# MATHEMATICS EDUCATION IN A TIME OF EARTHQUAKES: HOLDING ON AND LETTING GO

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In times of natural disasters, ordinary lives are unexpectedly thrown into extraordinary situations. In 2011, a devastating 6.3 magnitude earthquake struck Christchurch, a city of 380,000 people in the South Island of Aotearoa/New Zealand. In this article, we use mathematics education as a connecting thread to describe two stories of 2011; the first draws on our experiences as mathematics teacher educators in a university setting, and the second relates to a postgraduate mathematics education course and the remarkable group of educators who participated in the course. We aim to describe how mathematics education as a shared human activity played a number of important roles in that extraordinary year, in both deliberate and unexpected ways. And by drawing on our experiences, we hope to make sense of our changed understandings and practices, and at the same time engage with mathematics education as a "praxis of living" (Coles & Brown, 2015) in the different but still difficult post-disaster years.

The 22 February earthquake struck at 12.51 p.m. and although the 6.3 reading was less than the 7.1 earthquake in the previous September, the compression forces and alignment of the fault-lines in the surrounding hills of the city meant that it was far more destructive. There was significant loss of life and 185 people died, mostly in the centre of the city, with serious injuries sustained by many of the survivors. A national state of emergency was declared and the centre of the city cordoned off for the rest of the year. Significant aftershocks continued on a daily basis resulting in approximately 3 500 recorded by 1 June, followed by another large damaging aftershock on 13 June. By the year's end there had been 6 500 aftershocks. People living in the city and surrounding regions were under serious strain due to the effects on their families, homes and lives, as well as exhaustion and stress from aftershocks, interrupted sleep and the daily practical problems of living in a post-quake environment.

## A mathematical aside

The severity of an earthquake is often described in terms of its "magnitude", which is a measure of the energy released [1]. Magnitude is recorded on a logarithmic scale, such that each unit represents a significant increase in energy. For example, a magnitude 5 earthquake releases around 30 times more energy than a magnitude 4. Since the first earthquake in 2010, a new localised conversational pattern has emerged with quasi-mathematical references. A typical conversation could be:

> "That's a three, must be a three"
>
> "Yeah, three point seven I reckon"
>
> "Yeah, nah, more like three point five."

On one level we appeared to be talking about numbers or, at the very, least estimation, using a scale to represent each earthquake's intensity. These conversations occurred between friends and strangers alike, as a way of connecting to each other and describing our experiences:

> "Four point three, four point four," she said. "You'll be okay". She bounded upstairs to check the GeoNet website. She came back down triumphant. "Four point four." It was a daily game, this filing of earthquakes under precise knowable numbers, and a small attempt to assert human control. (Low, 2014, p. 43)

Specifically understood by locals, the closer our estimations were to the official reading the more we felt we were somehow making sense of a physical phenomenon that was beyond our control.

## Immediate and ongoing issues for mathematics teacher educators

During the three weeks immediately after the February earthquake, our focus was on safety and on keeping connected with our students and colleagues. We established email or phone contact with students as soon as systems were up and running, making connections and providing information about courses that were to begin in the middle of March, when the university was to re-open. We found that both undergraduate and postgraduate students really wanted face-to-face contact in either timetabled teaching classes or informal *ad hoc* meetings. These classes or meetings were opportunities for students to be with others as a distraction from damaged or temporary homes, to have contact with lecturers as a connection with their courses, and, most importantly, to share stories. Although our university prioritised online supervision and teaching due to a shortage of physical teaching spaces, we were able to schedule a limited number of class sessions for most of our courses. We were also aware that many student teachers had made arrangements among themselves to meet informally, where mathematics education course work was a legitimate purpose for much needed social connection and companionship.

Our staff materials and the mathematics education equipment and other resources we used in our courses were all trapped in a five-storey building that was damaged and assessed as dangerous for entry (this building has now been demolished). Jane was one of the last to leave the building on 22 February so knew that all staff offices and mathematics storerooms were a mess, as though everything had been spun in a washing machine and ended up on the floor, while Sue's office was drenched because sprinklers had been automatically activated. Although we received kind offers of resources from our New Zealand mathematics education colleagues, this was not a practical solution due to lack of storage in our homes or on campus. We therefore had to plan for teaching with a very different repertoire of resources. While we had to abandon much of our "normal" teacher education curriculum for our courses, we also had to design "new normal" curricula by working around significant constraints: disrupted contact with students, limited course time and a lack of physical resources. In addition, there was a need for additional care and support of students, plus significant pressure on staff time and energy, so we had to choose our priorities for mathematics education.

As the year progressed, we recognised that in such intense times we had to "constantly shift and negotiate our positionings as mathematics educators" (Boylan, Brown, Nolan, Portaankorva-Koivisto & Coles, 2015, p. 39). Our choices and decisions were informed by the social, conceptual and cultural resources that we brought to each situation. A core aspect of Sue's teaching, for example, has drawn on Mason's (2002) ideas about disciplined noticing, where noticing within both learning and teaching situations was reasoned and related to future actions. With substantial and ongoing changes to the curriculum of each course, decisions about how to proceed were examples of "being present and sensitive in the moment, having a reason to act and having a different act come to mind" (Mason, 2002, p. 1). Jane had often used Greeno's metaphor for number sense as navigating in a conceptual environment (Greeno, 1991) and this metaphor also proved useful in constrained times. Knowing your way around an environment means knowing what resources are available, where to find them, and how to use them. In our "new normal" of mathematics education, being attuned to affordances and constraints of our pedagogical environment took on new meanings (Greeno, 1994).

The importance of social relationships seems obvious, but in hindsight the new rhythm of social interaction was crucial. Our face-to-face classes started the way all Christchurch conversations seemed to start, with the sharing of immediate experiences: the aftershocks, the ongoing changes in the city, each person's situation or practical suggestions and offers of help. Although the focus was on our daily lives, we noticed that these shared conversations were about "interesting properties or relations they have heard about or discovered" (Greeno, 1991, p. 183). We recognised that these interactions were an important foundation of everyday social relations and we avoided the temptation to get the earthquake conversations over with in order to get on to mathematics education. Talking about our shared daily experiences created new communal funds of knowledge (Moll, Amanti, Neff & Gonzalez, 1992) and a means of sustaining caring social connections (Noddings, 2013). Mathematics education talk and practices still occurred, but in different ways and often in more focused and intense ways, as we will explain in the following section.

As lecturers, we were understanding of "quake brain"—a local term that described how it was easy to forget things, to start a sentence or a conversation and lose the thread:

> During the time of the thousands upon thousands of aftershocks, the bench shaking as you peeled the potatoes, the office desk jolting, the bed shuddering, people began to report a new syndrome: "quake brain". You were vague, forgetful. You left the car keys in the fridge, you forgot where you had parked the car. Dealing with everyday life, in addition to dealing with requirements of insurers, repairs, simply finding your way about the city, was simply too much. Your mind, it seemed, too had broken into 100 tiny pieces. (Farrell, 2015, p. 345)

For everyone in the city, including ourselves, there was a particular kind of exhaustion that built up during the year, especially after the large 13 June quake. We noticed that our students were tired and recognised that many were dealing with difficult ongoing situations so we were accepting of students who were doing their best. We decided to let go of some institutional protocols and were flexible about practical issues such as assignment submission dates, finding that over time, the quality of student participation and individual assignment work was equivalent to previous years. So in holding on to the value of social relations, we sustained necessary connections and pathways, and by letting go of some course expectations, we found that students had a different, but not diminished, course experience.

## Vignette of one mathematics education course

The postgraduate course, "Contemporary issues in mathematics education", was due to start in the week of the earthquake and so was understandably delayed for three weeks. Some of our enrolled students withdrew due to their changed family or school circumstances. Five students continued: three primary school teachers who had full time study awards providing leave from their schools until November, and two mathematics advisors responsible for in-service and other professional learning for primary school teachers. We had previously worked with the mathematics advisors so there were some established relationships before the course began. During the time that the university was closed, the three teachers were still connected with their schools and involved in their school clean-up and support of their school communities. By the time the course started, most city schools were open again in some form or other and the teachers could withdraw their commitment in order to focus on their studies.

Our retrospective reflections have identified three important aspects of this particular course that we think have implications for our mathematics education work with teachers. The first confirms the importance of social opportunities and, for these teachers, opportunities to talk with other experienced teachers. Next, to our surprise, a relatively contained base of research provided a rich focus for the

course. And lastly, an unexpected constraint on one course assessment prompted a response that we have continued to implement. We will briefly discuss each and in the spirit of the title of this article, we will highlight what we held on to and what we let go, or at least let go in its usual form.

As we have previously described, connecting socially was important whether online or face-to-face, and this was also the case for these five experienced educators. We established email or phone connections with everyone as soon as possible, and managed to meet face-to face on 11 April and again on 10 June, 1 July and 27 August, supplemented with emails and phone calls. The two advisors saw each other regularly in the course of their work and the three teachers met and corresponded informally.

A core philosophy of the mathematics education course was that teachers pursue interests and dilemmas of their own choosing in addition to engaging with the course content. We always suggested possible authors and/or readings and practical information about access to journals and other materials that would help them follow their interests without being overwhelmed in their searches of the mathematics education literature. We continued to keep to this practice but abandoned our usual ways of beginning the course after reading the contributions in the first online forum in late March. Instead of setting up inquiry themes that organised and scaffolded questions and discussion followed by prescribed readings and further content throughout the course, we immediately responded to a common issue put forward by each of the teachers—a concern about the between-class and within-class grouping practices in their schools.

The research of Jo Boaler was already part of the course content but we prioritised her work as the first theme of the course. We recognised that this focus on grouping practices was an example of dedicating more time and attention to one "place" in a conceptual environment, in order to activate resources and explore them in more depth (Greeno, 1991). By early April we had managed to find two copies of Boaler's (2008, 2009) book and it was the focus of our first class meeting. The USA version was accessed from the re-opened university library and Jane found her copy of the UK version during the second brief "raid" into her office under rescue team escort. These two books were passed around the group as a scarce but valued resource. One teacher managed to access a copy from the public library by late April, another ordered a copy and when it arrived, read it during a night of aftershocks.

One chapter generated the most attention and discussion: Chapter 5, "Making 'low ability' children: how different forms of grouping can make or break children" revealed how practices in primary classrooms restrict opportunities to learn and to participate in purposeful meaningful mathematics, particularly for lower streamed groups or classes. Reading this chapter was a "light bulb" moment because the research resonated with the teachers and advisors. We remember a shared sense of relief that here was a researcher who had made visible an important aspect of teachers' programmes and practices, and had validated their sense of unease and professional compromise related to grouping children according to their assessed "ability" in mathematics. During the first two class meetings, these experienced educators intensely discussed the ways that their current curricular and classroom practices and organisation shaped the learning opportunities for their students.

We were living in a city where our daily lives were being shaped by large forces in both the social and physical environments. And now our class conversations were about how teaching practices can shape learning for particular groups of students, and by thinking together about what was *important for students,* it was possible to consider how to change organisational and curricular contexts of a mathematics programme. Reassuringly, it was within our sphere of influence as educators to be able to make changes to how mathematics could be experienced by all of our students. As the year progressed, and the political and economic realities unfolded, equity became a critical focus of attention. In a city where there were now clearly going to be winners and losers (Klein, 2008), the three teachers in particular wanted to prioritise equity in their future classroom mathematics programmes (Boaler, 2008, 2009).

One other significant change to the course resulted from an external constraint on research opportunities. When a national state of emergency is declared in New Zealand, central agencies have the power to place a moratorium on some research activities. A moratorium on all new social research in the Canterbury region was imposed in order to focus resources on rescue and recovery efforts, to protect the affected population by prioritizing safety over research beneficence, and to manage the potential influx of researchers from outside (including from overseas) who see a natural disaster as a research opportunity. When the moratorium was lifted on 1 May 2011 (when the state of emergency was lifted), the Ministry of Education, in partnership with Canterbury schools, set out a research protocol for all new research in schools. In past years, our postgraduate mathematics education course involved a substantial assignment based on a small-scale research investigation carried out in the teacher's own context, often with a small group of students. Although theoretically it would have been possible to carry on with this assignment by registering with the Ministry of Education, we were very aware of the difficult situations in many local schools.

We decided to abandon the research assignment and instead trial a "Professional Inquiry" assignment, based around two cycles of pre-planning for an action research inquiry that could be carried out in the future. Although a new assignment, we retained some features, such as using an earlier assignment to provide a research-informed base for the focus and scope of the inquiry, and we scaffolded feedback and discussion at the beginning and midpoints of the process. We let go of the need for empirical data, something that is currently privileged at national and school governance levels. We held on to and strengthened the teacher description and rationale of their inquiry issue. The inclusion of at least two cycles of preparation provided opportunities for clarifying assumptions, revisiting existing research, and finding greater focus, resulting in more detailed written planning for their future action research. We also noticed a greater depth of teacher explanation and justification of their professional inquiry, using research and their praxis to communicate their thinking.

## Concluding reflections

Writing this article has been an opportunity for us to revisit and to further understand our work during 2011. A lapse of almost 5 years has provided renewed insights as we review our self study data and contribute new conversations. We held on to some fundamental principles such as the importance of social relationships in any learning and teaching situation. We also learned that our students, both beginning teachers and experienced practitioners, wanted to gather together in person on a regular basis, with or without us, and that meeting for mathematics education served important social and professional purposes. We re-calibrated our class conversations to prioritise new discursive ways of relating so that talk about immediate concerns could nurture and sustain more intense and often deeper mathematics education conversations.

We learned a great deal from the postgraduate class of teachers and advisors. We continued with core principles of responding to their interests and contexts but we let go much of the previous course content in order to pursue their immediate focus on Boaler's research. We relied on their valued experiences and thoughtful, knowledgeable critique of their contexts; these educators were clearly setting out their own paths during these times. In an email exchange with one course member at the end of that year, Jane wrote

> I often worried to Sue that we weren't "teaching" enough; … (not including) all the online "stuff'" (powerpoints, forums, *etc*.) that courses now seem to have. I think that is probably the lesson for me, was to focus on what you, the students, wanted, go with this and see where it headed. I saw you all as very independent learners and also learning so much from each other too, so it's good to know that you feel pleased with what *you* have achieved.

Another course participant recently reminded us that their course readings, thinking and writing served as a welcome distraction, even respite, from the daily difficulties, a legitimate time to *not* think about earthquakes and associated anxieties and unknowns. Our letting go probably resulted in a more co-constructed course, where course members were navigating both individual and shared pathways of exploration, with a greater commitment to their own learning through focussed reading and writing.

Earlier in this article we suggested that our teaching and curriculum design actions illustrated some of our pedagogical values for mathematics education. The records of our planning conversations during that year are understandably incomplete while we tried to thoughtfully respond rather than simply react to the pressing demands of our work. Looking back on that year, we believe that our pragmatic yet reasoned responses were informed by some shared ideas from the field of mathematics education. A conceptual lens of disciplined noticing was an implicit guiding principle when our pedagogical actions were directed to more intense mathematics education learning for our students in constrained times. Identifying diverse conceptual and material resources within our mathematics education environment also helped us to navigate our way through unknown pedagogical terrain (Wilson & McChesney, 2013). Some of our practices, such as the importance of social relationships and of student funds of knowledge, were already explicit in our courses. We also knew that in learning mathematics, "less can be more". It should not need a natural disaster to learn or re-learn these lessons! We believe, however, that by trying to make sense of our actions, decisions and responses, our reflective reconstruction of 2011 illustrates the concept of a praxis of living, described by Coles and Brown (2015), citing Bruner (1990), as "a way of being in which we find out about what we think and believe through observing what we do" (p. 45). Throughout this process we were also drawing on the wider field of mathematics education as a means of sustaining us in disrupted times.

## Postscript

In the years following the 2011 earthquakes, we have continued to adapt and respond to imposed changes to our courses and our professional environment. One consequence of our experiences is a greater understanding of some of the "essences" for student teacher learning in mathematics education, and these are important resources for us to hold on to in challenging times. In the three iterations of the postgraduate course since 2011, we have continued a substantial focus on equity in mathematics education, and retained and strengthened the professional inquiry assignment. We have noticed that the pressures on teachers in Christchurch have not diminished, simply changed due to centralised policies related to schooling in the region, the subsequent upheavals for many schools, and the rebuild and repair of school buildings. We have recognised that teachers are often exhausted earlier in each school term so we have continued our policy of flexible accommodation of their course work.

The media's pervasive reach means that we may be more aware than ever about natural disasters that regularly occur in many parts of planet Earth; there are earthquakes, floods, storms, landslides, bush or forest fires, cyclones, typhoons, and volcanic eruptions, where lives and daily practices are disrupted. We have written this article to make better sense of our experiences and to counter heroic or individual resilience narratives.

On Sunday 14 February, 2016, we had another significant earthquake followed by the typical envelope of aftershocks. Now known as the Valentine's Day earthquake, there was an uncanny sense of *déjà vu* for us at the university because February is the start of our first semester. This quake was less damaging, but our networks and systems are also more robust and within 24 hours our student teachers were in mathematics education classes, in checked and safe buildings. Jane's group of secondary student teachers rocked up first thing on Monday to continue the second week of their course, and similarly, in Sue's whole-cohort lecture of third year primary mathematics education, all students were present on the first day of their course. And yes, we both began our classes with the critical social glue of students sharing stories and looking out for each other.

## Notes

[1] The mathematics of earthquakes can be examined in more detail on the website of the US Geological Survey: http://earthquake.usgs.gov/learn/topics/measure.php

## References

Boaler, J. (2008) *What's Math Got To Do With It: Helping Children Learn to Love their Most Hated subject – And Why It's Important for America*. New York, NY: Viking.

Boaler, J. (2009) *The Elephant in the Classroom: Helping Children Learn and Love Mathematics.* London, UK: Souvenir Press.

Boylan, M., Brown, L., Nolan, K., Portaankorva-Koivisto, P. & Coles, A. (2015) Praxis in mathematics teacher education: introduction to a series of short communications. *For the Learning of Mathematics* **35**(1), 39.

Coles, A. & Brown, L. (2015) Being mathematics teacher educators in the praxis of living. *For the Learning of Mathematics* **35**(1), 45-47.

Farrell, F. (2015) *The Villa at the Edge of the Empire: One Hundred Ways to Read a City.* Wellington, New Zealand: Random House.

Greeno, J. (1991) Number sense as situated knowing in a conceptual domain. *Journal for Research in Mathematics Education* **22**(3), 170-218.

Greeno, J. (1994) Some further observations of the environment/model metaphor. *Journal for Research in Mathematics Education* **25**(1), 94-99.

Klein, N. (2008) *The Shock Doctrine: The Rise of Disaster Capitalism.* Toronto, ON: Random House.

Low, N. (2014) Ear to the ground. In Gracewood, J. & Andrew, S. (Eds.) *Tell You What: Great New Zealand Nonfiction 2015,* pp. 35-49. Auckland, NZ: Auckland University Press.

Mason, J. (2002) *Researching Your Own Practice: The Discipline of Noticing.* Abingdon, UK: Routledge.

Moll, L. C., Amanti, C., Neff, D. & Gonzalez, N. (1992) Funds of knowledge for teaching: using a qualitative approach to connect homes and classrooms. *Theory into Practice* **31**(2), 132-141.

Noddings, N. (2013) *Caring: A Relational Approach to Ethics and Moral Education* (2nd edition). Los Angeles, CA: University of California Press.

Wilson, S. & McChesney, J. (2013) Navigating and noticing: pre-service teachers' journeys in planning mathematics programmes. *Curriculum Matters* **9**, 102-119.


# Communications

## "Dear Math: I hate you"


MARION DEUTSCHE COHEN


"Dear Math, I hate you". Or "Dear Math, I love you". Or just plain "Dear Math". That's the nickname my students gave to the assignment to write a letter (or a poem, or a temper tantrum…) *to* math. The course is Mathematics in Literature. We study short fiction and poetry connecting to mathematics in some way (as science fiction connects to science). Students range from mathematics majors to math haters and math fearers.

Our readings have included stories like *Inflexible Logic* by Russell Maloney, about six monkeys who, way against the laws of probability, type, consistently and word for word, great works of literature. Our poems have included Rita Dove's *Flashcards*, about her childhood as a math whiz who nonetheless felt pressured by school and father when it came to mathematics. In the homework and class conversation questions, I encourage but don't require students to use the readings as points of departure for sharing their own experiences and lives.

This journal recently published "Monsters, lovers and former friends: exploring relationships with mathematics via personification" by Dov Zazkis (2015). The article describes the process of *personification*, which means attributing human qualities to non-human entities. Zazkis asked his students to "personify Math. Write a paragraph about who Math is… How long have you known each other? What does he/she/it look… act like? How has your relationship with Math changed over time?" My own "Dear Math" assignment is a special case of Zazkis's personification assignment. I had not previously given much thought to the idea of personification so I found Zazkis's article interesting and affirming.

Zazkis grouped his students' writing as envisioning mathematics as monster, lover, or former friend. In their writings, mathematics as monster was something inhuman, an enemy, to fear, avoid, and in general feel negative about. Mathematics as lover, and beloved, was something to feel comfortable with and positive about. And mathematics as former friend, and current un-friend if not downright enemy, was something or someone who had betrayed, disappointed, or refused to communicate; the relationship had deteriorated from good to bad to worse—to toxic and break-up. Zazkis's students wrote some revealing stories and, like my own students, sometimes in greater quantity than was required.

When I first introduced the Dear Math assignment, I was surprised that many, perhaps most, of my students had in their previous courses been discouraged from second-person writing. Possibly their teachers had meant to discourage second-person writing on certain occasions, but the *message* the students took away seemed to be that second-person writing was taboo. I wanted to convey my own message that, in many instances, second-person can be more than okay. We talked about the various ways in which we've all *already* used second-person—letters, email, texting, ordinary conversation, advertising, writing in (or to) a diary, songs ("You, you, you / I'm in love with…"), and self-help and guide books ("You shoulda coulda woulda…). There have also been pieces of literature written in second-person—for example, the best-selling novel *Bright Lights Big City* by Jay McInerney.

So second person is *not* taboo. To give the students further inspiration and affirmation, I read aloud to them three examples of second-person writing that were, in particular, writing to a specific field of study. Two of these were love poems; one, *An der Musik* (To Music), by Franz Schumer, a friend of Franz Schubert, who set the poem to music, and the other, *An der Mathematik* (To Mathematics), by me. The third reading was a hate letter to mathematics, that I had found on the internet. The students seemed to enjoy this third example, since it was written as though the writer had had a relationship with