these is covered is at the school's discretion.

The Nature of Science strand is compulsory for all students up to Year 10 and provides an integrating framework for the other strands. It has four aspects:

- understanding about science
- investigating in science
- communicating in science
- participating and contributing.

This compulsory strand emphasises the importance of scientific processes in helping students understand the way scientific knowledge is developed and how science relates to their lives and the everyday context of wider society. *Looking Ahead: Science Education for the Twenty-First Century* highlights how the Nature of Science strand is central to the positive outcomes of teaching science. These outcomes include:

- preparing students for a career using science
- building students' science literacy to enable informed participation in science related debates and issues as contributing citizens
- developing students' skills in scientific thinking and their knowledge of science as part of their intellectual enculturation.[3]

ERO's 2004 Report on Science Teaching

The Quality of Teaching in Years 4 and 8 Science, June 2004 was the first of a series of ERO evaluations examining the quality of teaching for specific learning areas and skills, in alignment with the Ministry of Education's National Education Monitoring Project (NEMP). The 2004 report identified aspects of good practice in science teaching and learning evident in schools at that time. During the evaluation ERO observed lessons and specifically focused on:

- student engagement and achievement
- teacher pedagogical knowledge and application
- learning and behavioural expectations
- classroom management
- use of appropriate resources and technologies

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[2] Ministry of Education 2007 *The New Zealand Curriculum for English-medium teaching and learning in years 1 – 13.*
[3] Gluckman, P (2011) *Looking Ahead: Science Education for the Twenty-First Century, Annex A:Inspired by Science Page 15.*

- assessment of student achievement.

In 2004 ERO looked at general good practice teaching rather than investigating more specialised science teaching strategies and opportunities for scientific investigation.

It found that 48 percent of schools had effective practice in these aspects of science teaching and in a further 40 percent practice was adequate. A strong correlation between effective practice and recent participation in professional development was evident. Accessing the expertise of science advisors was the most common form of professional development in science at that time.

In 2004 ERO identified that science was commonly taught as part of an integrated approach and on occasions this compromised the extent to which clear learning outcomes for science were identified. The report noted that teachers seemed to be more comfortable with non-science learning areas such as literacy. A lack of confidence in teaching science was a factor in classrooms where science lessons were less effective.

ERO's 2004 report also noted that in many schools science assessment practices required development. A lack of science self review was evident and only a small number of boards received information about science achievement. The report identified the need for improvement in teaching the integrating strands of the science curriculum.[4]

ERO's 2010 Good Practice Report

In 2010, ERO's report *Science in Years 5 to 8: Capable and Competent Teaching* was in part a response to the National Education Monitoring Project (NEMP) findings. NEMP identified a small drop in Years 4 and 8 students' scientific knowledge and understanding between 2003 and 2007. The 2007 NEMP science assessment also found that Year 8 students were significantly less engaged in science than in previous years.

The focus of ERO's 2010 report, *Science in Years 5 to 8: Capable and Competent Teaching,* was to provide models of good practice, as evident in the 13 schools reviewed. ERO evaluated each school's approach to science education based on the set of good practice indicators.[5] These included:

- high quality planning, including strategies for identifying and responding to students' prior knowledge, and for teaching them the significant scientific concepts
- flexible approaches that take advantage of students' curiosity and are able to meet their diverse needs
- an emphasis on the quality of students' thinking, or conceptual development
- high quality investigations, reflection and discussions that help students develop their understanding of scientific knowledge and processes

[4] This report was written before the implementation of the current science curriculum. The previous science curriculum contained two integrating strands that served a similar purpose to the current Nature of Science strand.
[5] See Appendix 1.

- engaging practical activities that allow students to investigate their own ideas as well as those of others. These activities are collaborative, relevant, and draw on local contexts as well as students' interests.
- the use of literacy strategies to support scientific learning and, in some cases, to provide additional context for reinforcing literacy skills
- the careful integration of numeracy and literacy teaching so science activities are not lost
- teachers' sensitivity to students' religious and cultural backgrounds
- links to careers that directly or indirectly use scientific understanding
- high quality assessment and feedback that lets students know how they are achieving in science, informed classroom teaching and learning, and are used as the basis of meaningful reports to the board and parents.

The 2010 ERO report identified that schools faced some significant challenges in providing high quality science teaching and learning. These included:

- teachers' lack of confidence and ability to consistently teach science well
- the quality of pre-service science education for teachers
- the need to develop teaching that consistently improves students' scientific understanding and thinking
- the assessment and reporting of science achievement
- schools access to high quality professional development in science.

Most schools in the 2010 ERO report were at the beginning stages of developing their science programmes. Many staff reported that science had, in recent years, been less of a school priority. They pointed to the emphasis placed on numeracy, literacy, inquiry learning, assessment and information communication technologies (ICT) initiatives as having impacted on the quality and quantity of science taught.

Looking Ahead: Science Education for the Twenty-First Century

Since ERO's 2010 report, the Prime Minister's Chief Science Advisor has released a report, *Looking Ahead: Science Education for the Twenty-First Century, April 2011*. It stresses the need for a population that is better educated in science as a necessary prerequisite to having an economy based on knowledge and innovation. The report acknowledges teachers' efforts and successes to date, while recognising the need for more effective pre-service science education, and the need for ongoing professional learning and development and support for primary teachers to develop their understanding and pedagogical practice in science.

The report argues that *The New Zealand Curriculum* [6] requires from schools a focus on "*scientific literacy to enable understanding of the Nature of Science and its relationship to society, rather than a focus that is heavily weighted in content*

[6] Ministry of Education 2007 *The New Zealand Curriculum for English-medium teaching and learning in years 1 – 13.*

knowledge".[7] It acknowledges that schools are still at the beginning phase of making the necessary changes to implement this focus. The report states that *The New Zealand Curriculum* "*has had very little effect on the way science is taught in schools.*"[8]

Science and literacy and numeracy

In recent years, schools have been expected to focus on literacy and numeracy learning. *The National Administration Guidelines* require each board, through the principal and staff, to develop and implement teaching and learning programmes that give priority to student achievement in literacy and numeracy, especially in Years 1 to 8. The introduction of the National Standards for achievement in reading, writing and mathematics in 2010 further underlined the importance of students achieving well in literacy and numeracy so they can have success with all areas of the curriculum.

Literacy and numeracy skills are essential for students to develop their abilities in science. A strong grasp of reading, writing and mathematics gives them the necessary skills to comprehend scientific text, diagrams and data and report their own investigations.

The 'communicating in science' aspect of the Nature of Science strand provides an explicit link between literacy and science learning. It states that at curriculum levels 3 and 4 students should:

- begin to use a range of scientific symbols, conventions and vocabulary
- engage with a range of science texts and begin to question the purposes for which these texts are constructed.[9]

The Prime Minister's Chief Science Advisor's report acknowledges this focus on literacy and numeracy learning and sees that science "*as well as being an important subject in its own right, offers a context in which this can occur".* [10]

Science and inquiry learning

An inquiry-based approach to teaching and learning in primary schools has become increasingly common in recent years. The approach integrates a range of curriculum areas including, but not exclusively, literacy and numeracy and is in part an attempt to provide authentic contexts for learning. It reflects a focus on developing students' thinking skills. It is an approach that reflects aspects of *The New Zealand Curriculum*, which encourage teachers to explore links between the learning areas.[11] The Key Competencies identify the need for students to *"actively seek, use and create*

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[7] Gluckman, P (2011) *Looking Ahead: Science Education for the Twenty-First Century; Annex B:Engaging Young New Zealanders with Science Page 58.*
[8] Gluckman, P (2011) *Looking Ahead: Science Education for the Twenty-First Century; Annex A:Inspired by Science.*
[9] Ministry of Education 2007 *The New Zealand Curriculum for English-medium teaching and learning in years 1 – 13.*
[10] Gluckman, P (2011) *Looking Ahead: Science Education for the Twenty-First Century; Annex B:Engaging Young New Zealanders with Science Page 61.*
[11] Ministry of Education 2007 *The New Zealand Curriculum for English-medium teaching and learning in years 1 – 13* Page 39.

knowledge" to *"ask questions, and challenge the basis of assumptions and perceptions"* and *"make plans and manage projects"*.[12]

The inquiry-based approach is intended to enable students to explore areas that interest them. The approach draws on a wide range of student skills and competencies. The inquiry starts with a 'big question'. Students explore, develop further questions, research information and carry out wide-ranging investigations. They gather and analyse information, generate solutions and sometimes take action. Knowledge is not compartmentalised and contexts may come from a range of curriculum learning areas, with social studies and science being most favoured in this approach along with health, the arts and technologies that are included to a lesser extent.

Methodology

As part of ERO's regular education reviews ERO investigated science teaching and learning in 100 schools. Forty four were full primary schools, 43 contributing primaries, 8 were intermediates, 3 were composite schools and 2 were Years 7 to 13 secondary schools.

A team of reviewers with particular science curriculum expertise carried out the evaluation. They observed lessons in Years 5 to 8 classes, analysed documents, and met with senior managers, trustees, teachers and students.

ERO evaluated each school's approach to science education based on the set of good practice indicators used in the 2010 ERO report *Science in Years 5 to 8: Capable and Competent Teaching.*[13] In addition, ERO evaluated self review of science teaching and learning using the self-review questions provided for schools in that report.[14]

Evaluation Framework

This evaluation sought to answer the questions:

- How well is science taught and organised in Years 5 to 8?
- What is the context surrounding science education in Years 5 to 8?
- How does the school's leadership ensure high quality curriculum design, teaching strategies and professional development for science?
- How well is science planned to support students in Years 5 to 8 develop scientific knowledge, understanding and skills?
- How well has the school integrated their mathematics, reading and writing teaching into science plans?
- How well does the assessment of science support learning?
- What is the quality of classroom teaching for Years 5 to 8 science?

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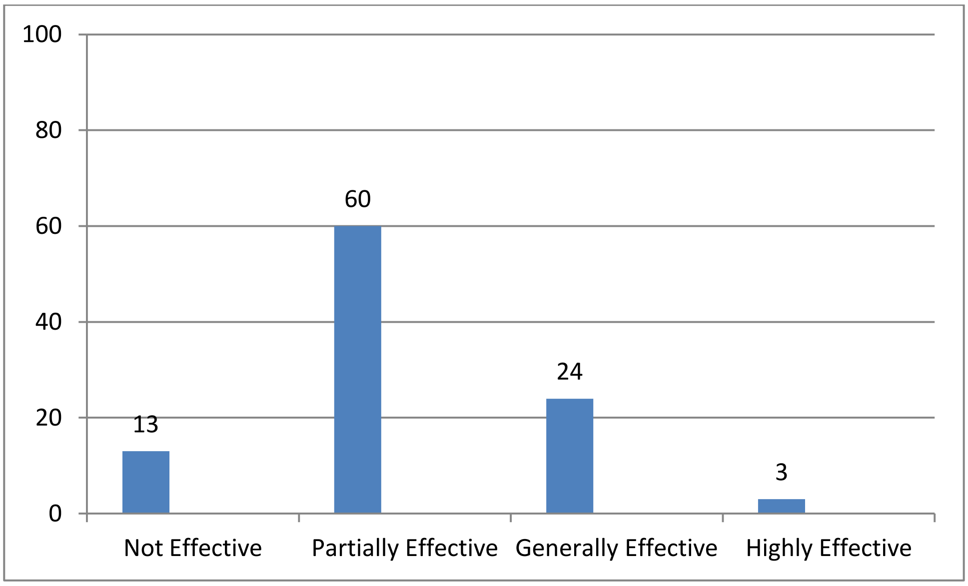
[12] Ministry of Education 2007 *The New Zealand Curriculum for English-medium teaching and learning in years 1 – 13* Page 12.
[13] See Appendix 1
[14] See Appendix 2

Findings

The overall quality of science teaching and learning raised concerns. Only 3 percent of the 100 schools had science programmes that were considered to be highly effective. A further quarter were identified as generally effective. Less than two thirds of the schools were considered partially effective and just over a tenth not effective.

Figure 1: Overall Quality of Schools' Science Programme



Common features found across the 27 schools with generally and highly effective science programmes were:

- school leaders actively promoted science teaching and learning, and worked in partnership with a curriculum leader with a passion for science
- support provided for staff to raise their confidence and competence in science teaching through ongoing professional learning and development opportunities
- clear expectations and guidelines for teacher planning with opportunities for students to experience all curriculum strands within an agreed time frame including a regular focus on the Nature of Science strand, particularly on the investigative process and language of science
- flexible and responsive programmes clearly connected to students' interests and daily lives
- science-specific lessons, directly related to an identified science concept
- hands-on, cooperative learning activities that engaged students with teachers acting as facilitators as students influenced the direction of their own learning
- the successful integration of science with literacy and mathematics learning, and with an inquiry learning approach
- clearly defined, expected learning outcomes outlined for students, with progress assessed through science-appropriate assessment tools
- regular evaluation of science programmes through well-developed school self review.

In schools where science teaching and learning was not effective or partially effective:

- there was a lack of science leadership
- science was accorded a low priority compared with other curriculum areas, particularly literacy and numeracy
- the science curriculum had not been reviewed to match the *The New Zealand Curriculum* requirements
- teachers were not provided with clear expectations and guidelines for science teaching and learning
- quality assurance processes to monitor the implementation of science programmes were not evident
- science programmes lacked coherence and continuity
- students experienced knowledge based programmes rather than interactive, investigative approaches, and did not have opportunities to learn concepts from the Nature of Science strand
- the integrity of science learning was lost in integrated learning units
- teachers did not have useful processes for assessing students' achievement and progress
- science was not part of the school's self-review processes
- there was no budget or time allocation for science, resulting in limited resources or time for hands-on student learning activities
- teachers did not receive professional learning opportunities to develop their science knowledge and skills.

These findings are developed and discussed in more detail under the headings of leading science to support student outcomes; planning high quality science education to support learning teaching and learning; and assessment and self review of teaching and learning in science.

Leading science to support student outcomes

High quality science teaching depends on effective school leadership. Such leadership provides:

- clear expectations and/or goals for science learning
- access to useful professional learning development for staff in this curriculum area and feedback on the quality of their teaching
- appropriate resourcing for a science programme
- a suitable lead teacher who helps staff build their confidence and provide good quality science teaching.

In schools where effective science leadership was evident students received high quality learning opportunities in science.

Effective leadership

In schools with effective or generally effective programmes for Years 5 to 8 students, the principal actively promoted science teaching and learning. They set clear expectations for curriculum design and programme planning, teaching and review. Senior leaders closely monitored curriculum contexts and time allocated to science. Senior leaders who placed a high priority on science learning ensured that teachers who were less confident with science teaching did not avoid this area. They ensured that they maintained its integrity when implementing an inquiry-based approach to the curriculum. All senior leaders in these schools showed a good knowledge of what was being taught, and of the agreed school-wide approaches to science learning.

These schools had an appropriate, specified science budget and good resources for science teaching and learning. Materials for practical activities that supported the school's plan for science contexts were available, well organised and easily accessible. Staff and students continually added to them to extend the opportunities for future learning.

Some leaders used science expertise from the school community, including parents and people from local iwi, and nearby secondary schools. Such resource people provided practical experience that linked to the teaching programme. They participated in lessons and presented science as a career option for students. Effective science leaders encouraged the use of community facilities such as museums, wildlife and marine reserves, and universities.

Principals in these schools identified and encouraged an appropriate leader of science teaching and learning. These lead teachers had a strong interest in science and proactively mentored and supported other staff. They shared new ideas and research at regular staff meetings, and provided professional readings. The science leader modelled lessons for teachers. While some had an academic background in science, the key quality of science leaders was the interest and passion they brought to their role. In some cases the principal and/or lead teacher had undertaken further individual professional learning development to better lead science teaching and learning.

The lead teacher and principal worked in partnership to build staff confidence through developing teachers' knowledge and skills. Teachers were sometimes surveyed to ascertain their competence and confidence in teaching science. In addition to support from senior leaders, staff were given opportunities for professional learning development with external providers through board-funded, in-school development sessions.

Senior staff gave teachers feedback about their science teaching. In those schools where science was identified as a priority, improved science teaching was sometimes considered as part of the appraisal cycle. Leadership teams fostered the notion that you don't have to be a science expert, rather you need to be a learner along with the students. Teachers had permission to be creative and were willing to 'give things a go'. They gained confidence through collegial support.

Principals expected ongoing improvement by requiring science to be part of all levels of well developed school self review. Teachers evaluated their class science programmes and student achievement was reported to the board.

Ineffective science leadership

In the schools with partially or not effective science programmes for Years 5 to 8 students, the principal showed little or no interest in science or gave it much less priority than other curriculum areas. Sometimes senior leaders had little knowledge as to what extent science was included in classroom programmes. Some of these schools had no designated leadership for science and decisions about what, if any, science teaching and learning took place were made entirely by classroom teachers or teachers across a syndicate.

Some schools had a nominal lead teacher who lacked an understanding of science education. Lead teachers were not always clear on what their role entailed. Sometimes a notion of shared responsibility for science resulted in no leadership for this curriculum area.

Science leaders whose teaching responsibilities were in Years 1 to 3 sometimes lacked the understanding of appropriate pedagogy for senior students. Some schools had no staff member with academic qualifications in science. However, this was not necessarily a barrier to successful science leadership as seen earlier. On occasions the lead teacher was a part-time or provisionally registered teacher with the attendant challenges of such a position. However, in a few such cases the person's enthusiasm, energy and willingness to be a co-learner with staff and students made the delegation successful.

Planning high quality science education to support learning

High quality planning for science includes a clear strategy for teaching the science curriculum objectives, with special emphasis on the Nature of Science strand. Planning guidelines outline how students will learn core scientific ideas, scientific process skills and investigate their own ideas through a range of engaging activities. Guidelines for assessment are also included with clear learning outcomes and suitable methods for assessing students' scientific skills, processes and knowledge.

Judgements on the quality of planning were based on examining planning documents for all of the classrooms visited, observing teaching and learning, wall displays of student work, science fair exhibits, and on discussions with senior managers, teachers and students.

The quality of planning for science teaching and learning in the 100 schools involved in this evaluation generally mirrored the quality of science leadership.

Good quality planning

The following describes the features of schools identified as having effective planning for the science programmes for Years 5 to 8.

Consultative planning

Clear expectations and guidelines for teacher planning were evident. Schools planned to cover all curriculum strands over a specified period of time, usually within two years, but sometimes less. In some schools, team leaders discussed and decided the strand and theme for the next term then the teaching teams discussed the activities and associated resourcing needed to implement the programme.

Early in the planning cycle teachers explored students' prior knowledge, understanding and interests before developing learning activities. Units of work were planned using a common template that provided for a school-wide approach through identifying relevant key competencies, use of ICT, inquiry processes and the place of literacy and mathematics learning in the planned unit. Consequently, all staff and students were thoroughly consulted and contributed to curriculum design.

Investigative process
The Nature of Science strand received regular focus, particularly on the investigative process and the language of science. Teachers guided their students to value and use the investigative processes. They designed programmes that developed students understanding of trial and error as an aspect of science, developing an idea and then testing their theory. Teachers planned hands on/experimental activities, in carefully selected groups, to enable students to learn to value precision and accuracy. They were expected to use structured thinking processes and ICTs in the investigative process. Authentic science learning gave students well-defined opportunities to predict, experiment, make and test things, by following a scientific method to arrive at conclusions.

Engaging students
The school science overview had clear expectations for engaging students. They had opportunities to investigate, understand, explain and apply their learning to the world they lived in. Students were developing an understanding of scientific principles that impacted on their everyday lives. The more meaningful and relevant the context was to students' interests, the more motivated they were. Provision was made for reinforcing concepts through a variety of real-life experiences and, where possible, the local area context was effectively used. Individual student's interests were catered for through individual exploration.

Students were able to learn about science concepts beyond school by visiting science events at other schools and at museums and science centres. Planning included aspects to help students understand that science is highly valued by the community and provides possible future career options. One school curriculum document outlined how the science learning process, *'should develop students' sense of awe and wonder'* for the world around them.

Integrated learning
Schools with good quality planning successfully integrated science within inquiry learning. The Nature of Science strand provided a framework for the learning. Lessons were science specific and directly related to an identified science concept rather than obscured by teaching that overly emphasised a wide range of different curriculum areas. Clear teaching and learning sequences led to well-defined science learning outcomes as students followed appropriate, scientific, investigative processes. A few schools enhanced their students' science learning with successful connections to materials and food technology, and environmental learning.

Poor quality planning

In two-thirds of schools visited, planning did not provide a useful framework for science teaching and learning. Some of these schools had good quality planning in other learning areas.

Poor quality planning lacked coherence, without regard for the contexts students had already been taught or the programme gaps that might limit their access to the broad education they are entitled to. Programme decisions did not always provide assurance that students would be introduced to the knowledge and skills from across the science curriculum strands, and the overarching Nature of Science strand. Although there was some tracking of the science taught, it did not usually include the Nature of Science strand. On occasions a science focus tended to be once a year and limited to units related to the Living World or Planet Earth and Beyond.

Planning in less effective schools was frequently ad hoc with decisions made on a term-by-term basis about the next science 'topic' without understanding its context or incorporating real science processes in the teaching and learning. There was little evidence of awareness of the Nature of Science strand or its place in the curriculum. In fact this strand was often the least well taught and understood aspect of the science curriculum.

In some schools teachers and students were not certain of which activities or lessons were part of their science programme. In these schools the Enviro-School programme was seen as the entire school science programme or there was confusion as to what constitutes the technology curriculum and what constitutes science.

Meaningful learning

Clear learning objectives and teaching points were absent from teaching plans. Activities planned may have been of interest to students, but were not directly related to developing science understanding and skills. Teachers were not provided with clear guidelines about effective science teaching. Some programmes were knowledge based where students researched information or were provided with facts to learn. Few planned interactive, thinking, talking and experimenting approaches to science were evident. Planning did not consider students' interests or cultural background and knowledge.

Equity

In a few schools students did not have equitable access to science learning. In these schools students withdrawn to attend Gifted and Talented (GATE) programmes got more opportunities to participate in authentic science learning than other students. Such programmes provided more opportunities for students to follow their own interests in science.

Time allocation

ERO encountered the same difficulties determining the time spent on teaching science in a school during any one year as mentioned in *Looking Ahead: Science Education for the Twenty-First Century*.[15] Time allocated to science teaching and learning was usually not specified in planning and science was frequently incorporated into inquiry-learning units of work.

Schools' focus on designing a curriculum that made certain students participate in the required learning of the science curriculum was highly variable. It ranged from all strands covered over one year, with the Nature of Science integrated into every topic, to teachers taking random discrete lessons, based on their own interests, whenever they could fit them in. Schools that gave science teaching some priority tended to

[15] *Looking Ahead: Science Education for the Twenty-First Century; Annex A: Inspired by Science Page 32.*

plan objectives from all strands for over a two year period, with a science focus for four of the eight terms. It is worth noting that social studies was taught over all eight terms in some of these schools with minimal opportunities to learn science. Other variations included objectives from all strands included over four years, a whole school focus on science every three years with no science taught in intervening years, and a topic focus once a year.

Integration of mathematics, reading and writing into science planning

Some schools had difficulty balancing the need for a literacy and numeracy focus against teaching other curriculum areas such as science. There was little evidence of schools considering the National Standards in reading, writing and mathematics in their science programme planning.

About half the schools had made some attempt to integrate literacy and mathematics into science units. The extent, quality and usefulness of this integration, and its impact on science teaching and learning, were variable. At one end of the spectrum science became merely a vehicle or context for literacy and mathematics teaching with no real science investigation or learning evident.

Effective integration made the science learning central and provided students with the specialist tools necessary for such learning. Students require particular literacy and mathematics proficiencies to carry out science investigations. Teachers identified these proficiencies, ascertained students' current knowledge and skills and then provided appropriate teaching, within the science context, to enable them to utilise these skills effectively.

Literacy

Vocabulary development was the most frequently observed form of literacy integration to science programmes. Effective schools' unit plans often identified specific science vocabulary that was relevant to an investigation. Strategies to introduce this vocabulary and develop students' confidence using it correctly included visual prompts such as charts, diagrams and key-word cards. Teachers built up lists of verbs and adverbs with students that would be useful to write up experiments. They were persistent in requiring students to use appropriate scientific language consistently, as students could not understand what they were observing without suitable vocabulary. Where these practices were evident students used scientific language confidently. Where appropriate vocabulary was not used students did not always realise they were studying science.

Developing the writing skills required to report scientific investigations was a feature of programmes where literacy and science learning were integrated well. Recount, procedural, explanatory, and report writing skills were developed and used. It was clear that these were part of the scientific process and not literacy activities in disguise. At the other extreme, students spent a lot of time copying text from the white board or books.

Guided reading was part of a few science programmes. Students' comprehension and information seeking skills were developed in a carefully sequenced way to help them understand suitable books or digital material. They were shown how to seek out key words or ideas. When this was not done well, considerable time was spent entirely on reading about science related things from books or online, rather than doing any hands-on investigation.

Science-related texts and other materials were sometimes used in reading programmes, outside of the allocated science time, to broaden and deepen students' awareness of scientific concepts and to cater for students' interests. This was most commonly seen with science material used in guided or shared reading. A few teachers used writing time to develop students' science-specific writing skills and to get them to record aspects of their science investigations, or to stimulate creative writing within a science context.

Aspects of information literacy were often integrated into science. This was useful when it was focused on giving students the research skills required to seek out information from multiple sources to provide context and broaden their understanding of what they were finding in their investigations.

Mathematics

Integration of mathematics was less common. Teachers said the sequence in which mathematics concepts were taught did not always align well with opportunities for mathematics teaching in their science programmes. A few teachers were integrating aspects of measuring, designing tables and graphs, statistics, estimations and developing scales into their science planning, providing students with the necessary tools for their investigations. However, most teachers did not take advantage of the full range of opportunities available for integrating mathematics into their science programmes.

In most schools literacy or mathematics integration meant science was merely a context for learning in those curriculum areas. Sometimes there was no attempt at integrating any of the science curriculum objectives. The fact that students incidentally used literacy or mathematics skills in science learning was seen as evidence of integration rather than that these are the building blocks of all learning. Integration, when done inappropriately, was detrimental to an interactive approach to science. Integration was forced and the links made were inappropriate.

Inquiry learning

Much science teaching and learning was incorporated into an inquiry approach. In the hands of a confident and capable teacher, inquiry learning provided opportunities for students to develop valuable thinking and questioning skills for scientific investigation. However, in some schools the approach risked losing the integrity of science in the process. In the absence of strong and knowledgeable science leadership, science can be subsumed by the inquiry process.

Science was frequently merged in an integrated/inquiry curriculum model, incorporating inquiry learning with little experimental science. Sometimes students did not know they were learning science as this was not made explicit. The inquiry approach enabled teachers to tick off science as having been 'done'.

High quality examples of successfully integrating science into inquiry-based teaching and learning were limited. Only a few schools maintained the integrity of science within inquiry-learning units of work.

Teaching and learning

High quality science teaching and learning requires teachers to be enthusiastic about teaching science, have sound pedagogical and subject knowledge and set high expectations for student achievement. Effective teachers of science use a wide range of teaching strategies that:

- build on students' existing knowledge and understanding
- provide engaging, relevant practical learning activities
- engage and motivate students so they enjoy science
- maintain a challenging, but safe and inclusive learning environment
- enable students to see science as relevant to their futures.

Science teaching was observed in Years 5 to 8 classrooms across half of the schools. In most of these schools science teaching in two or three classrooms was observed. The remainder of schools were not teaching science at the time of the ERO review. Judgements on the quality of teaching and learning were based on the classroom observations, planning, documentation, wall displays and science fair exhibits, and on discussions with senior managers, teachers and students.

There was considerable variability in the quality of science teaching and learning across schools. Even in the one school where there was sometimes a 'champion'[16] teacher of science, other teachers within the school were much less effective at teaching science.

Effective practice

Teachers in classrooms with effective science programmes were highly enthusiastic about teaching science. Many had sound pedagogical and subject knowledge and high expectations for student achievement in science.

Lessons were science specific and directly related to an identified science concept. Clear teaching and learning sequences resulted in well-defined, science learning outcomes. Teachers used pre-test information to adjust planning to better meet students' needs and build on their existing knowledge and understanding. Learning outcomes were well defined. Appropriate forms of assessment were used to determine whether those outcomes had been achieved. Students were provided with easily understood success criteria and the learning sequence scaffolded their learning logically. Teachers provided unambiguous instructions on expectations for the lesson.

Teachers acted as facilitators as students influenced the direction of their own learning. They gave students useful ongoing feedback on their progress. Good teacher questioning encouraged independent thinking and reflection. Students could talk about their learning confidently and knew what they were trying to achieve. Teachers insisted on students using scientific language, and helped them develop core scientific ideas while also assisting them to investigate their own.

[16] Gluckman, P (2011) *Looking Ahead: Science Education for the Twenty-First Century; Annex B:Engaging Young New Zealanders with Science Page 62.*

Students made predictions and were familiar with the investigative process, including fair testing. They used structured thinking processes in lessons and ICT (including 'Skyping'[17] in the classroom with local and overseas 'experts'), where appropriate. Students' predictions and descriptions of their observations included their own ideas. They blogged about their thinking, problems and their solutions.

Lessons were engaging. Students worked cooperatively in groups, moved around the classroom and participated enthusiastically in their investigations and discussions. They looked forward to doing science at intermediate or secondary school.

Programmes were flexible and responsive so students who were particularly interested could take a concept further through individual or group explorations. Participation in the school science fair was one vehicle used to do this, particularly when the focus was on student thinking and work and not subject to parents being overly involved in completing the project. Many teachers developed links into tikanga and te reo Māori with Matariki[18] being a popular focus. Students were making connections between scientific knowledge and every day decisions and actions.

Limited effectiveness

In most classrooms however many of these effective practices were not evident. Often students commented on being re-taught work that they had already covered in previous years. They did not know they had been learning science as the science learning was not made explicit and there was confusion between whether they had been involved in science or technology.

Practical work in some classrooms was based on flawed investigative approaches and showed gaps in teachers' scientific understanding. Some teachers provided stand-alone lessons with activities that did not clearly link to the science curriculum. In other classrooms, students were not always involved in experimental work and were sometimes only spectators when their teacher demonstrated a practical activity. Some students' comments indicated that teachers had difficulty in managing practical science sessions.

A key factor in the quality of science teaching and learning is the lack of confidence demonstrated by many teachers in teaching this curriculum area. This reflects a lack of knowledge and understanding of the science curriculum, and of what constitutes effective science teaching and learning. It is manifest in the fact that some teachers avoid teaching science as part of their classroom programme. When science is taught this lack of confidence leads to a more easily managed, teacher directed approach. Teachers find the certainty of teaching content knowledge is easier than facilitating students' participation in an investigative process where the outcome may be uncertain.

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[17] Skype is a trademark term for a form of video conferencing.

[18] The Māori new year. This is marked by the rise of Matariki (Pleiades) and the sighting of the next new moon. The pre-dawn rise of Matariki can be seen in the last few days of May every year and the new year is marked at the sighting of the next new moon which occurs during June.

Assessment and self review of teaching and learning in science

Assessment

The Te Kete Ipurangi (TKI) website[19] provides science assessment exemplars and matrices. These assist teachers to assess students' progress in science learning, review class or school science programmes and provide achievement information for analysis and reporting to the board. ERO saw little evidence that teachers are making effective use of this resource.

Only a small number of the 100 schools used assessment effectively to provide feedback to students; inform parents, the community and board; and help staff evaluate the effectiveness of teaching and learning. Schools with high quality science planning had clearly defined expected learning outcomes for students and used assessment to determine whether those outcomes had been achieved. Other schools had little useful data on student achievement in science.

Effective assessment
Teachers used a range of assessment practices, including diagnostic information, pre and post knowledge testing and well-designed practical tasks for students to demonstrate their learning. Students received feedback on their progress through a range of regular formative processes. Teachers used appropriate questions from NEMP studies as models for assessing students and identifying possible misunderstandings of science concepts.

Summative assessment was guided by progress indicators that reflected the Nature of Science strand. These indicators assessed students' inquiry and problem solving skills. Teachers used national/local baseline matrices to help analyse individual student achievement in relation to the curriculum levels. In some schools teachers had established an assessment matrix using the New Zealand Council for Educational Research (NZCER), Assessment Resource Bank (ARB), exemplars and school developed assessments to identify students' progress against expectations.

This information was then collated, analysed and used to inform professional discussions, planning and teaching. It was reported to the board, school community and parents. Data gathered and analysed from these assessments informed school self review.

Ineffective assessment
Other schools did not effectively use science assessment information for teaching and learning or self review. When they did assess science the information lacked a focus on what students should know and demonstrate, in part due to a lack of clear teaching and learning objectives in the planning. The process of making judgements about progress was not linked to success criteria that reflected science knowledge and skills, or benchmarked against national exemplars or the ARB. This information was generally not collated, analysed and reported to the board. Consequently, trustees were not well informed on the effectiveness of science programmes.

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[19] This is a website developed and maintained by the Ministry of Education that provides teaching and learning resources for teachers and principals.

Teachers used formative assessments and anecdotal notes and/or some student self assessment. There was little reporting to parents on science achievement, or in some cases generalised ‘I can’ statements formed the basis of this reporting. While all these forms of assessment have their place, they do not provide teachers, parents and whānau with a summative picture of students’ achievement in science or the science teaching programme’s effectiveness.

In a small number of schools teachers did not assess students’ progress and achievement in science.

Self review

Self review of science programmes’ effectiveness was a low priority for most schools. Only two schools had highly effective self-review processes with a further eleven having generally effective processes.

Most schools had limited self review that focused on science. In some cases this was indicative of the low quality of self review in the school generally but in many others that had robust self-review processes in other curriculum areas, it reflected the low priority given to science education in the school. A lack of moderated science achievement information, or of school-wide achievement information in science, meant there was no sound basis for self review of science. At best there was some collation of information of the ‘above, achieved and below’ variety in individual classes. Most boards had little information about the quality of science teaching and the outcomes for students from the school’s science programmes.

Very few schools had good quality examples of systematic science self review. These schools had strong science leadership, where science was a priority and where students received good quality, science teaching. One useful strategy in primary and intermediate schools was informal consultation with the local high school, or former students, as to how well prepared they were for science learning at secondary school. This then led to modification of the programme. Useful models of self review observed by ERO follow.

Contributing primary school, urban, medium size, mid decile

At the end of each planned science unit all teachers did an extensive Plus/Minus/Interesting (PMI) type of review, which included student achievement information. Senior leaders collated these reviews into a school wide report. The information in this report was analysed and evaluated to develop recommendations for the ongoing improvement of the science programme.

The school had established an assessment matrix, using the ARB, exemplars and school developed assessments, to identify students’ progress against expectations. The senior leadership team had comprehensive information on the effectiveness of completed science units and student achievement against school expectations. They analysed data for cohorts and groups. The board received an overview of this information.

Contributing primary school, urban, large, high decile

The deputy principal and lead teacher for science conducted an extensive review of science in 2010. They talked with and surveyed staff, management, community, parents and students. The science leaders collated, analysed and shared these survey results with staff community and the board. They made recommendations that resulted in a totally different approach to the implementation of science in 2011.

Teaching teams and teachers regularly reviewed units of work and identified positive practices, which they continued and less successful practices, which they refined or discarded.

Full primary school, urban, medium size, high decile

At this school science was taught as part of integrated curriculum units with an emphasis on preserving the integrity of the subject. Individual teachers gathered specified assessment information in a range of subjects, including science. They used this to evaluate science achievement information and what it showed about teaching effectiveness, at syndicate meetings, and to inform changes for future planning of teaching and learning.

The achievement information was shared with the integrated curriculum leadership team. This team, which included a science leader, provided the board with a report on the quality of teaching and learning in integrated studies. The reports included recommendations for professional learning development, interventions, special teaching programmes or resourcing. The most detailed of these were for literacy and mathematics but the integrated curriculum reports gave useful information on science.

Science was also reviewed as part of the school's overall curriculum development and review.

Intermediate and Years 7 to 13 schools

The wide range in effectiveness of practices was found across schools, including contributing and full primary, intermediate, composite and Years 7 to 13 secondary schools.

Students in intermediate schools often had access to specialist facilities such as a science laboratory. Intermediate schools were more likely to liaise directly with secondary schools about the nature and content of their science programme. In these schools science might be taught by a specialist, or the class teacher, or on occasions a combination of both. While the number of intermediate schools in this study was not large, there was no evidence that the quality of science teaching overall was higher in intermediates than in full primary schools.

Students in composite schools and Years 7 to 13 secondary schools had access to specialist facilities and resource people. There was potential to develop a seamless science curriculum across the school. Again schools varied in the extent to which they were taking advantage of these opportunities.

Conclusion

Common themes are evident in the successive evaluations of the teaching and learning of science in Years 4 to 8 since ERO's 2004 report.[20] Teachers' lack of confidence in this curriculum area has been apparent in each of the three reports. These evaluations have all noted the need for a greater focus on teaching the integrating strand of the science curriculum, and the inability of many teachers to maintain the integrity of science within an integrated approach. Unsuitable science assessment practices are also a consistent feature.

It is of concern that ERO's findings indicate that science programmes have not improved since the 2004 ERO science report. The 2007 NEMP science assessment found that Year 8 students were significantly less engaged in science than in previous years. In ERO's 2012 report only twenty seven per cent of schools in the sample were judged to be providing effective or generally effective science programmes for Years 5 to 8 students.

Changes have occurred in the context for science teaching and learning since 2004. The science curriculum was revised as part of the introduction of *The New Zealand Curriculum*, placing an increased focus on the integrating Nature of Science strand. In 2010 schools were expected to review their science programmes in response to *The New Zealand Curriculum*. This has not yet occurred in many schools and as a result many leaders and teachers have not grasped the requirements of the current science curriculum.

The teaching of literacy and numeracy for Years 5 to 8 students has gained a higher priority. Many schools have not been able to balance meeting this priority with the requirement to provide students with high quality opportunities for science learning. In effective primary school science programmes the science learning remains central while students concurrently acquire the specialist language and mathematics skills that support their science learning. In the ineffective programmes the science learning is lost, with learning in a range of other curriculum areas, including literacy and numeracy, taking precedence. Few principals and teachers demonstrated an understanding of how they could integrate the National Standards in reading, writing and mathematics across the curriculum, including into their science programmes.

It is timely for many schools to review the priority they give to science teaching and learning. They should consider what steps they may need to take to build teachers' confidence in teaching science through developing staff knowledge of effective science pedagogy.

Effective practice in teaching science has been linked to participation in suitable professional learning development in ERO's successive evaluations of teaching of this curriculum area. However, opportunities for ongoing professional learning development in science have decreased since ERO's 2004 report with the disbanding of science advisors.

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[20] *The Quality of Teaching in Years 4 and 8 Science June 2004.*
Science in Years 5 to 8: Capable and Competent Teaching.
Gluckman, P (2011) *Looking Ahead: Science Education for the Twenty-First Century.*
Science Education in Upper Primary (2011).

ERO found science ‘champions’, teachers and schools who were providing effective teaching in science. These leaders with a passion for science motivate and support staff to provide students with stimulating and challenging opportunities for learning. Some of these schools have successfully used in-school mentoring or have drawn on community expertise to supplement teacher knowledge. However, in the two thirds of schools where leadership with a strong commitment to science is not apparent less confident teachers often do not have the opportunities for professional learning in this curriculum area.

The lack of confidence and competence in science teaching and learning in Years 5 to 8 indicates the need for greater support for teachers and principals in this area. Teachers’ need well considered pre-service training that effectively prepares them for teaching science. Many require ongoing professional learning development opportunities in science to enable them to confidently teach science as discrete lessons within an integrated approach. This is essential to raise the quality of science teaching and learning and consequently students’ science literacy and understanding.

Students have the right to participate in science programmes that build on an innate excitement about discovering the world around them. These programmes should have a clear focus on allowing them to explore this world through the use of hands on, scientific, investigative processes. Students should learn through contexts that acknowledge their unique social and cultural experiences and interests. They should be supported to use well developed, thinking and questioning skills and be confident to make predictions, which they then test. Students should be able to describe their findings confidently, using appropriate scientific language. Such learning will equip them to be participants in the science-related decisions that society must take and successfully participate in a society that is increasingly based on knowledge and innovation.

Next steps

ERO recommends that the New Zealand Teachers Council investigate:

- how well the nature and quality of pre-service training for teaching science in Years 1 to 8 is enabling teachers to build their confidence to effectively teach science.

ERO recommends that the Ministry of Education investigate opportunities for support and ongoing professional learning development for teachers in:

- integrating literacy and numeracy into science teaching and learning
- considering the place of National Standards for achievement in reading, writing and mathematics across all learning areas, including science
- developing an approach to inquiry learning that maintains the integrity of different learning areas, including science.

On the basis of this report ERO recommends that schools review the:

- priority given to science teaching and learning in their curriculum
- quality of science teaching and learning, using the indicators of capable teaching and learning in ERO’s 2010 good practice report.

Appendix 1: Indicators of capable practice in science

Leading science education

Indicator	Characteristics
The principal provides leadership for the science curriculum	• The principal and board of trustees have clear expectations and/or goals for learning in science (e.g. in the strategic plan) • The principal, senior management and board of trustees value and promote science teaching across the school • There is a shared understanding about science as an important/necessary area of the curriculum, rather than an add-on • There is a shared understanding about what good practice looks like in science education • Science is suitably resourced in terms of equipment, time and professional development • The principal ensures that there is suitable feedback on the quality of science teaching (e.g. through performance management or some other less formal approach) • Science is celebrated at the school and community level • Science achievement is reported to the board as part of a self-review process aimed at ongoing improvement in science teaching • The principal ensures that there is professional development, resources and confidence for teachers to teach science
There is a designated lead-teacher of science	• This leader is suitably qualified in terms of the subject and pedagogical knowledge • This leader is able to manage the planning, assessment, classroom management and resource issues of science education • This leader is able to work well with other staff members to help build their confidence, planning, assessment, classroom management and overall quality of their science teaching

Planning and assessment

Indicator	Characteristics
Science curriculum planning	• The school has a clear plan for delivering the objectives of the science curriculum, with special emphasis on the Nature of Science strand • The planning shows that students have regular opportunities to undertake science, and know that they are doing science • The planning allows for a range of engaging activities • The school's planning reflects the need for students to learn core scientific ideas, scientific process skills and have time to investigate their own ideas • The science learning attempts to make connections with the lives of students and/or aspects of society • The planning builds on the existing knowledge and understanding of students and allows students to apply and test their knowledge • The school uses relevant practical work to engage students • The school has clear learning outcomes and suitable methods for assessing the scientific skills, process and knowledge of students
The assessment of science	• The school uses the science exemplars (or some other national/local baseline matrices and/or ARBs) to help analyse individual student achievement in relation to the levels of the curriculum • Different forms of assessment are used to assess scientific process, skills and knowledge (including practical work) • The assessment is flexible to allow for individual students goals and investigations • The assessment information on science is collated, analysed and used to inform professional discussions, planning and teaching • Science achievement information is reported to the board, school community and parents • Students understand the specific criteria they need to meet to be successful in science activities • Parents receive information about student achievement in science • Feedback to students is focused on supporting and improving learning

Classroom teaching of science

Indicator	Characteristics
Teachers	• Teachers are enthusiastic about teaching science • Teachers have a sound pedagogical and subject knowledge base • The teacher has high expectations for student achievement
Teaching strategies	• Teachers establish students’ alternative conceptions/prior knowledge as part of teaching • Teachers make connections to the lives of students, aspects of society and the ideas in other subjects • Teachers build on the existing knowledge and understanding of students • Teachers help students develop core scientific ideas while investigating their own ideas • Teachers use a range of engaging, relevant practical activities with students • Teachers use of a wide range of strategies to engage different groups of students, e.g. Pacific, Māori, boys and girls • Teachers use strategies that take into account the religious ideas of some students • Teachers use technology, as appropriate, to support and extend student’s learning
Classroom management	• The classroom management strategies enable students to move safely around the classroom • The learning environment is challenging, but safe and inclusive • Teachers can give good instructions to ensure that students can safely carry out the lesson
Student achievement	• Students are achieving in line with/or above the curriculum expectations • Students see themselves as successful (high self efficacy)
Student engagement	• Students like doing science at school • Students are motivated by their classroom science activities • Students think they are learning well in science • Students are enthusiastic about doing more science at school
Integration of careers teaching into science (Years 7 and 8 especially)	• Students have an opportunity to investigate scientific careers • Students have an opportunity to hear about, or observe, the work of science-based careers • Students see the relevance of science to their futures

Appendix 2: Self review questions

Science programme planning

- How well does your school's plan for teaching science set out how the Nature of Science strand is to be taught?
- To what extent does your school-wide plan for science reflect any school-wide priorities, the Key Competencies of *The New Zealand Curriculum* and how student prior knowledge is to be identified and used?
- To what extent does your school-wide plan for science allow teachers to respond to the interests of students?

The professional knowledge of teachers

- How does your school assist teachers to develop their knowledge of both science and science teaching? How effective is this assistance?

Science pedagogy

- How well do the science lessons at your school connect with the lives of students?
- How engaging are science lessons for students? What data has the school collected to identify what students think of their science lessons?
- How is student thinking, discussion and investigation supported by classroom teaching?

Science competitions

- How does any use of science competitions by your school enhance student learning in science?
- What is the quality of feedback that students receive on any science fair projects they complete?

Science, numeracy and literacy

- How well does your school's science teaching complement student achievement and progress in numeracy and literacy?
- What literacy and numeracy strategies can be applied to improve student learning in science?

Science and diverse students

- How do Māori students experience science at your school? What Māori scientific contexts does your school's science programme draw from?
- To what extent is science education responsive to students of different abilities, genders and cultures?

Careers education and science

- To what extent do students make links between your school science programme and the different sorts of science and science-based jobs that exist?

The strategic place of science

- How is the teaching of science documented in the school's strategic plan? What, if any, goals have been set by your school for learning in science?
- What events, learning experiences or celebrations does your school have to value science and science learning?
- Who is responsible for leading science education at the school? What, if anything, do they need to support the science teaching of other staff?

Science resources

- What science resources does the school have? Is there a list of these resources?
- What assistance do teachers have for accessing, developing and maintaining science resources?
- What science resources could be borrowed from nearby schools or resource centres?

Assessment

- How do you know that the science assessment in your school is aligned with the levels in *The New Zealand Curriculum*?
- What science achievement information is collected, used and analysed, at your school?
- What is the quality of feedback that students receive on their work in science?

Self review of science

- To what extent does the board of trustees receive high quality information about student achievement in science?
- To what extent does the information provided to the board of trustees about science teaching and learning demonstrate the improvements that have been made to teaching and learning over time?

Reporting to parents

- To what extent do parents receive information on how well their child is achieving in science in terms of the curriculum levels?
- To what extent do the reports to parents make it clear what a child's strengths are in science and what are the key things they can develop?
- Are students at your school able to report back to parents what they know about science and what their science learning goals are for the future?