

## Rethinking professional learning and development in primary science

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This paper aims to promote discussion among policy makers, educators, and other stakeholders about how we, as a nation, might provide more effective science education at the primary school level. In recent years, concern has been expressed that New Zealand primary schools are not preparing students as well as they could in science, and, as a result, a number of science professional learning and development (PLD) opportunities have recently been offered to primary schools. These PLD opportunities are being funded from a range of sources including the Ministry of Education (MoE).<sup>2</sup> This paper explores some of the challenges involved in making the most effective use of these PLD opportunities and makes suggestions for rethinking science PLD in the primary school.

Traditionally problems with science education in primary schools have been explained in terms of teachers' lack of content knowledge and confidence in science, and numerous studies have explored these inadequacies. A remedy commonly suggested is to provide PLD that directly addresses these deficiencies. However, maybe it is time to pause and consider whether there could be other explanations for why our primary-aged students are not doing as well in science as we would like. Perhaps it is not so much teachers' knowledge and confidence that is the central issue, but their lack of clarity about the purpose of science in the primary curriculum. A number of international studies have shown that primary teachers will embrace science and develop the necessary conceptual knowledge if they can see how science can support the purpose of the wider primary curriculum.<sup>3</sup>

To date in New Zealand there has been little research or PLD focusing specifically on how learning in science might contribute to the core purpose of the wider primary curriculum. For example, if the development of literacy and numeracy skills is seen as the core purpose of the primary curriculum, could science be a useful context for developing and practising these skills? Alternatively, if developing certain dispositions (such as the key competencies in *The New*

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<sup>2</sup> Between 2009 (when the School Support Services science advisors' contracts were discontinued) and 2012 (when the current MoE PLD contracts started) there had been no MoE-funded PLD in primary science.

<sup>3</sup> See, for example, Tytler (2010).

*Zealand Curriculum (NZC)* (Ministry of Education, 2007)) is seen as the core purpose of the primary curriculum, then could science be the vehicle for developing curiosity, questioning, critical thinking, etc? Viewed through either of these lenses, science could become central to the primary curriculum rather than being an “add on” that falls off when life gets too busy—despite the best intentions in the world. The important thing is that the actual purpose for the inclusion of science in the curriculum is made explicit. This would allow a more coherent school-based curriculum to be developed—and potentially support schools to provide more opportunities for students to learn science.

Compounding this confusion in purpose is the low status science has in the primary curriculum, especially compared with literacy and numeracy.<sup>4</sup> If the status is to be addressed, then teachers (and the wider community) need to think differently about the purpose of science in *NZC*, and the primary curriculum in general.

### *Science in NZC*

*NZC* states:

In science, students explore how both the natural physical world and science itself work **so that** they can participate as critical, informed, and responsible citizens in a society in which science plays a significant role. (Ministry of Education, 2007, p. 17)

This is the purpose of science in *NZC*, and such a purpose has implications for what is taught in science—and what should be assessed. Science is seen as important for *all* students, not just those heading for science-related careers. Traditionally school science has focused largely on the acquisition of facts and the development of skills (and this makes assessment a relatively easy task). But science for citizenship requires more than that. It is about developing students who are able to engage critically with science. Knowledge is still important, but students also have to be ready, willing, and able to *use* this knowledge. Thought of in this way, science learning aims to develop in students a set of science-specific capabilities. These capabilities are a subset of the capabilities that students need for living and lifelong learning.<sup>5</sup> A curriculum that sets out to develop capabilities or competencies is concerned with developing how people *are* in the world, not just simply with what they know or can do.

This, of course, has far-reaching implications for both teaching and assessment, but as yet there is little guidance for teachers as to what such a curriculum might look like in practice. At the classroom level, how would teachers go about designing learning opportunities that nurture the development of critical, informed, responsible citizens? What would such citizens be ready,

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<sup>4</sup> In NZCER’s National Survey of Primary schools (2007) principals reported science to be at the bottom of their areas of curriculum emphasis (Schagen & Hipkins, 2008). More recently the 2012 Education Review Office report *Science in the New Zealand Curriculum—years 5–8* concluded science appears to be a low priority in Years 5–8.

<sup>5</sup> The key competencies in *NZC* are defined on page 12 as “the capabilities for living and lifelong learning”.

willing, and able to do as adults, as teenagers, as young children? What might teachers assess and how?

Without a clear idea of what the end goal would actually involve or examples of what appropriate learning experiences and assessments might look like, teachers are likely to fall back on their own experiences of school science rather than thinking about the goal of science for citizenship. This seems to be what happened in many schools in relation to the Nature of Science strand of *NZC*. When the New Zealand curriculum was revised in 2007 the Nature of Science strand became the overarching and unifying strand of the Science learning area. The intent of this strand was to support the citizenship purpose of science in *NZC*. According to the curriculum document, this strand was intended to help students “develop the skills, attitudes, and values to build a foundation for understanding the world” (Ministry of Education, 2007, p. 28). However, in the absence of support for teachers as to what this strand was really about and what it might look like in practice, it was commonly interpreted as more content to learn. Or it was ignored.

The MoE has recently attempted to address this lack of support for teachers and has published some resources to support them to think about what science learning might look like if the goal is to produce citizens who are ready, willing, and able to engage with science.<sup>6</sup> Although this is welcome support, the resources are only likely to be well used if teachers are supported to engage deeply with the thinking behind the development of these resources.

To be effective, any PLD in primary science will need to address the (now explicitly stated) purpose of science in the curriculum and its contribution to the wider primary curriculum. It will also need to support teachers to rethink their assumptions about science and its role in primary schools. This sort of learning will require teachers to look at the world in new ways, not just add new knowledge and skills to existing schema. They will also need to engage with science themselves, as citizens. Ultimately the goal of any PLD for teachers must be improved outcomes for students, but there is an argument here for focusing first on teachers and their beliefs about education, teaching and learning, and science.

This sort of learning is no easy task. It is exacerbated by a lack of leadership in science education, and, for MoE-funded PLD facilitators, the current context within which they work.

### *The MoE-funded PLD context*

In 2011, the MoE made dramatic changes to a long-established model of PLD provision in New Zealand. These changes were made alongside a number of other changes aimed at reducing the disparity in achievement between different groups of students in New Zealand. PLD funding became contestable.<sup>7</sup> The MoE then let national and regional contracts across a range of specified areas to providers—many of whom had formed consortia. PLD was targeted at schools that were deemed to be in most need of it, and some schools were directed to receive PLD. In the case of

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<sup>6</sup> These resources are available at <http://scienceonline.tki.org.nz/>

<sup>7</sup> Previously the MoE had contracted the School Support Services arms of universities to provide PLD.

primary science PLD, provision was made available in 2012 and schools had to apply to their regional MoE office to receive support. The contract to provide primary science PLD was let to one consortium for the North Island and to a different consortium for the South Island. Both these consortia took different approaches to how the PLD was provided, but the MoE set the parameters:

This PLD focuses on the science learning area of *The New Zealand Curriculum* that achieves a system-wide shift in outcomes for priority learner groups. It places a clear focus on the learning of science through the nature of science (NoS) strand. Students will develop their understanding about science, learn about investigating in science, develop their ability to communicate in scientific ways, and bring a scientific perspective to decisions and actions as appropriate.<sup>8</sup>

As this quote shows, the emphasis of this PLD is on the Nature of Science strand of *NZC* and, although implicitly supporting a science-for-citizenship purpose, it could easily be interpreted as “more stuff” to learn, rather than supporting a more coherent curriculum.

The initial science PLD contracts were for 2 years, and were renegotiated for 2014.

These changes to the way MOE-funded PLD is provided in New Zealand have been accompanied by greater demands for accountability for impact on learning. PLD providers are required to provide evidence both of improvements in student learning and of a school’s ability to carry out self-review and effective ongoing PLD.

The primary role of the PLD provider now appears to be to work in partnership with school leaders and teachers to build their capabilities to take control of their own learning for the benefit of their students, rather than to provide teachers with a range of opportunities to enhance their understanding of how to implement an effective science curriculum.<sup>9</sup> This model provides a challenge for science PLD because it requires teachers to enquire into their own practice, basing their decisions on evidence of “valued student outcomes”.<sup>10</sup> In mathematics and literacy it is possible and appropriate to engage teachers in inquiry into their own practice, based on student data, but this is often not the case in science. This is partly because, for many primary teachers, an appropriate goal at this stage is simply to include some science in their class programmes. Another reason why such teacher inquiry is not feasible in science at this stage in many primary

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<sup>8</sup> <http://nzcurriculum.tki.org.nz/System-of-support-incl.-PLD/School-initiated-supports/Professional-learning-and-development>

<sup>9</sup> For further discussion of the various roles of PLD providers see Timperley (2011).

<sup>10</sup> In New Zealand, the Professional Learning and Development Best Evidence Synthesis (BES) (2007), the Inservice Teacher Educators Project 2006–07 (INSTEP), and the Literacy and Numeracy Projects have had a major effect on the way educators and policy makers have constructed PLD for teachers. While these projects have provided invaluable insights into what makes effective PLD, there is a question as to how directly applicable many of the findings are to improving science learning in New Zealand primary schools in the 21st century. (The Professional Learning and Development BES did include studies of science PLD, but the majority of these studies were from other countries which, unlike New Zealand, have prescriptive curricula and teacher support materials that detail what needs to be taught in science.)

schools is that there is currently little shared agreement as to what counts as “valued student outcomes” and few robust ways of gathering meaningful data on student achievement in science. Furthermore, teachers are unlikely to want to expend large amounts of time and energy inquiring into their practice in curriculum areas (such as science) that many currently consider marginal to the core business of primary schools.

The changes to the provision of MOE-funded PLD have also meant significant changes to the work context of the people who provide the PLD. When PLD was provided by the School Support Services arms of universities, each university was responsible for the PLD in their geographical area. Schools in the area wanting support would contact their School Support Service and “advisers” would go into the school and provide advice and guidance. The advisers were part of a team of people who, although working in different curriculum areas, worked in the same geographic area and could support each other with their shared knowledge of the schools within which they worked. In many cases these advisers also had ready links to the preservice teacher education lecturers with expertise in their curriculum areas.

The context today is very different. For example, primary science PLD is provided in the North Island by the Te Toi Tupu consortium.<sup>11</sup> The primary science PLD team consists of eight facilitators (several of whom work part time in this project) spread across the North Island. Because of the spread of schools it is usually not possible for science facilitators to work together in a school, and science facilitators are unlikely to be closely connected to other (non-science) facilitators in their area because of the contestable nature of PLD provision. This new context can be very isolating for facilitators, particularly for new facilitators straight from teaching positions in schools, and opportunities for PLD for the facilitators themselves are limited. It is a credit to the individuals concerned (and the induction and support provided by their employers) that the facilitators have been largely able to “learn on the job”. Schools are providing the team with very positive feedback.

### *Science PLD for the future*

The range of recent opportunities for PLD in science has generally been well received by primary schools. But as we shape the PLD of the future there is a need to think further about approaches that will most effectively support New Zealand students to become “critical, informed, and responsible citizens in a society in which science plays a significant role”.

In the immediate future there could be PLD that supports primary teachers in two different ways:

1. In the first approach teachers would be supported to see how science can contribute to the development of “confident, connected, actively involved, lifelong learners” (this is the vision of *NZC*) and to use science as a vehicle for developing the key competencies,

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<sup>11</sup> This education consortium is made up of five organisations—Cognition Education, CORE Education, NZCER, University of Waikato, and Waikato-Tainui College for Research and Development.

literacy, and numeracy—thus creating a more coherent curriculum (*coherence* is one of the principles that underpin *NZC*). This approach should help science in the primary curriculum become less marginalised and make it more manageable for teachers. This approach does not mean that science content knowledge is not important. Knowledge is still important but what teachers can *do* with this knowledge is the critical thing. This PLD focuses on supporting teachers to *think* differently—not simply on incorporating new teaching strategies and content knowledge into their existing repertoires. In the first instance the focus of such PLD would be on teacher change, not student outcomes. Facilitators of this type of PLD would need in-depth knowledge of curriculum, science education, and adult learning and development. They would also need to be familiar with the context of primary schools and the range of resources currently available to support teachers. The facilitators would also need to be engaged with science themselves as citizens so they can model the sorts of dispositions they want to nurture in teachers.

2. The second approach would be designed to encourage teachers themselves to engage with science *as citizens*. Just as facilitators need to model for teachers the sorts of dispositions to be nurtured if the goal of science education is science for citizenship, so too do teachers need to model these dispositions for their students. When the goal of education is to develop dispositions then it is important for teachers to model the sorts of attitudes and behaviours they want students to develop. Dispositions are formed through regular exposure to what teachers *do*, not what they *say* they believe.<sup>12</sup> The focus of this approach to PLD is not about teachers learning science so that they can repeat activities with their students, but rather on them engaging as science learners themselves. This approach would involve engaging teachers with topical socio-scientific issues and science stories in the media. It is different from the existing government-funded Teacher Fellowships that place teachers with science research organisations for a set period of time, but would still need input from the science community, particularly those involved with science communication and outreach. This type of PLD would likely be facilitated by people who know enough about both the school system and the science community to be able to act as “brokers” between people with different areas of expertise.

Contracts for the provision of both sorts of PLD would need to acknowledge the challenges involved in developing robust science curricula in primary schools and include appropriate accountability measures. In the immediate future any PLD will need to focus primarily on teacher learning rather than student achievement.

In order to provide effectively for the PLD needs of schools, there is an urgent need to strengthen the profession of PLD providers. Primary science PLD facilitators need deep knowledge of curriculum and science education. They need to know about adult learning and development. They need to be familiar with how primary schools work and with how the science community works. They also need to be well networked so that they can draw on relevant resources. This is a

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<sup>12</sup> For more about this see Lucas, Claxton, and Spencer (2013).

specialised role and it is unrealistic to expect new facilitators to be able to learn on the job, even when good induction programmes are in place. The job of a science facilitator is different from that of a classroom teacher and there is, in my opinion, an urgent need for some sort of specialised programmes to grow this expertise in science education in New Zealand.

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