RE-ENVISAGING THE TEACHING OF MATHEMATICS: ONE STUDENT TEACHER'S EXPERIENCE LEARNING TO TEACH PRIMARY MATHEMATICS IN A MANNER CONGRUENT WITH THE NEW ZEALAND CURRICULUM.

JUDY BAILEY
Faculty of Education
The University of Waikato

Abstract

Teacher education can provide opportunities for contributing towards a re-envisaging of the teaching and learning of mathematics in the primary classroom. This study documents the experiences of one student teacher who, during her mathematics education courses, embraced a perception of mathematics as a social, creative and experiential discipline. During her subsequent teaching practicum she sought to teach mathematics using a variety of problems set in meaningful contexts with an emphasis on children being creators of mathematics. Michele's experience suggests that student teachers can effectively learn and implement ways of teaching mathematics that support the aspirations of New Zealand's curriculum document.

Key words

Mathematics, primary teacher education, New Zealand Curriculum.

Introduction

There have been attempts to change the nature of teaching and learning mathematics in New Zealand over the past few decades (Walshaw & Openshaw, 2011). In the mathematics curriculum document (Ministry of Education, 1992) a focus was placed on problem-solving, developing logic and reasoning, and communicating mathematical ideas. The curriculum advocated for the use of a problem-solving approach and identified mathematics as a creative discipline with a focus on thinking and requiring communication (Ministry of Education, 1992). In a similar vein, the revised New Zealand Curriculum (Ministry of Education, 2007) includes an expectation that the key competencies (thinking; relating to others; using language, symbols and texts; managing self; and participating and contributing) will be an integral part of all learning areas including mathematics. In the statement describing mathematics and statistics, mathematics is positioned as an active discipline where learners are creating, exploring, investigating, justifying, explaining, communicating and making sense (Ministry of Education, 2007). Each set of mathematics and statistics achievement objectives is preceded with a statement that reads, "In a range of meaningful contexts, students will be engaged in thinking mathematically and statistically. They will solve problems and model situations …" (Ministry of Education, 2007).

Data collected for the 2010 New Zealand Council for Education Research survey (Burgon, Hipkins, & Hodgen, 2012) regarding the implementation of the New Zealand Curriculum (Ministry of Education, 2007) revealed that there have not yet been widespread changes to the curriculum being enacted in the classroom. It is also reported that the introduction of the New Zealand Curriculum Mathematics, Reading and Writing Standards for Years 1–8 (Ministry of Education, 2009; commonly referred to as the National Standards) has diverted some energy and attention away from the New Zealand Curriculum implementation (Burgon, Hipkins, & Hodgen, 2012). If primary mathematics teaching and learning is to reflect the intent of New Zealand's curriculum document, student teachers may need to be provided with experiences that support them to construct alternative ways of thinking about teaching and learning, including in the discipline of mathematics. Student teachers who have experienced didactic modes of teaching and learning may need to encounter ideas that are incongruent with their own experiences, beliefs and opinions in order to challenge and shift these. Support from teacher educators may be needed for alternative ideas to be considered, and for student teachers to make conceptual changes (Coburn, 2005; Kane, 2007; Korthagen, 2004; Labaree, 2000; Russell, 2007). For example, teacher educators could engage student teachers in solving mathematical problems set in a range of meaningful contexts. When such problems are presented, mathematics can become an experiential process where learners are regarded as creators of mathematical knowledge

(Anthony & Walshaw, 2007) and mathematics is seen as a social human activity (Freudenthal, 1991). Rather than following set, pre-determined steps, multiple strategies or approaches are likely to be used in the solving of problems, and in some cases there may be multiple solutions (Breyfogle & Williams, 2008). Learners will be expected to justify their answers and methods and also support, communicate with and help others in their learning (Boaler, 2002, 2008). When teaching mathematics in this way there is an embedded focus on the development of a relational rather than instrumental or procedural mathematical understanding. A relational understanding of mathematics is where a learner has a deep understanding of and makes connections between ideas, and can draw on more than one way to solve mathematical problems (Suggate, Davis, & Goulding, 1998).

This study

This paper reports on a small study with one student teacher, Michele (pseudonym), and her experiences of teaching and learning in primary mathematics in a manner congruent with the New Zealand Curriculum (Ministry of Education, 2007). This student teacher completed two mathematics education courses towards her teaching qualification. Both courses modelled mathematics as a social, creative and experiential discipline, and included an emphasis on the development of relational understanding of the mathematics ideas being explored. Following successful completion of the second-year mathematics education course, Michele embarked on her second teaching practicum: a six-week block where she worked in a school alongside an associate teacher, teaching across a range of learning areas including mathematics. Following the practicum Michele met with the author, and in a semi-structured, recorded interview, shared her experiences about the teaching of mathematics with an emphasis on the knowledge gained from the second mathematics education course, and second practicum. Documents, including her assignments and planning and assessments from practicum, were also collected. Data were analysed for themes and insights into Michele's experiences of teaching mathematics.

Overview of Michele's experience

Learning through an assignment

The final assignment completed in the second-year mathematics education course included planning, teaching and evaluating a mathematics unit with a small group of 11–12-year-old children. Michele described her initial attempts in her unit and teaching as still quite traditional and "task-oriented" with a focus on short tasks, and wanting one specific answer from the children. After reflecting on her first teaching session Michele adapted her unit to include problem-solving (Michele sometimes called these investigations) with an emphasis on children's sense-making. An example of an additional task was a "Rope Number Line Activity: This rope (5 m) represents one whole. I want you to use it to construct a number line between 0 and 1. On that number line mark (accurately, do not guess) the fractions, percentages and decimals that you know". This task exemplifies some of the characteristics of a problem re: being open-ended, requiring children to explore and be the "thinkers", needing a longer period of time to complete, and catering for different levels of understanding. Michele referred to her developing approach as an inquiry or "explorative" approach to learning mathematics, and explained that "this whole concept of being able to explore and do inquiry learning through mathematics was new to me and I really enjoy it". Michele wrote in her assignment:

> I have always enjoyed mathematics and this paper has expanded my mathematical thinking. One aspect that I have found especially stimulating is the move away from the rote learning of mathematics that I was taught when I was at school. This has challenged me to develop a fractions unit, with an approach different to that which I was familiar with that allowed the students to use explorative approaches whilst giving fractional thinking a contextual relevance.… After the second lesson I realised that I had not allowed enough time for reflection and was not encouraging the students to share their ideas, and build on peers' ideas. Nor had I provided any open-ended investigations.…

Having eventually and successfully merged an "explorative approach" into her unit, Michele decided to incorporate this approach in her mathematics teaching during the second practicum. During the pre-practicum meeting with her associate teacher Michele was informed she would be teaching

measurement, with a focus on length, perimeter, area and volume, to a class of 25 Year 7 and 8 children.

Consolidating new learning

Michele began her practicum mathematics unit with a traditional pencil and paper pre-test of short answer questions (as required by her practicum school). She also wanted to include more open-ended tasks in this diagnostic assessment, and so conducted an additional exploratory session where the children were asked to do and think about four measurement activities that were stationed around the classroom. These included an activity to explore the children's understandings about the measuring of length in millimetres, centimetres, metres and kilometres; a task that explored relationships between perimeter and area; a task on interpreting a scale on a map to estimate distances; and a scaling of a three-dimensional rectangular prism. Michele provided appropriate equipment at each station for the children to use if they wished. The children rotated around the four stations in small groups. At each station the children were required to individually record their thinking on paper. These recordings were collected and analysed by Michele using a system of no understanding, little understanding, some understanding and thorough understanding. Michele observed that the mathematical ideas embedded in the "station tasks" were not fully understood or completed by most of the children at this point. From an analysis of the children's thinking Michele decided to begin her unit with a recap of conversions between metric units for length (mm, cm, m and km). She then moved on to perimeter; the relationship between area and perimeter; the volume of cuboids; and, lastly, the scaling of three-dimensional rectangular prisms.

Michele structured each section within her unit in a similar sequence. To start, small groups shared their thinking about the idea (e.g., perimeter). This was followed by whole class sharing/brainstorms and then whole-class teaching occurred which sometimes included the use of worksheets and textbooks for practising the application of formulae. The children's original "station" work was then handed back for their re-consideration. Time was provided for thinking about and completing the original exploratory task.

Additional contextually based tasks were introduced into the unit at appropriate points. The "station" tasks and most of the unit-based activities required some time (e.g., half or most of a one-hour lesson) to complete. While most of Michele's planned activities had one solution, there were usually a range of possible approaches to solve the question and/or complete the task. For example, a task she included focusing on area and perimeter was, "Mary has 24 metres of fencing to make a paddock for her pet lamb. How should she put up the fence to create the largest area of grass?" This task has many solutions but only one that maximises the area of grass for the lamb. Students were able to explore the area of a variety of shapes, compare their relative areas, and also learn that a perimeter can remain constant but the area of shapes enclosed by that perimeter will vary.

Children as problem-solvers

On numerous occasions during the recorded interview Michele referred to the importance of children developing a deep and connected understanding of what they were learning. Michele did not view her role as demonstrating a particular mathematical procedure that the children were then expected to follow. Rather, there was an expectation children would be problem-solvers with an embedded emphasis on the children making sense of the mathematics being encountered. Michele described her role as one of being a facilitator of the children's thinking. She said she wanted the children to engage in discussion, and explained how she asked questions throughout her teaching to encourage their thinking and sense-making. She provided time for children to think and make connections, and recorded their ideas on the whiteboard so others could access them. An example Michele described centred on the children's efforts to determine the formulae for finding the perimeter of polygons. When the children offered "length + width" as a formula for determining the perimeter of a rectangle she recorded this on the whiteboard, expecting the children to make sense of the suggestion and offer other ideas. An alternative suggestion of "length + width x 2 [sic]" was then suggested by another child and eventually this was revised to "the sum of all sides" when the possibility of shapes other

than quadrilaterals were considered. Michele deliberately sought to not be the person who "corrected" the formulae. She said, "I didn't correct it … I let them correct.…"

Michele also explained that it was important to "give them [the children] the chance to understand it [the formula] in their own words or their own thinking". She emphasised the importance of children using their own language rather than formal, mathematical language, comparing it to her trying to learn a new subject in a new language. She explained she would need to learn the new subject in her own language first before using a "different" (mathematical) language.

Michele mentioned that some of the children in the practicum class did not enjoy questions not being immediately answered, and being expected to think through problems for themselves. Michele explained that she had persevered with the facilitation role rather than be pressured by the children into being "the person with the answers".

Meaningful contexts

The use of meaningful contexts to explore mathematical ideas was very important to Michele. On numerous occasions she explained how valuable it was to use contexts relevant to the children and their life beyond the classroom. She said, "I think it's exciting when children see mathematics outside of the classroom, outside of the book." An example of this was the creation of a scenario where a tissue box did not fit into the dashboard of Michele's car. The task asked children to reduce all dimensions by one half, and find out what the new tissue box would look like. Although this was not a problem as such, Michele envisaged the children experiencing first hand the resulting change in volume (reduced to 1/8) when a rectangular prism is reduced by one half in three dimensions. Michele was resourceful in locating and using a variety of resources that incorporated contexts like the tissue-box task. These included ideas from text-books, web-based activities and children's literature; for example, *Sir Cumference and the First Round Table* by Cindy Neuschwander (1997) was used to explore the meaning of π.

Catering for a range of learners

Michele stated that this "inquiry or explorative" approach benefited and simultaneously catered for a range of learners, even those who might be perceived as not being mathematically able. She described how she thought it was important for *all* children to "discuss, share, consolidate and learn new things". Michele suggested that perhaps there was no need for teaching children in separate ability groups as is common practice in many schools. She suggested that her experience indicated that using combinations of whole-class and small group work with an emphasis on children thinking and making sense of the mathematics simultaneously catered for a range of learners.

That the children in the practicum class were engaged with Michele's mathematics unit was verified by her lesson evaluations, comments from her associate teacher, and a "trainee teacher survey" completed by the children towards the end of Michele's practicum. Twelve out of 16 children responding to the survey indicated that they usually or always (options included sometimes, usually, always and unsure) found they were interested and motivated by Michele's lessons (this question referred to all curriculum subjects). Children were also asked to write in response to the "starter" "The best things I have done in class during one of the trainee teacher's lessons are…". Thirteen out of 24 comments referred to mathematics and included comments such as "learning how to work out the circumference of a circle" and "I now knoe [sic] what pi is" and "maths (measurement) she made it easy to understand and really clear" and "learning the formulas [sic] for volume, areas and perimeter".

Discussion

Links to the New Zealand Curriculum

These interview data indicate that Michele appears to be learning to teach mathematics in a manner congruent with the intent of the New Zealand Curriculum vision, learning area description of mathematics and description of effective pedagogy (Ministry of Education, 2007). Michele's emphasis on using contexts that connected with the learners is also consistent with the contention

made in the New Zealand Curriculum document that students' prior learning and experiences are taken into consideration. Teaching mathematics in the way Michelle described is also compatible with problem-based learning where a problem suitable for the learners is chosen and the emphasis is on connecting "the problem with the context of the students' world, so that it presents authentic opportunities" (Bartlett, 2005, p. 25). Michele provided the children with a social, creative and experiential approach to learning mathematics. She established a setting where children were encouraged to discuss their ideas with each other, and the tasks she used allowed the children to experience the ideas being explored and discover (create) mathematical ideas themselves.

Michele's description of her teaching practice demonstrated that key competencies such as "thinking" can be effectively integrated with mathematics teaching and learning. Michele expected the children to be thinkers, with an emphasis on making sense of the ideas being explored. An example of the children "creating knowledge", one aspect of the key competency thinking, was Michele's expectation that the children devise the formula for finding the perimeters of shapes. Opportunities were also provided for children to work with each other, drawing on their combined existing knowledge to make increasing sense of the varying formulae that were proposed during lessons. In this process links can also be seen to the key competency of "relating to others". Aligning with the expectation that mathematics learning can be social and include "participating and contributing", Michele sought to establish an atmosphere where children could effectively work together and share their ideas. Such prioritising of the key competencies is fundamental to the successful implementation of the New Zealand Curriculum (Barker, 2008; Hipkins, 2006; Hipkins & Boyd, 2011).

That Michele readily articulated connections between her teaching practice and the New Zealand Curriculum is consistent with the research reported by Bailey and colleagues (2010). They found some student teachers, albeit a small number, were able to make and enact connections between their mathematics teaching practice and aspects of the curriculum document, such as the key competencies. When Michele was asked about links between her practice and the document, she said she could see connections to the key competencies, and also referred to an aspect of the vision where children are regarded as lifelong learners. She believed this approach to the learning and teaching of mathematics was "teaching children how to learn, and I think by doing it like this you are teaching them to be ongoing learners throughout life. You are teaching them that the answer isn't always going to come from a teacher". Michele's emphasis on lifelong learning is consistent with the findings of the 2010 NZCER survey (Burgon et al., 2012) regarding practising teachers' perceptions about the curriculum document, with almost all teachers being found to regard this aspect as particularly important. Supporting children to learn how to learn is one of the principles of the curriculum (Ministry of Education, 2007, p. 9), and the expectation of children being active seekers, users and creators of knowledge appears in the vision (p. 8). Michele's cognisance of these aspects of supporting children to learn is rather impressive given her position as a pre-service teacher.

What might Michele's experiences mean for others?

The 2010 New Zealand Council for Education Research survey of the implementation of the New Zealand Curriculum reported "gaps between the value teachers accorded to specific practices and the self-reported frequency of classroom implementation of those practices. Seeing something as important had not necessarily translated into specific changes in pedagogy" (Burgon et al., p. x). Michele first became aware of such a "gap" in her practice during her mathematics education unit plan assignment. Her willingness to think about and reflect on her teaching practice as suggested by the "teaching as inquiry" model in the New Zealand Curriculum (p. 35) suggests that a disposition to reflect is a necessary attribute for teachers to have to affect change in pedagogy. Such "reflecting on practice" is regarded as a critical activity in curriculum change in Begg's model of "educational development" (Begg, 2008).

Also apparent in Michele's practice is an openness to consider alternative ways of teaching that move beyond past, personal mathematical experiences. This suggests self-awareness and an inquiring disposition may enable the disruption of what Kane (2007) refers to as the robust and tenacious nature of student teachers' preconceptions. As Michele remembers, her personal experiences as a learner of mathematics included transmissive teaching, rote-learning, and completing mathematics exercises

quickly. She also spoke about her enjoyment of and confidence in this subject. Michele explained that when she was a learner at school there was no exploratory or inquiry learning in mathematics. Even though Michele's memories of her school mathematics experiences were positive, she was also aware of the less than positive school mathematical experiences that many of her fellow student teachers had shared. Michele demonstrated her openness to teach in a different way, stating, "I wanted to change the way I had been taught". She was delighted that this "new" way of teaching mathematics could be a reality in the classroom. Reflecting about the children's engagement, she said, "It was working."

Michele's experiences suggest there needs to be perseverance when trying something new. As Michele began her teaching of the mathematics unit for her university-based assignment she realised that despite her intentions to teach in a more open way, she was initially not achieving what she hoped for. Re-focusing her intention, changing her planning and being willing to adapt her activities provided a way forward. Perseverance was also needed later, in the face of some resistance from some children, evident during Michele's practicum teaching. Perseverance is known to be a key issue in learning mathematics (see Lee, 2009) and is also likely to be an important factor when dealing with what Timperley, Wilson, Barrar and Fung (2007) refer to as the challenging shifts teachers are expected to make in times of mathematical reform.

The data collected in this study would support the contention that, although not a guarantee of success for improved outcomes for student learning, there needs to be time and repeated opportunities for teachers to learn when undertaking professional development in mathematics education (Timperley et al., 2007). Michele's experience suggests that changing one's teaching is an incremental process taking time and multiple opportunities to consider and trial new ideas. The mathematics education courses offered in Michele's teacher education programme created opportunities for her to re-envisage mathematics teaching and learning. Repeated occasions within a class setting (of up to 30 student teachers) to engage in and consider a range of ways to solve mathematical problems that catered for a range of learning needs, with an embedded emphasis on developing a relational understanding, appear to have had an impact on Michele's thinking. Additional opportunities in her own teaching practice, for the unit plan assignment and during practicum, furthered her learning.

It is important to consider why Michele was successfully able to engage and embed a new way of learning and teaching mathematics. Michele's attitude, engagement and achievement during her mathematics education courses demonstrated her confidence and mathematical competence. Did this enable her significant professional development? Maybe it was her willingness to deeply engage in class activities, study the provided readings and thoughtfully reflect on her own experiences? An important question to be asked is whether student teachers that are not initially positive about mathematics and/or are mathematically anxious can also experience and implement change? Another question to consider is aligned with the thinking of Tanase and Wang (2010). They suggest, "… whether these changes can be hold [sic] throughout their program and into their actual teaching is still a question that is worth exploration" (p. 1246).

It is interesting to note that Michelle experienced resistance from some children to the expectation of being the "thinkers" and not having questions answered immediately by the teacher. It would seem the competency of "managing self", where students work towards developing a can-do attitude, is one that can need careful and ongoing development in mathematics. Michele explained that she persevered with the facilitation role rather than be pressured by the children into being "the person with the answers". Michele's persevering, at least in the short term of this practicum, contrasts with the teacher mentioned by Dossey (1992). The students in his class found this approach to be threatening, and he returned to a more traditional, presentation mode of mathematics teaching. Maybe Michele's confidence in mathematics (evident in her assignment work and discussions about practicum), as well as her earlier, successful attempts with this mathematics teaching approach facilitated her perseverance.

Conclusion

Teaching mathematics is a complex and challenging task. Student teachers have much to learn as they begin their journey to become teachers who are effective with supporting children's learning in mathematics. Michele appears to have developed deep and rich insights about a range of issues to do

with the teaching and learning of mathematics. Having completed two compulsory mathematics education courses, Michele's commentary indicated she had experienced considerable conceptual change regarding what it might mean to learn and teach mathematics. She successfully implemented a social, creative and experiential approach for supporting children's mathematics learning during her final mathematics education assignment work and second teaching practicum. Michele's approach is congruent with aspects of the New Zealand Curriculum's vision, learning area description of mathematics, of effective pedagogy, and the key competencies of thinking and managing self and aspects of relating to others. A study of Michele's experiences suggests being aware of and reflective about one's current teaching practice, a willingness to make changes, and perseverance are important attributes for student teachers to have. Michele's positive experience is consistent with the suggestion from Tanase and Wang (2010) that, to some degree, conceptual change may be possible for some student teachers during a short-term intervention. This case study provides hope that the aspirations of New Zealand's current curriculum document can be fulfilled within the mathematics classroom by student teachers who actively engage in learning about teaching mathematics in a manner congruent with the New Zealand Curriculum.

Acknowledgments

With gratitude, and in admiration of "Michele"—for her willingness and openness to learn and implement new ideas with a focus on supporting children's learning in mathematics.

References

Anthony, G., & Walshaw, M. (2007). *Effective pedagogy in Mathematics/Pāngarau. Best Evidence Synthesis Iteration [BES]*. Wellington, New Zealand: Ministry of Education.

Bailey, J., Blakeney-Williams, M., Carss, W., Cowie, B., Hawera, N., & Taylor, M. (2010). Exploring the front end of New Zealand Curriculum in student teacher education: An example from language and mathematics education. *Waikato Journal of Education, 15*(1), 65–78.

Barker, M. (2008). The New Zealand Curriculum and preservice teacher education: Public document, private perceptions. *Curriculum Matters, 4,* 7–19.

Bartlett, J. (2005). *Developing independent learners: The planning and implementation of an inquiry-based curriculum integration programme at Kuranui College*. Wellington, New Zealand: New Zealand Council for Educational Research.

Begg, A. (2008). *Emerging curriculum*. Rotterdam, The Netherlands: Sense.

Boaler, J. (2002). *Experiencing school mathematics: Traditional and reform approaches to teaching and their impact on student learning*. Mahwah, NJ: Lawrence Erlbaum.

Boaler, J. (2008). *What's math got to do with it?: Helping children learn to love their least favorite subject—and why it's important for America*. New York, NY: Viking.

Breyfogle, L., & Williams, L. (2008). Designing and implementing worthwhile tasks. *Teaching Children Mathematics, 15*(5), 276–280.

Burgon, J., Hipkins, R., & Hodgen, E. (2012). *The primary school curriculum: Assimilation, adaptation or transformation. NZC at primary and intermediate level: Findings from the NZCER National Survey of Primary Schools 2010*. Wellington, New Zealand: New Zealand Council for Educational Research.

Coburn, C. E. (2005). The role of non-system actors in the relationship between policy and practice: The case of reading instruction in California. *Educational Evaluation and Policy Analysis, 27*(1), 23–52.

Dossey, J. A. (1992). The nature of mathematics: Its role and its influence. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 39–48). New York, NY: Maxwell.

Freudenthal, H. (1991). *Revisiting mathematics education: China lectures*. London, England: Kluwer.

Hipkins, R. (2006). *Background to the key competencies.* A report prepared by NZCER for the Ministry of Education. Wellington, New Zealand: New Zealand Council for Educational Research.

Hipkins, R., & Boyd, S. (2011). The recursive elaboration of key competencies as agents of curriculum change. *Curriculum Matters, 7,* 70–86.

Kane, R. (2007). From naïve practitioner to teacher educator and researcher: constructing a personal pedagogy of teacher education. In. T. Russell & J. Loughran (Eds.), *Enacting a pedagogy of teacher education: Values, relationships and practices* (pp. 60–76). London, England: Routledge.

Korthagen, F. (2004). In search of the essence of a good teacher: Towards a more holistic approach in teacher education. *Teaching and Teacher Education, 20,* 77–97.

Labaree, D. (2000). On the nature of teaching and teacher education. *Journal of Teacher Education, 51*(3), 228–233.

Lee, C. (2009). Fixed or growth—does it matter? *Mathematics Teaching, 212,* 44–46.

Ministry of Education. (1992). *Mathematics in the New Zealand Curriculum*. Wellington, New Zealand: Learning Media.

Ministry of Education. (2007). T*he New Zealand Curriculum: For English-medium teaching and learning in Years 1–13*. Wellington, New Zealand: Learning Media.

Ministry of Education. (2009). *New Zealand Curriculum Mathematics, Reading and Writing Standards for Years 1-8*. Wellington, New Zealand: Learning Media.

Neuschwander, C. (1997). *Sir Cumference and the first round table: A math adventure*. Watertown, MA: Charlesbridge.

Russell, T. (2007). How experience changed my values as a teacher educator. In T. Russell & J. Loughran (Eds.), *Enacting a pedagogy of teacher education* (pp. 182–191). London, England: Routledge.

Suggate, J., Davis, A., & Goulding, M. (1998). *Mathematical knowledge for primary teachers*. London, England: David Fulton.

Tanase, M., & Wang, J. (2010). Initial epistemological beliefs transformation in one teacher education classroom: Case study of four pre-service teachers. *Teaching and Teacher Education, 26*(6), 1238–1248.

Timperley, H., Wilson, A., Barrar, H., & Fung, I. (2007). *Teacher professional learning and development: Best Evidence Synthesis Iteration*. Wellington, New Zealand: Ministry of Education.

Walshaw, M., & Openshaw, R. (2011). Mathematics curriculum change: Parliamentary discussion over the past two decades. *Curriculum Matters, 7,* 8–25.