

## What teachers' want: Supporting primary school teachers in teaching science

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### Abstract

Impending change can provide us with the opportunity to rethink and renew the things that we do. The first phase of the Australian Curriculum implementation offers primary school teachers the chance to examine their approaches to science learning and teaching. This paper focuses on the perceptions of three primary school teachers regarding what support is required to foster science teaching in primary classrooms. In acknowledging these voices, implications for science teaching practice and leadership are proposed and positive actions to encourage change are identified.

### Introduction

The implementation of the Australian Curriculum (ACARA, 2013) presents us – science educators – with the opportunity to acknowledge and embrace change. We are charged with the responsibility of implementing a new science curriculum across the compulsory years of schooling. And while arguments abound regarding the merit of these policy decisions and subsequent curriculum documents, turning these words into quality science learning and teaching opportunities is the reality we are facing. This change could, from a more positive vantage point, be interpreted as the laying down of a challenge. A challenge that encourages us to engage, on system-, school- and classroom-based levels, in more rigorous thinking, discussions and actions around implementing the new curriculum in ways that reflect 21<sup>st</sup> century approaches to science learning and teaching.

Angela's journey as a science teacher educator began in May 2010 and coincided with more concerted efforts to bring notions of a national curriculum to fruition in Australia. Science was earmarked as one of the learning areas to be included in the first phase of the rollout. Being new to this role and seeing a new curriculum on the horizon, it became evident to me that change was afoot, on a personal level as well as within the science education field. In making sense of these changes, I started to wonder what teachers, from primary school settings in particular, might want in terms of sustaining their science teaching as new ideas, approaches and initiatives supporting this new curriculum are introduced. From that point, the purpose of this study - to examine what support primary school teachers perceive they need to teach science – emerged. This led to the development of the following research question as a guiding premise: what is it that primary school teachers need to support the teaching of science in their classrooms?

The reluctance of primary school teachers to teach science in their classrooms is well documented (e.g., Appleton, 2006; Tytler, 2007) with the literature citing issues such as limited science content knowledge and low levels of confidence in teaching content matter as being key deterrents (Harlen, 1997; Tytler, Waldrup, & Griffiths, 2002). Concerns about the need for sophisticated equipment and a lack of time and space to deliver science within an already overcrowded curriculum have also been raised by teachers as impacting on their willingness to teach science (Appleton, 2002). Typically, it is a combination of these issues that result in minimum time being devoted to science learning and teaching in many primary school classrooms.

Within the context of the existing literature around primary school science teaching, the themes revealed through this study do not necessarily offer any insights that are surprising or new. Re-iteration of the fact that resources, time, space and science knowledge continue to be issues experienced by primary school teachers and remain a hurdle to the teaching of science in their

classrooms. Inherently important to this research was the opportunity to capture the opinions of primary school teachers regarding what would support them in teaching science as the cusp of change approaches. Through acknowledging these voices, we – the science education community – are better positioned to respond to the impending changes in ways that matter and are relevant.

### **Method**

This study began with a process of contacting principals of primary schools from the catholic, government and independent jurisdictions, located in one of the Victorian metropolitan regions, to invite them and their staff to participate in this project. The idea behind working with schools near the university's campus was to discover how local primary school teachers wanted to be supported in the teaching of science. This could lead to better understandings of how the university and these schools could establish (new) links that would be beneficial in directly addressing their needs. However, this process turned out to be more challenging than initially imagined. Of the 33 schools in this region, three expressed interest in being involved in this research. We are very aware of and sympathetic towards the competing demands facing school principals and teachers. However, this experience caused us to question what might be the best ways for us, as researchers, to work with schools and teachers on research projects in the future.

The study combines quantitative and qualitative modes of data collection as a way of providing a more complete picture of the phenomenon being examined – primary school teachers' perceptions of what support they need in teaching science. In this case, quantitative data, in the form of questionnaire responses, was gathered to provide a big picture sense of primary school teachers' needs. Qualitative data was also gathered in the form of semi-structured interviews. This approach enabled trends in the teachers' responses to be noted, but also allowed for an in-depth account of the teachers' perspectives to be developed (Creswell & Plano Clark, 2010).

While this study could be considered as using a mixed methods approach, specifically a triangulation design (Creswell & Plano Clark, 2011), it is a problematic label. Mixed methods research draws upon the strengths of both quantitative and qualitative methods to answer research questions (Pasick, et al., 2009). In this instance, there were a small number of questionnaire respondents (n=9) while typically the strength of a quantitative approach would be having a large sample size. This suggests that caution must be taken in referring to this study as mixed methods in nature and is acknowledged as a methodological limitation of this research.

This paper reports only on the qualitative component of this research by exploring the perceptions of three primary school teachers as shared through individual interviews. By focusing on their stories, it is hoped some insights will be provided into what it is primary school teachers would like in terms of support for teaching science and how some of the barriers faced can be readdressed.

### **Participants**

The participants in this study were three primary school teachers, two females and one male, from three government primary schools – Helene, Ken and Nerida. They were experienced teachers and had each been teaching in primary schools, on average, for 25 years with a range from 17 to 32 years. All three held science-specific leadership roles within their school. Helene, Ken and Nerida expressed interest in sharing their opinions in an interview after completing the online anonymous questionnaire, the quantitative component of this project.

## **Data collection**

The semi-structured interviews were conducted during Term 3, 2011. The purpose of conducting the interviews was to assist in developing an in-depth understanding of what primary school teachers believe they need to support the teaching of science. With this purpose in mind, it seemed that a semi-structured interview format was the most practical and functional way of collecting this information (Stake, 2000). A convenient time was arranged with each teacher and the interviews were conducted at their respective schools. Each interview went for approximately 40 minutes and was recorded using a digital recorder before being transcribed.

## **Data analysis**

The interview transcripts were examined to identify the themes underpinning the three teachers' perceptions about the support required for teaching science in primary schools. Analytic induction, as described by Erickson (1986), was used to analyse the data from the interviews. This approach to data analysis allowed the themes to emerge rather than imposing pre-existing ideas and thoughts on the data (Corbin & Strauss, 2008). Four themes characterise the required supports identified by these teachers: resources; time; space; and teacher knowledge. After re-reading the interview transcripts a number of times, quotes were identified that provided supporting evidence for these themes.

## **Findings and Discussion**

The findings of this project are presented around the four themes: resources, time, space, and teacher knowledge. Within each theme, the three participating primary school teachers' perspectives about the required support in teaching science are shared.

### **Resources**

The interviews revealed that Helene, Ken and Nerida engaged with a vast array of resources to support the science learning and teaching occurring in their classrooms. While resourcing was seen as an enabling factor for the teaching of science, it could also be viewed as an inhibitor.

Helene's sharing of her least successful science lesson further underscores the tensions that can be experienced by teachers around resourcing science lessons. This lesson involved classifying rocks. She experienced difficulties such as: sourcing materials (a variety of rock types); managing safety issues (crushing rocks involved the use of hammers and goggles); considering hygiene (cleaning the goggles between use by different students); experiencing technology difficulties (digital microscope was not compatible with computer in the classroom); and managing resources (not enough material for each student, so not all students could participate in the activities at once). For Helene, this was "all a bit disastrous" and led her to feel "[she] didn't want to do [this lesson] ever again". In contrast, her most successful science lesson involved the classification of animals and relied on students using whatever resources they can access in the classroom to assist in the development of their understandings. Helene considered this lesson successful because it focused on "what the children have come up with", "requires [the students] to use their language and draw on their own resources" and "doesn't require any particular equipment". While the use of and need for resources is very dependent on the science concept under consideration, there is still an interesting message in Helene's experiences. This suggests science teaching in primary schools does not necessarily need to involve complex materials and resources to result in meaningful and valuable learning. This is not to suggest that primary school teachers should shy away from resource intensive lessons. Helene's not so successful lesson led her to reflect on this experience and consider ways in which she would do this differently, such as create larger groups, assign roles to students and make time to trial equipment before use in a lesson.

In their interviews, Ken and Nerida both raised other practical solutions for dealing with resources and resourcing issues. In Ken's experience, the role of strong leadership is critical because if a science coordinator is responsible for resourcing and supporting science teaching for an entire school this can subsequently impact on when and how science is taught in classrooms.

If you don't have a strong leader running the science program, putting things in front of people, assisting with resources, sharing ideas, it would struggle very much. In the past, you used to have to do a timetable and you used to have to timetable in science. Now science would fall, in our school, into integrated studies and without support some people would overlook science as part of their teaching.

Staff at Nerida's school have worked at developing and maintaining resource kits to ease the burden on staff to source and prepare materials; a factor which she believes to be a major barrier to science teaching in primary schools.

I don't think teachers are prepared to sit, work an activity or experiment or piece of equipment through, have a go at it, take it home, work it through more for themselves and then come back and work it through with the kids. We are now set up so that these resources are ready to roll at any time.

These kits store instructions and items related to particular science topics in plastic containers.

### **Time**

Resourcing is an important component in the teaching of science in primary schools. However, teachers need opportunities to engage with different materials, resources and technologies that enhance their science lessons. The three teachers cited time as impacting on science teaching. They suggested that a lack of time influenced their ability to plan science lessons, access and develop resources and materials, increase their knowledge of different topics and resources, spend time sharing ideas with colleagues, and timetable science into their classroom activities.

Dealing with a crowded curriculum is not an uncommon experience for primary school teachers with competing demands from different learning areas, national assessment priorities and extra-curricula expectations. A practical solution that primary schools often employ is an integrated approach to ensure that all of these requirements are achieved. Helene referred to her school making closer connections between science and literacy to use teaching time more efficiently.

In the past, we had to try and isolate particularly the literacy teaching block into straight teaching, but more recently we have started to incorporate science into that block where appropriate. We also work on developing literacy skills in science.

Helene identified two ways in which science and literacy were being connected in her school: either using a science topic, such as dinosaurs or the human body, as a context for literacy skill development or enhancing specific literacy skills, such as procedural writing or developing arguments, using scientific concepts. Ken also mentioned an integrative approach to teaching science as a way of coping with time demands, but looked beyond connections with only literacy. For him, opportunities to build science into a variety of learning areas meant that science teaching occurs at a number of different times rather than in one teaching block, which enables more science teaching to occur and results in stronger connections being made across multi-disciplinary concepts and contexts. Nerida spoke about primary school teachers noticing and grasping teachable moments as a way of making more time for pertinent science teaching as well as highlighting the role of science in our everyday lives.

I really don't think that you can teach science once a term or focus on one time in a year that is especially for science. You have to talk about it, you know, in everyday things that you do and that happen. You need to mention science and take advantage of those moments that crop up where you could do some impromptu science teaching.

These comments point to teachers working smarter in the ways they think about and deliver curriculum and underscores the importance of moving from a compartmentalized view of learning to a more holistic, thematic approach. While impromptu science teaching might be desirable, it requires teachers to be knowledgeable and able to make immediate links and teach accordingly.

### **Space**

With time comes the intangible notion of space, in the sense of having the opportunity to take the time to think. However, two of these three teachers also considered space in the physical sense as important in terms of supporting and enhancing science teaching in primary schools.

Helene and Nerida viewed the importance of space and its impact on science teaching differently. For Helene, the single most important way that science could be improved in her school would be through the provision of a dedicated science room. She contends if teachers knew they had a specialized and equipped space they could use for teaching science they would go to greater effort to work out how they could use that space to improve their approach to science.

I think the room would make a lot of difference. If we had one room that was decked out for science, I think people would go in there and think 'Oh, beautiful, all I have to do is to find out what I can do in here!' and they would do it. But at the present, it's a matter of having to find the time, find the place, find the equipment and then find out what you can do. It's just too much.

Nerida suggested that one of the main barriers for primary teachers in teaching science is the mess that it generates and that rather than thinking about a specialized science room as a solution, there is a need to think differently about the ways in which teachers use existing space.

Still the biggest drawback is [science] makes a mess. It would be ideal if you could have a room that you could go into for your messy bits, close it and leave it and walk away. But that's in an ideal world and I don't think it's going to happen. I think instead we need to work more closely with students, and it could be through the allocation of roles, to ensure that the cleaning up of mess from science lesson is not left to the teacher. We also need to think more about how we use different spaces in the school when we teach science – on the oval, in the undercover area or in a space with a wet area. There are different possibilities.

Nerida's comments suggest that rather than using a lack of dedicated space as a barrier to teaching science to instead think more broadly about how school spaces could be utilized.

### **Teacher knowledge**

Having resources, time and space may not be entirely valued by primary school teachers if they do not believe they have the required knowledge, or at least confidence in their knowledge, to teach science. Helene, Ken and Nerida referred to their colleagues' level and perceived lack of science content knowledge as restricting their teaching of science. Two of these three teachers offered ways of turning these perceptions around and improving the quality of science teaching.

Many primary school teachers lack confidence in their own science knowledge, which impacts on their ability to feel able to teach science in their classroom. Helene identified professional development as playing a key role in developing teacher knowledge and imparting confidence in primary school teachers about their ability to teach science.

A lack of access to equipment or to a room is not a great inhibitor of science teaching, but someone's knowledge is. It is the knowledge of what a scientific thing that you are trying to prove is and how to do it. And the only way you can do that is through professional development.

Helene lamented the loss of curriculum consultants who had in the past visited schools and supported teachers by having conversations about their practice, but saw professional development as helping to fill this gap. However, for her, there seemed to be a lack of quality opportunities and experiences being offered in the area of science in recent times. And while network meetings take place where support can be sought, Helene was concerned that ideas that are exchanged during these sessions run the risk of not being new or innovative.

Ken stressed the science lessons at his school were characterized by students being encouraged to ask many questions as a way of developing interest and fostering curiosity in science rather than focusing on fact-finding and reinforcing that there is one correct answer in science. However, he did acknowledge that this could be an intimidating prospect for staff.

So that's maybe one area where our kids fit in really well because they ask questions about everything. And they just see [science] as one of the areas where they can ask questions about anything. But we have to reinforce for all the teachers that it doesn't matter if you don't know the answers because [the students] are prepared to work with you to find out.

Both of these approaches to building teacher knowledge in science can be effective with one looking towards experts in the field for input and the other working with students as co-constructors of understanding within an open-ended learning environment.

### **Implications and Conclusions**

The emergence of resources, time, space and teacher knowledge as key areas of support required by primary school teachers in teaching science are hardly ground breaking findings. Anecdotally most of us can draw upon experiences of and opinions about the significance of these constructs on the work of teachers generally. Past research (e.g., Appleton, 2002; Harlen, 1997) has identified these factors as specifically impacting on the ways in which primary school teachers think about and approach science teaching. Through documenting the perspectives of three primary school teachers, we are not only adding to the body of knowledge existing around primary science teaching but highlighting that these concerns continue to have a presence. As curricula change approaches, there is a real need to carefully examine our thinking about primary science teaching if these areas identified as needing attention are to be recognized and addressed.

These findings have implications for primary school teachers, principals and leadership teams, and teacher educators. It is all too easy to let the hurdles we face impact on us solving the problem or improving the situation. In this instance, the potential barriers for primary school teachers as imposed by resources, time, space and teacher knowledge on their teaching of primary science have been problematised and possible solutions have been posed. As highlighted through the stories of Helene, Ken and Nerida, primary teachers can position themselves to think differently so that they can overcome the issues they face rather than letting them impact on the teaching of science in their classrooms. However, this can be difficult to achieve in light of competing

demands within schools. This is where the support of principals and school leadership teams are required to ensure that teaching staff can be provided with the resources they need to teach science. Teacher educators also play an important role in supporting future primary school teachers to think differently about teaching science. This research raises queries about the ways in which primary pre-service teachers are made aware of potential barriers to science teaching and how they are equipped with proactive strategies to deal with these.

This study only begins to scratch the surface in terms of what primary school teachers perceive they need to support their science teaching. There are also obvious tensions existing within this research in terms of drawing strong conclusions based on such a small sample. Although with resources, time, space and teacher knowledge emerging as recurring themes through the literature, there seems to be a need to extend research initiatives to examine more closely what primary school teachers are doing to overcome these barriers. Presenting some good news stories seems like an appropriate way in which to showcase how primary school science teaching can be re-imagined, re-invigorated and re-energized. From this point, the possibilities are endless.

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