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Teachers' Attitudes Toward Teaching Science in a New Zealand Intermediate School

Yvonne Ualesi
University of Auckland

Gillian Ward
University of Auckland

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Yvonne Ualesi
Gillian Ward
University of Auckland, New Zealand

Abstract: Concern has been raised globally that a lack of interest by teachers towards teaching science has a negative impact on the children they teach. While attention has been paid to the teacher as a contributing factor to students' attitudes, less has been written about the attitudes of teachers. To bridge this gap, the current study examines six Year 8 teachers' attitudes towards teaching science in a New Zealand intermediate school. Biographical data was gathered and individual semi-structured interviews were conducted that explored the teachers' attitudes. van Aalderen-Smeets et al.'s (2012) framework, which takes a multidimensional view of attitudes, is used as a lens to examine the attitudes of the participants in the current study. In general, the participants had a positive attitude towards teaching science. The dimensions contributing to their positivity or negativity are discussed. Implications for supporting teachers to teach science through professional learning and development opportunities in order to create positive attitudes to teach science are proposed.

Introduction

Teachers' attitudes towards teaching science are important as they influence their teaching which in turn affects student achievement and interest in science (Crooks, Smith, & Flockton, 2008; Harlen, 1997; Harlen & Holroyd, 1997; Mulholland & Wallace, 1996; van Aalderen-Smeets, Walma van der Molen, & Asma, 2012). To understand the importance of teachers' attitudes this article first considers the purpose of science education, we then argue that it is worth examining teachers' attitudes toward science and discuss a theoretical framework that outlines the construct of attitude. This framework is then used as a lens to examine a group of intermediate school teachers' attitudes toward teaching science.

The Purpose of Teaching Science

Throughout the 1990s and early 2000s there were numerous publications that discussed the purpose, aims, or goals for science education (e.g., Bybee, 1993; Claxton, 1991). More recently the purpose of science education has been outlined in the 2008 report by the OECD (Organisation for Economic Co-operation and Development [OECD], 2008). There are two key foci. One is to provide children with knowledge in the science disciplines so they can pursue science at a tertiary level and as a career (OECD, 2008; Osborne, 2007). The other aspect is to develop students' scientific literacy so they can participate as citizens whereby they have an understanding of the world around them (OECD, 2008). It is the latter

purpose, that of the development of scientific literacy, that has become the focus of science education internationally.

The aims of science education in the *New Zealand Curriculum* [NZC] (Ministry of Education [MOE], 2007) mirror the goals of the 2008 report by the OECD (2008). The New Zealand curriculum document (2007) defines the aim of science education as "Including the development of knowledge and understanding, skills of scientific investigation and attitudes on which such investigation depends" (p. 13) so that students "can participate as critical, informed, and responsible citizens" (p. 17). But over a number of years it appears that children's interest in, and focus on, science has been left wanting. So teachers have a significant role to play in organizing a science programme that meets the aims of the NZC (MOE, 2007) and in turn motivates children's learning in science.

The National Education Monitoring Project [NEMP] (Crooks et al., 2008) reported that over a period from 1999 to 2007 there has been a drop in the number of Year 8 (approximately age 12) students that enjoyed science. Students in the study also reported they did not do science or practical investigations at school, however students indicated they would like to do more science at school. More recently, the *National Monitoring Study of Student Achievement Science 2012* [NMSSA] (Educational Assessment Research Unit [EARU] & New Zealand Council for Educational Research [NZCER], 2013) reported similar findings, with Year 8 students experiencing science through listening to their teacher with few opportunities for practical science. The report also notes that with respect to achievement, those Year 8 students with low Attitude to Science scores also had lower achievement.

One of the challenges for New Zealand primary school teachers is the requirement that they teach across the eight learning areas within the New Zealand curriculum: The Arts, English, Health and Physical Education, Learning Languages, Mathematics and Statistics, Science, Social Sciences, and Technology. However this requirement does not mean that all learning areas are treated equally. A report by the Education Review Office [ERO] (2012) acknowledged that due to a school curriculum heavily focused on teaching numeracy and literacy, a lower priority has been placed on teaching science in primary schools. Consequently, it becomes increasingly difficult to ignore the concern expressed by researchers, educators, and policy makers of the decreasing interest of young people in science (Meylan, 2010; Osborne, Simon, & Collins, 2003; van Aalderen-Smeets et al., 2012).

It is clear that primary teachers in New Zealand are instrumental in providing quality learning experiences for students to explore both how both their natural and physical world and science itself works. The task of preparing students to participate as "critical, informed, and responsible citizens in a society in which science has a significant role" (MOE, 2007, p. 17) is crucial (Bull, Gilbert, Barwick, Hipkins & Baker, 2010; Crooks et al., 2008; ERO, 2012; MOE, 2007; OECD, 2008). Teachers' attitudes towards teaching science is therefore of importance, particularly in Year 8 where students are starting to consolidate their ideas of science and its importance to their lives.

Teachers' Attitudes toward Teaching Science

Over the last 30 to 40 years there has been a plethora of research focused on primary teachers' attitudes toward teaching science. A literature search that investigated attitudes towards science and the teaching of science of both experienced and initial teacher education primary teachers, found 41 quantitative studies and four qualitative studies published between 1985 and 2010 (van Aalderen-Smeets et al., 2012). What is evident over the time period is the lack of qualitative studies. More recent studies continue to use quantitative approaches to

examine teachers' attitudes (e.g. Turkmen, 2013; Senler, 2016). In addition, studies in the area of research towards science teaching are less prevalent than attitudes to science *per se* (Senler, 2016). The current study addresses this gap by using a qualitative approach that focusses on teachers' attitudes toward the teaching of science. So in the process of gaining insight into the teachers' attitudes, data can be collected that provides in-depth detail, feelings and emotions (Strauss & Corbin, 1998). Something that is not possible with quantitative studies.

In van Aalderen-Smeets et al. (2012) review many of the research studies share commonalities with respect to the characteristics of teachers who have negative attitudes toward teaching science. Teachers with negative attitudes towards teaching science spend few hours teaching science, particularly when there was a lack of available resources (Appleton & Kindt, 1999). Teachers with less positive attitudes toward science teaching also tended to rely on planning by others (Harlen & Holroyd, 1997). Most noticeable, in many studies, is low self-efficacy beliefs and confidence about teaching science that impacts teachers' attitudes in negative ways. Lack of confidence is evident for not only beginning teachers (Appleton & Kindt, 1999; Skamp, 1991) but also for experienced teachers (Harlen & Holroyd, 1997; Skamp, 1991; Yates & Goodrum, 1990).

Increasing teacher's science knowledge has been found to be important in improving teacher attitudes (Harlen & Holroyd, 1997). But rather than just focusing on how to teach science and increasing science knowledge, there is also need to improve self-efficacy and confidence in order to increase teacher positivity towards science teaching (Tosun, 2000). Once teachers' attitudes improved and confidence increased, their teaching also improved (Osborne et al., 2003; van Aalderen-Smeets et al., 2012).

There are few research studies in the New Zealand context that aim to understand what teacher's attitudes are toward teaching science. Much of the research to date has focused on students' attitudes toward science with a mention of the teacher as a contributing factor rather than on teachers' attitudes toward teaching science *per se* (Bull et al., 2010; Crooks et al., 2008; EARU & NZCER, 2013; ERO, 2012). Given that teachers' attitudes are fundamental to what goes on in the science classroom, an investigation into teachers' attitudes at a local level is worthwhile.

With the concern around Year 8 students' achievement and interest in science, or lack thereof, and the impact teachers' attitudes have on student learning it seems worthwhile to examine Year 8 teachers. The current study contributes to the field by focusing on a group of teachers from a New Zealand intermediate (upper primary) school and sought to understand "What are Year 8 teachers' attitudes toward teaching science?"

Theoretical Framework

Attitudes can be considered a part of people's belief systems (Jones & Carter, 2013) however, 'attitude' is a construct that has been difficult to define (Tytler, 2014). van Aalderen-Smeets et al. (2012) argue that many attitudes studies fail to provide a sound definition for the construct of attitude. In addition, they note methodological problems with studies on teachers' attitudes, in respect to poorly designed measuring instruments or inadequate analysis In part, this is because the construct of attitude is multidimensional (See van Aalderen-Smeets et al. (2012) for a full critique of the research studies they reviewed). As a result van Aalderen-Smeets et al. (2012) addressed their concerns by developing a new multidimensional framework for the construct of primary teachers' attitudes toward science and science teaching.

The current study uses this multidimensional framework to examine teachers' attitudes towards teaching science. While using only one framework could be considered a limitation of the current study, this framework was chosen for its recent insights into the concept of attitudes. In addition, the framework addresses the concerns about the construct of attitude and methodological problems of previous attitudes research studies. van Aalderen-Smeets et al. (2012) define attitude according to its constituent parts and differentiate between personal attitudes and professional attitudes, aspects that are not present in many previous studies. Personal attitude focuses on an individual's attitude toward science, whereas professional attitude focuses more on attitude toward the teaching of science. While recognizing that a person's professional attitude toward teaching science may be influenced by their personal attitude and vice versa (Asma, Walma van der Molen, & van Aalderen-Smeets, 2011), the current study emphasizes professional attitude, given that the research focused on attitudes toward teaching science.

An Outline of the Multi-Dimensional Framework Used in the Current Study

In their framework, van Aalderen-Smeets et al. (2012) note that attitude is multi-dimensional with several underlying attributes. They divide the construct of attitude into three dimensions: *cognitive beliefs*, *affective states*, and *perceived control*. These dimensions and their attributes or sub-components with respect to professional attitude are explained below.

Cognitive beliefs are divided into three sub-components: perceived relevance, perceived difficulty, and gender beliefs. Perceived relevance refers to a teacher's belief about the importance of teaching science. Perceived difficulty is used to describe beliefs about the difficulty of teaching science relative to other curriculum areas. Gender beliefs as a sub-category comprises teachers' perceptions about gender differences associated with teaching science, for example, the different abilities men and women have with respect to science teaching and differences with respect to boys and girls in the science classroom.

The affective dimension involves feelings related to teaching science, divided into sub-components, both positive and negative. Positive feelings would be associated with the enjoyment of science teaching and negative feelings are associated with fear and anxiousness about teaching science. These emotions can occur simultaneously, that is, a teacher can enjoy teaching science yet at the same time experience anxiety about teaching science. Consequently, the two sub-components are related but also independent (van Aalderen-Smeets & Walma van der Molen, 2013).

How much control a teacher perceives they have over their teaching is described as perceived control. The two sub-components of this dimension are self-efficacy and context dependency. In van Aalderen-Smeets et al.'s (2012) view "self-efficacy consists of cognitive and affective aspects that are focused on people's internal beliefs about and feelings of being in control to execute particular behaviors" (p. 177). Professional self-efficacy relates to a teacher's perception of their own ability to teach science. Internal factors such as abilities, knowledge, or experience might influence a person's self-efficacy. van Aalderen-Smeets et al. (2012) differentiate self-efficacy from perceived difficulty, for example, a teacher could perceive that science is a difficult subject to teach relative to other subjects, but they might have high self-efficacy with regard to their ability to teach science.

Context dependency is a sub-category that focuses on external factors that influence a teacher's perception of being in control and making it easier or harder to teach science – an example of external factors are resources and materials used to teach science. A teacher may

believe that certain external factors have a slight influence on teaching or be certain that specific external factors are necessary for teaching.

Within the framework there is a clear distinction made between self-efficacy and context factors. A teacher might have high self-efficacy and have high context dependency, that is, a teacher perceives they need particular resources and materials in order to teach science (Asma et al., 2011; van Aalderen-Smeets et al., 2012). Other possibilities could include a teacher with low self-efficacy and high context dependency or a teacher with high self-efficacy and a low context dependency (van Aalderen-Smeets et al. 2012).

Within van Aalderen-Smeets et al.'s (2012) framework, the three dimensions influence the behavioural intention to teach science and in turn, a teacher's intention may or may not result in action. That is, behaviour and behavioural intention are outcomes of attitude.

Research Design

An interpretivist paradigm centres on an inductive understanding of the meanings people bring to situations and behaviour. The current study is located within an interpretive paradigm as the focus of the study was on understanding, describing, and interpreting various teachers' ideas, experiences, and attitudes about teaching primary science (Punch, 2005; Tolich & Davidson, 2011). The qualitative approach taken to collect data is associated with the interpretivist paradigm. The study collected data in which two data sources, biographical data and interviews were used. According to Neuman (1997), a qualitative approach is appropriate to gather data in which there are few participants and the context is situationally constrained, in this case one intermediate school.

Context

The school chosen was an intermediate school in a large New Zealand city. A determining factor in choosing this site was the accessibility of the school to one of the researchers and as such was a sample of convenience (Punch, 2005), however the researcher took care to ensure participants were unknown to the researcher to avoid a conflict of interest (Snook, 2003). The school had a purpose built laboratory and the science content the teachers had access to was developed by a lead science curriculum leader and included a science content booklet resource.

Year 8 teachers were the focus of the study since studies indicated a decrease in student enjoyment at Year 8 (Crooks et al., 2008; EARU & NZCER, 2013). Consequently, Year 8 teachers' attitudes and motivations to teach or not teach science may impact their students' enjoyment and interest in science. Expressions of interest to take part in the research were sought after presenting the aims of the research study to all the intermediate school staff at a staff meeting. Those Year 8 teachers who were interested in participating made contact through the Year 8 syndicate leader. From a pool of 11 Year 8 teachers a total of six teachers volunteered.

Data Collection and Analysis

Data were gathered from two sources. First the participating teachers were asked to complete a questionnaire to provide relevant biographical data. These data are displayed in

Table 1. Pseudonyms are used and given the small population of intermediate school teachers, all participants have been given female names to further increase anonymity.

Teacher	Age at interview (years)	Qualification in science	Length of time teaching at the school	Length of time teaching
Anne	30	No	7 weeks	7 weeks
Barbara	44	No	3 terms	4 years
Cathy	50	Ye	11 years	25 years
Deidre	46	No	7 years	17 years
Eleanor	46	No	16 years	23 years
Fiona	22	No	7 weeks	7 weeks

Table 1: Year 8 Teachers' Profiles

The participants ranged in age from 22 years of age to 50 years of age. In terms of science qualifications, only Cathy had a science degree. The other teachers had teaching qualifications that included a compulsory science education course within their undergraduate teacher education degree. Anne and Fiona were both beginning teachers so had little experience in the school teaching science when the interviews were conducted, although they had both completed 21 weeks of practica during their undergraduate degree. Half of the teachers had been teaching for more than 10 years and in addition, had been teaching in the intermediate school for a long time. Despite all teachers being expected to teach science, the focus of school professional development has been on literacy and numeracy there had been little opportunity for science professional development for all teachers.

The second source of data were obtained through the participating teachers taking part in a one-to-one individual semi-structured interview. This qualitative approach enabled the researchers (and authors of this paper) to gain an understanding of the individual intermediate school teachers' lived experiences in the classroom context (Creswell, 2013). Individual interviews allowed flexibility where probing and elaboration of individual answers could take place (Creswell, 2013).

The interviews were conducted by one of the researchers who had not met the participants previously. The interviews were conducted within the teacher's own classroom, to create ease and reduce any potential tension or nervousness that might arise from being interviewed (Creswell, 2013). The interview questions were given to the participants prior to the interview so as to allow them adequate time to think deeply about the questions and feel comfortable with the questions prior to the interview. The questions were open ended and where appropriate the interviewer probed and explored answers of respondents individually.

With the teacher's permission an audio tape was used to record the interview and interview notes were taken. The audio tapes were transcribed and the interview notes were transferred immediately to the interview transcript, taking note of any significant details in non-verbal cues through body language. At this stage the participants were given the opportunity to check the transcripts for accuracy. None of the participants wished to revise their transcript.

A thematic analysis of the interview data were undertaken through the use of open,

axial, and selected coding (Glaser & Strauss, 1967; Punch, 2005). The themes were verified with both authors stating and defending their ideas and adopting or challenging those of the other author (Author, 2015). The themes were also examined against the participants' biographical data. The university's Human Participants Ethics Committee approved the study. All participants gave informed consent prior to data collection and could withdraw from the study prior to data analysis.

Findings

The data revealed three overarching themes associated with teachers' attitudes toward teaching science. These themes were: understanding the purpose of teaching primary science; the perceived importance of a structured science programme in order to teach science; and, their perceived ability to teach science. The themes are presented below.

Understanding the Purpose of Teaching Primary Science

All of the teachers who could clearly articulate a purpose for teaching science felt the most positive toward science teaching. They also believed that science is a very important curriculum subject for Year 8 students and could see the value in teaching science.

Encouraging Children to Understand the World around Them

The purpose for the teachers was two-fold. Anne, Barbara, Cathy, Deidre, and Eleanor thought one of the purposes of teaching science was to encourage children to understand the world around them. They believed that in order to achieve this aim their teaching should involve opportunity for children to test their hypotheses through investigations and practical work. These teachers also thought that teaching science helped children develop a curiosity about the world around them. Eleanor thought it was important that children question the world around them, she stated "I wish and possibly that it is, that kids go 'oh there is all this stuff out there how does it work?' … They have questions that they want answered".

Anne, a beginning teacher, had a very enthusiastic attitude toward teaching science. She shared similar thoughts on the purpose of primary science, describing students hypothesizing, setting up experiments, and investigating using different variables and drawing conclusions from these. She stated:

> *"To get an overview and understanding of … I think the idea about hypothesis is really important … knowing what it takes to set up an experiment ... the initial investigation coming up with questions or hypotheses then writing up experiments …then being able to have an outcome, make a conclusion from the experiment … but also just having a curiosity."*

Fiona did not share the same ideas as the other teachers and found it difficult to express her beliefs about the purpose of science education. She believed that the aim of science in the classroom was "to try and be as inclusive as you can, have everyone engaged, included, and happy." But she was not sure that was actually happening in the classroom.

Science as a Career Possibility for Children

The second purpose for teaching science to their students was the opportunities science offered for future career possibilities. When asked to rate out of 10 the importance of science as a curriculum subject for Year 8 students and provide reasons for the importance of teaching science, most rated it highly. The reason given being the subject's perceived importance at high school and future science related careers. Anne, a beginning teacher, talked at length about the importance of teaching science stating "10/10 very, very important because it leads to so many different fields in terms of your [student's] career" and as a consequence she believed it was important to emphasise science in her teaching. Eleanor talked about the need for students to have success in primary science which would affect their success at secondary school by stating, "There are things in science that I think are missing if they don't get a good science education in primary … so if they're not successful in high school then they won't get those jobs." Even though Fiona showed a lack of enthusiasm about teaching science she did believe science was important for future careers and stated "It's good to give them science because it kind of pushes them. It gives them an idea of where they could go in the future." Fiona believed teaching science was important if it was relevant to a student's life or their background. But she talked about how learning about seeds and plants did not connect with her students. Fiona held a belief that the content being taught did not serve her students and therefore she held quite a negative view of teaching science.

The more experienced teachers, Barbara, Cathy, Deidre, and Eleanor spoke at length about the learning possibilities of students gaining a deep conceptual understanding of their world. Eleanor spoke with fervor about teaching forensic science which she felt was more relevant to students' lives. Cathy spoke excitedly about activities which put students in the position of a scientist, involved in projects that investigated environmental issues and other real world issues. These ideas held by experienced participants reflected a sense of enjoyment and confidence when teaching science.

The Importance of a Structured Science Programme

The science content the teachers had access to was available in a science content booklet which was developed by a lead science curriculum leader. The booklet outlined the topics to be taught and provided background to the science activities. This structured approach to science teaching in the school was appreciated by all of the teachers as they felt it supported their teaching of Year 8 science. Teachers reported they felt more confident with units and plans which were provided for them. Barbara stated, "We have science teaching units which I feel are really, really good for them … practical stuff and we have our own laboratory." Having a structured programme to deliver was a contributing factor in whether teachers liked or disliked teaching Year 8 science and is reflected by Anne:

> *"I was delighted when I started working here to find that there were unit plans that were already written … this school has a laboratory as well that is set up and to help me out as well being a [Beginning Teacher] … there is also a student timetable that's been written up for the teachers as a guide to what parts of the unit plan are to be taught each week."*

The prepared units were also viewed as a helpful back up plan to their teaching, "When I feel confident and I give the answer that's great. When I'm not so confident that's when I turn to the unit" (Deidre).

In particular the more experienced teachers expressed positive feelings about teaching science in the laboratory. Barbara commented, "I used to be uncomfortable because it was

like waiting for an accident. But since the lab has been built up … now everything has been perfect." Despite residual anxiety felt due to safety issues in the laboratory, some teachers discussed the need for more autonomy. These more experienced participants felt constrained and wanted to go outside the scope of the programme and try new things. By having more autonomy they perceived their level of enjoyment of teaching science would increase. Deidre describes this by saying "Okay it's so prescribed here that you don't get as excited as you should do … it's pretty prescribed."

Perceived Ability to Teach Science

Most participants spoke about the complexity and specialized vocabulary in the science curriculum. Deidre, an experienced teacher without a science background, sometimes felt anxious when teaching science. She made reference to the difficulty of scientific language stating, "We've got this booklet and it's got this incredible high level vocab words and I can't pronounce all these parts of plants and that sort of thing so it's just really annoying." In contrast, Anne stated that although she may not have the science knowledge it did not put her off teaching science. She commented, "I don't want them to miss out because I don't have the knowledge ... so I think always positive because I personally love science."

While teachers felt anxious about the difficulty of scientific language they also made frequent references to feeling competent enough to tackle most science questions asked by their students. They were able to recall and identify teaching episodes where students asked difficult science questions which they were unable to respond to immediately. Most participants referred to feeling somewhat anxious but confident to investigate unknown content. Fiona, a beginning teacher, was not very enthusiastic or confident in teaching science. Fiona reflected her negative attitude by stating:

> *"You come into a school … you are faced with science and I can't say nah I couldn't teach it. I have to do it. So when I have to study what I am going to teach I am always very doubtful."*

Fiona felt inadequate when teaching science. However, when she used the prepared booklet and took the time to prepare her own science lessons her confidence and level of enjoyment increased and her perceived level of difficulty of the task reduced. She stated "I had revised my booklet a few times so I knew what I was talking about [and] didn't have to refer to it so much."

Discussion

This study set out to investigate Year 8 teachers' attitudes toward the teaching of science. In general, the teachers had positive attitudes toward teaching science to primary students. The 'dimensions of attitudes toward science' framework proposed by van Aalderen-Smeets et al. (2012), and discussed earlier in the current paper, is used as a lens by which to understand the teachers' attitude toward teaching science. This framework was used independently of data coding in the current study, and thus adds weight to the validation of the van Aaldereen-Smeets framework. By using the framework further understanding of the teachers' attitude toward science teaching could be garnered.

The discussion is framed using the three dimensions and their subcomponents:

1. Cognitive beliefs: perceived relevance; perceived difficulty; and gender beliefs
2. Affective states: enjoyment and anxiety
3. Perceived control: self-efficacy and context dependency

Teachers' Cognitive Beliefs: A Purpose for Teaching Science

In the current study all the teachers, except Fiona, believed that primary science was important and could clearly articulate a purpose for teaching primary science. The teachers believed the purpose of science education was to give students an opportunity to develop investigations about the world around them and to give them a foundation for further science learning. This belief impacted positively on their professional attitude toward science teaching (van Aalderen-Smeets et al., 2012) as they could see the value of teaching science. When teachers perceive science as relevant and important they often have positive attitudes (OECD, 2008; van Aalderen-Smeets et al., 2012, van Aalderen-Smeets & Walma van der Molen, 2013). While Fiona thought science was important for a career in science she could not articulate clear aims or purposes for teaching science. Nor did she think science was relevant to the lives of the students she taught. These aspects seem to have contributed to her negative attitude toward teaching science.

Not only did most of the participants perceive the importance of science they also recognised the importance of their role as teachers in achieving the aims of science education. Regardless of teaching experience, science or non-science backgrounds, teachers discussed their role as important in assisting students to investigate and build hypotheses about the world in which they live. As the primary school curricula focuses on literacy and numeracy it is unsurprising that the importance of science is down played. So, it is heartening that the majority of teachers in the current study saw the value of teaching science.

The perceived difficulty of science relative to other subject areas can influence teachers' attitudes toward teaching science. While the teachers in the current study did not state overtly that teaching science was more difficult relative to other curriculum areas, some of the teachers did make comment about difficulties in relation to science language. Because of the issue they had with understanding the science language for themselves, they were more anxious and found it more challenging to teach science. So while the content booklet was helpful for planning, its inclusion of perceived complex and difficult language suggests that some teachers still need additional substantive content support, and material resources alone are insufficient to support their teaching.

Gender beliefs have been found to influence teachers' attitudes towards science teaching (van Aalderen-Smeets et al., 2012). However, in the current study the teachers did not delineate between men and women's abilities with respect to science teaching nor with respect to boys and girls in their classroom.

Teachers' Affective States: Enjoyment and Anxiety of Science Teaching

The degree to which a teacher has positive or negative emotions when teaching science may affect their attitude and behavior (Mulholland & Wallace, 1996; van Aalderen-Smeets et al., 2012; van Aalderen-Smeets & Walma van der Molen, 2013). Teachers in this current study experienced both enjoyment and anxiety when teaching science (van Aalderen-Smeets & Walma van der Molen, 2013). This aligns with the NMSSA report that also reports teachers enjoy science but do not always feel confident to teach the subject (EARU & NZCER, 2013). The study by van Aalderen-Smeets and Walma van der Molen (2013) suggests that teachers who enjoy teaching science but also feel anxious about it "view teaching science as a challenge" (p. 593). The current study shows that when teachers felt a sense of enjoyment and passion teaching science it had a direct positive influence on their attitudes toward teaching science. Even if there was a slight element of anxiety when

teaching science, teachers who also experienced positive feelings of joy and pleasure were willing to learn about science related concepts (Mulholland & Wallace, 1996).

Teachers' Perceived Control over Their Teaching

The participants in the current study who had the most teaching experience had a high sense of self-efficacy and felt confident about teaching science which in turn influenced their attitude to teaching science in positive ways. However, teachers who perceived themselves as capable of approaching the task of teaching science concepts which may be perceived as difficult and stressful, may have positive attitudes regardless of their background or experience (Bandura, 1997). This was certainly the case for Anne, a beginning teacher, who had little experience in teaching but also had a high sense of self-efficacy toward teaching science.

No matter whether teachers in the current study had high or low self-efficacy toward teaching science all of the teachers had a high context dependency. They appreciated the provision of a laboratory space and relied on supplied materials to help them teach science. All the teachers described feelings of confidence toward having a space to teach science to their students. Teachers reported positive feelings in having a science laboratory with access to the necessary equipment to conduct practical experiments as opposed to teaching science in the classroom. They believed that this was also a much safer way to teach science to students.

The teachers reported having a higher sense of self-confidence when teaching science units from written resources, pre-designed by the school's science curriculum leader. They believed such contextual factors were necessary for teaching (van Aalderen-Smeets et al., 2012). In particular, teachers with the least teaching experience felt having a structured science programme supported their science teaching. Teaching confidence toward science occurs when teachers feel well supported, particularly when they are in the early stages of developing understanding in science ideas (Harlen, 1997; Harlen & Holroyd, 1997; Sharp, Hopkin, & Lewthwaite, 2011).

However, having a structured programme was not a panacea for increasing motivation to teach science and having a positive attitude while doing so. While Fiona had the support of the written resource she still did not have the motivation to teach science as she did not see its value for the students in her classroom. So in this case any support for developing content knowledge or pedagogical content knowledge was not going to increase the amount of time Fiona gave to science teaching.

In addition, while the teachers with more experience appreciated a programme of science that had been developed for their use, they also reported the need for more autonomy when teaching in such a structured programme. This may show that teachers who have the pedagogical content knowledge have more confidence or self-efficacy to teach science and therefore require more autonomy teaching science to support a positive attitude toward science (Bandura, 1997; van Aalderen-Smeets & Walma van der Molen, 2013).

For Deidre, a teacher with experience, she had mixed feelings about the resources. She experienced anxiety about the written resources due to the difficulty of scientific language used. At the same time she appreciated being able to go to the resources if she got stuck when teaching, but she also noted she wanted more autonomy from the prescriptive nature of the programme. This mixture of feelings highlights the multidimensional notion of attitude and the complexity embedded within the construct.

Implications

Both the ERO report (2012), and the NMSSA (EARU & NZCER, 2013) state that schools should raise their commitment to science teaching and learning. They call for opportunities for greater support and ongoing professional learning and development for teachers. This current study, albeit small scale, offers some insights into teachers' attitudes toward teaching science and consequently some implications for teacher support and professional learning and development, to create positive attitudes towards teaching science.

For the participants in the current study it appears their school was committed to science teaching and learning and provided the resources to support their practice. Irrespective of their teaching background or level of experience, the teachers in this study were mostly appreciative of the support they received, particularly the two beginning teachers. However, cognizance needs to be taken of the multiple needs that teachers have with respect to support. While teachers were appreciative of the pre-prepared materials, some teachers also needed the opportunity to have some control over what they taught. So it appears that while there is a dependency on contextual factors there is also a need to create a culture of autonomy with regard to teaching science, particularly for more experienced teachers. For other teachers, while support through resources and space was well received, there was still a level of anxiety about teaching science. So, the level of support needed is greater than the provision of a science resource booklet. Support through collegial and collaborative planning, and sustained peer-to-peer mentoring has the potential to improve attitudes. Particularly, if those with positive attitudes act as role models (Taylor, Peplau & Seals, 2006). Therefore, in considering future science learning environments, schools need to focus on the provision of emotional and collegial support, and give due consideration to the affective state of their teachers, as well as providing systemic support through resource material and spaces in which to teach science effectively. The challenge for schools is to offer a range of support measures, systemic as well as emotional and to find a balance between the perceived need of contextual factors to support teaching science and the need for autonomy. Given that attitudes are informed and shaped through a variety of personal experiences, indications from the current study, suggest that the type of support provided needs to be done on an individual basis.

The current study also raises implications for teachers' professional learning and development. Given the teachers' responses and perceptions, little traction will be gained in engaging teachers in science professional development without first uncovering teachers' motivations for wanting to, or not wanting to, teach science in the first place. For the teachers in this study, having a clear understanding of the relevance and purpose of science and the significance of their role in teaching children science, were contributing factors to a positive attitude. If they could see the value in teaching science for the children in their classroom they were more likely to find the time to teach science. This may be the case for other Year 8 teachers too. So, it is important that there is a clear focus on the purpose of science and paying attention to teachers' reasons, or not, for teaching science, prior to any professional development about science pedagogy. This is maybe more significant than ever, when it is apparent that literacy and numeracy take precedent over other curriculum areas.

The current study also has implications for the approach to professional learning and development. A multidimensional approach to professional development has been reported as having achieved some success (e.g., Lewthwaite, 2006; van Aalderen-Smeets, Walma van der Molen, van Hest, & Poortman, 2017*).* van Aalderen-Smeets et al. (2017) found that teachers engaged in a large scale inquiry project had only some positive effect in changing primary teacher's attitude, but note that a previous study by van Aalderen-Smeets and Walma van der Molen (2013), in which professional development that specifically focussed on attitude

change, had a greater impact on teachers' attitudes. As a result, a combination of approaches, that is, inquiry and a focus on attitude change, is suggested for supporting changes in teachers' attitudes towards science teaching.

The authors of this current study, suggest that given the individualised needs of the teachers, a multidimensional approach has much to offer and propose that the potential success of a multidimensional approach could be investigated further. Drawing on previous research about teachers' understanding of the Nature of Science (NOS), the current authors propose that the success of a multidimensional approach could rest on the findings within the NOS research. In studies about NOS, change has occurred when activities have been both *explicit* and *reflexive* (Lederman, 2007). The authors of this current study suggest that the same could be true for changes to attitudes in which teachers need to engage in professional development that has a focus on attitudinal change and that this is made *explicit* to the teachers undertaking professional development. And, given teachers' individual needs, teachers be given multiple opportunities to *reflect* on the changes they are making at both an individual and collective level.

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