Editorial

Researching High Quality Pedagogical Practices in Mathematics Education: Shifting beyond identifying and implementing to empowering the next generation

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You could read MTED Issue 16(2) from the perspective of a walk down a Mathematics Education Memory Lane. There are reminders of a transmission pedagogy in mathematics education (Adam and Chigeza), and *some of* what we have focused on over time to improve the quality of mathematics education: developing conceptual understanding (Stohlmann, Cramer, Moore and Maiorca), using assessment as a pedagogical tool (Wallace), building student personal characteristics to enhance their learning opportunities (Clarke, Roche, Cheeseman and van der Schans), increasing students' idiosyncratic participation in mathematics learning that can increase their engagement (Marshman and Brown), and overcoming the disengagement of some teachers with mathematics learning and teaching (Maasepp and Bobis). Many of these papers capture the struggles encountered in orienting pre-service teachers (PSTs) and teachers to the identified practices, and increasing their capacity to enact these practices. Some capture the complexities associated with enacting such pedagogies and learning outcomes from them. One of the questions Raoul Adam and Pholemon Chigeza consider is the possible synthesis of transmission and discovery pedagogies that are generally considered as a binary. Your walk down memory lane may help you consider such a possibility and benefits from it. A summary of each paper is now provided to entice you into the MTED 16(2).

With regard to conceptual understanding, Stohlman, Cramer, Moore and Maiorca's paper "Changing pre-service elementary teachers' beliefs about mathematical knowledge" offers us opportunity to examine the impact that a mathematics and pedagogy course emphasising conceptual understanding had on 30 PSTs' beliefs and mathematical knowledge. The course design employed the Lesh Translation Model (Lesh, 1979) to construct understanding of conceptual mathematical knowledge through multiple representations and make connections between and within these representations. The PSTs were provided with representations of Grade 6 children's thinking of a fractions division problem to illustrate the benefits of understanding conceptually. After small group discussions on procedural and conceptual knowledge of mathematics, a reflection assignment focusing on "How would you know if students understood fraction division?" was completed by the PSTs. Insights from this task revealed a pedagogical shift in the PSTs' appreciation for well-structured classroom activities developing mathematical reasoning, and conceptual knowledge adds meaning to the procedures. How the PSTs' beliefs translate into future practice is the next step to investigate.

With regard to assessment, the professional learning journey of secondary mathematics PSTs in their understanding and practice of assessment is the focus of the study reported in Wallace's paper "Secondary Mathematics Pre-service Teachers' Assessment Perspectives and Practices: An Evolutionary Portrait". Wallace frames his study using a linear dimension model of traditional to reform-oriented assessment practice. He identifies three phases of learning through qualitative analysis of three semi-structured interviews with PSTs, from diverse backgrounds in prior study and

employment experience, conducted across a course of PST education. These phases are summarised as learning how to assess, learning what to assess and then learning how to use the information gathered by assessment. He notes that PSTs spend longer in the phase of learning how to assess, as they experiment with different methods of assessment before moving on to consider and appreciate the other dimensions of assessment knowledge and practice.

With regard to personal characteristics of students that can be built to increase students' mathematics learning potential, a noticeable issue associated with employing challenging tasks in the classroom has been finding ways to encourage student persistence in the face of a challenge. The *Encouraging Persistence Maintaining Challenge* project is a professional learning program to assist teachers in constructing new knowledge and practices with non-persistent students. In their paper "Teaching Strategies for Building Student Persistence on Challenging Tasks: Insights Emerging from Two Approaches to Teacher Professional Learning," Clarke, Roche, Cheeseman and van der Schans present two different professional learning experiences of primary and secondary teachers. The first is "the Victorian professional learning approach", a two-day professional learning workshop with 55 teachers, and the second, "the Tasmanian professional learning approach", a model employing demonstration lessons with 12 teachers observing multiple lessons taught by expert teachers in one day. Although similar outcomes were noted at the conclusion of participation in the two models in successfully supporting teachers' understanding of students' persistence, differences in the focus of these two cohorts were also recorded, such as, monitoring children for the Tasmanian teachers and aspects of "time" for the Victorian teachers. When selecting professional learning approaches in the future these differences may be worthy of consideration.

In relation to student engagement with mathematical ideas, socio-cultural theory of epistemology and pedagogy is employed to frame Marshman and Brown's study "Coming to Know and do Mathematics with Disengaged Students." They investigate inquiry-based pedagogy for a class of disengaged Year 9 students in an Australian secondary school. They employ qualitative analyses of students' written reflections at the end of each lesson, and the teacher's reflective journal to evaluate collective argumentation as a means of scaffolding students' learning. Their findings illustrate the value of expecting students to present and justify their findings to the class for the successful application of the model of collective argumentation for engaging these Year 9 students. In some sense this study illustrates the way in which an abstract epistemological perspective of mathematics as reasoning and argumentation can be developed through implementation of inquiry-based pedagogy.

In relation to PSTs negativity associated with teaching and learning mathematics, in "Prospective primary teachers' beliefs about mathematics," Maasepp and Bobis make a case for addressing these negative beliefs because this negativity has a detrimental impact on future teaching practices. This paper examines the impact a mathematics content-focused intervention designed to nurture positive mathematical beliefs via collaborative group work and inquiry-based learning experiences had on five PSTs. The PSTs' beliefs were tracked through several approaches including the creation of a concept map that was reviewed and added to over time. Interviews, workshop observations, and an analysis of the concept maps revealed the tutor's teaching practices and personal interest in mathematics and the practical tutorial activities inspiring creative thinking were fundamental in promoting a new perspectives of mathematics in PSTs. The selection of appropriate tutors who possess a strong mathematics content knowledge and able to develop a positive rapport with PSTs is critical for fostering an environment for positive change of beliefs.

Raoul Adam and Pholemon Chigeza in "A binary-epistemic approach to the identification and (re)solution of "wicked" epistemic-pedagogic problems in mathematics education" review the literature to explore and resolve oppositional positions in mathematics epistemology and mathematics pedagogy. They theorise these oppositional positions as binary, that is either/or positions, for example transmission/discovery pedagogy and concrete/abstract epistemology, and claim that binary perspectives are detrimental for the students' experience of mathematics. They present three models of juxtaposition of these binaries and argue for a more balanced approach to epistemology and pedagogy, one that is situated and contextual. They illustrate this model with an

example from Year 5 Australian Curriculum. These binaries are confronting for PSTs and challenging for practicing teachers as born out in the other papers in this issue. Their recommendation of a more balanced and equitable epistemological and pedagogical approach is an invitation for further research on enacting this approach in practice.

Many papers in this issue portray a shift beyond developing pedagogies associated with the constructs identified herein, towards introducing PSTs and teachers into such practices. These papers show that there are several aspects to what needs to be addressed associated with differences between *realising* what could be possible and *implementing* practices to achieve this. They also provide insights into how this could be achieved. As we read about those entering pre-service teacher education who are disengaged with mathematics learning and teaching, we are reminded of how important it is to nurture the development of PSTs / teachers' expertise in pedagogical practices that engage students in the learning of mathematics. No matter how far we come, there is still more to consider and explore. There are papers within that capture many aspects of the complexity of teaching and learning, and point beyond what is already illuminated in cutting edge practices to what could be accented to further increase learning quality. Your walk down memory lane with reminders of a transmission approach and 'new pedagogies' that have developed over time will hopefully support your considerations of possibilities for connecting what have been identified as binary approaches, whether there are benefits to doing so, and how taking such a direction might impact PST education and teacher professional learning. These papers provide much food for thought.

References

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