The impact of experiences, dispositions, and beliefs on practice

Robyn Reaburn
University of Tasmania
Carol Murphy
University of Tasmania
Tracey Muir
University of Tasmania
Noleine Fitzallen
LaTrobe University

It has long been recognised that how mathematics educators view the nature of mathematics affects the way they teach it. For example, those who believe that mathematics consists of only rules and procedures, are more likely to teach just rules and procedures. Those who believe that mathematics is a static body of knowledge out there to be discovered, are more likely to teach with the aim of developing students' understanding. Those who believe that mathematics is a dynamic, ever expanding area of human creation, are more likely to encourage their students to be problem-posers and problem-solvers (Ernest, 1989). In reality, it is expected that mathematics teachers will teach using a variety of these approaches, depending on the topic, context, and their own experiences. It is important, therefore, that mathematics educators examine their beliefs and what affect these might have on their teaching. The papers in this issue examine this intertwining of beliefs about mathematics and teaching, along with experiences, and the impact they have on teaching practice.

For many Pre-Service Teachers (PSTs) their first introduction to considering beliefs about mathematics will occur when they read their course syllabi in their tertiary studies. In this issue, Max examines the syllabi of mathematics content courses for elementary PSTs and describes what messages the syllabi give about the nature of mathematics, both openly and implied. Many of these syllabi state that mathematics is part of the real world, and that mathematics is a sense-making activity. In addition, many of these syllabi encourage students to believe that they are capable of doing mathematics and promote collaboration so that students motivate each other, share ideas, and access more difficult tasks. This paper challenges teacher educators and teachers to examine their own syllabi to see what messages are being conveyed about mathematics and mathematics learning.

Two other articles by Mandt and by Jao et al. examine the dispositions and beliefs of PSTs. Mandt describes the concept of "eudaimonia" (living well and flourishing) in relation to the emotional nuances that emerge in PSTs' narratives as they talk about their journey to becoming a mathematics teacher. The PSTs expressed excitement as they learnt how to fulfil their desire to be "good" mathematics teachers, and "hope" for a good relationship with students to help them through their struggles. In contrast, when the PSTs explored how their identity evolves from these emotional nuances, they felt "frustration" because the teaching they observed in schools did not match their beliefs about good teaching that had developed during their teaching training. Despite their frustration, overall, the PSTs saw themselves as developing an identity as reform mathematics teachers.

Jao et al., take the position that reform-based teaching, which encourages student-centred and inquiry-based teaching approaches, increases students' autonomy and confidence. Their paper describes a qualitative study where mathematics PSTs were asked to describe experiences in their mathematics content and mathematics pedagogy courses that affected their thinking about teaching mathematics. They found that at first the PSTs tended to use traditional

approaches to teach mathematics, partly because this is the way they were taught themselves. For many of the PSTs the mathematics pedagogy courses were their first experience of reform-based teaching approaches. Part of the PSTs pedagogy courses were spent in practice teaching to their peers, and they were very positive about these experiences, because they could practice reform-teaching methods in a non-threatening environment. In contrast, the mathematics content courses were usually taught in a traditional manner. However, the greatest impact was the time spent on field placements, where they experienced collaboration, were encouraged to try out different ideas, and learnt about the variety of students they would encounter in the future. In their conclusion, Jao et al. stress the importance of allowing PSTs to experience authentic teaching experiences.

Quigley examines classroom teachers' beliefs about a widely used component of current mathematics teaching in elementary schools, the use of concrete materials. She found that the majority of participant classroom teachers believed that the use of concrete materials enhances student engagement and understanding, and allows students to represent their thinking about mathematical concepts. When it came to how these concrete materials were used in the classroom, the teachers stated that they were useful for demonstrating concepts, but that it was also important to ask challenging questions during their use. In addition, the students used these concrete materials when working independently. Quigley suggests that the teachers who use these materials held a constructivist view of learning, that is, "learning [is] a student construction of knowledge, including the use of and reflection on physical actions" (Reys et al., 2020). In her conclusion, Quigley also gives a timely reminder that teachers need to consider the difference between "engagement" and "fun".

We now come to the final two papers in this issue, Calleja et al. and Benning. These papers describe experiences of mathematics teachers while undertaking professional development (PD). Calleja et al. describe PD using a Just-in-Time learning (JITL) process to support teachers to learn about and enact inquiry teaching in their classrooms. The JITL process has three aspects, learner self-directedness, time-independent learning, and the provision of applicable materials. This PD involved the use of online resources, face-to-face meetings, the development of community within and across schools, and the sharing of reflections of students' reactions to the inquiry learning that resulted. The on-line resources were available at any time the teachers felt they were needed. Using the zone of enactment model (Spillane, 1999) as a framework for their analysis, the authors found that the participants became more mindful of students' previous experiences in mathematics and of the students' ideas. They became more aware that students were resources for improving their own inquiry practices. The participants also reported that the collegiate support improved their strategies in the classroom, and helped them to persist in using inquiry learning. The participants also talked about increased confidence to take on challenges, to accept critique from colleagues, and feel better able to change. However, some of the participants did feel isolated within their own schools.

The final paper in this issue, by Benning, also examines the results of a PD program. This program aimed to develop practising teachers' skills in effective mathematics pedagogy (Anthony & Walshaw, 2007) using Geogebra, a widely used software application for teaching mathematics. Such PD has the potential to develop teachers' TPCK - the integrated knowledge of technology, pedagogy, content, and beliefs about how technology supports mathematics learning (Mishra & Koehler, 2006). The study found that the teachers were effective in using Geogebra to produce worthwhile mathematical tasks (Anthony & Walshaw), where students could make connections and develop mathematical ideas, and where the teachers were enabled to use a range of assessment strategies. The teachers, however, were less successful in promoting mathematical discussion and searching for alternative solutions.

In summary, these papers illustrate how teachers' experiences and beliefs about mathematics, how students learn, and how to teach mathematics, affects what teachers do in the classroom, and what practices are enacted. We commend these papers to you and hope that they prompt you to reflect on your own beliefs and practices, and the impact they have on the students you teach.

Anthony, G., & Walshaw, M. (2007). *Effective pedagogy in mathematics/pāngarau: Best evidence synthesis iteration [BES*]. Ministry of Education.

Ernest, P. (1989). The impact of beliefs on the teaching of mathematics. In P. Ernest (ed.), *Mathematics teaching: The state of the art.* The Falmer Press.

Hinz, B., Walker, L., & Witter, M. (2019). *Learning from the best: What makes an excellent teacher of mathematics?* https://pivotpl.com/wp-content/uploads/2020/07/Learning-from-the-best_-What-makes-an-excellent-teacher-of-maths.pdf

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017-1054.

Reys, R., Lidquist, M., Lambdin, D. V., Smith, N. L., Rogers, A., Cooke, A., Bennett, S., Ewing, B., & West, J. (2020). *Helping children learn mathematics* (3rd Aust. ed.). John Wiley & Sons Australia.

Spillane, J. P. (1999). External reform initiatives and teachers' efforts to reconstruct their practice: The mediating role of teachers' zones of enactment. *Journal of Curriculum Studies, 31*(2), 143–175.