

*Editorial*

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## Complexities of teaching—features of teacher education programs and professional learning practices to support their development

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The four articles in this MTED Edition include research from tertiary (Kensington-Miller and Yoon), secondary (Wasserman and Ham), and primary mathematics learning (Beswick & Muir) contexts and a teacher statistical literacy focus (Chick & Pearce). They capture differences in the extent to which those whose learning is the focus controlled the learning situations in which they participated. For example, Kensington-Miller and Yoon's tertiary mathematics lecturer controlled his changes to questioning in his lecturers whilst supported by mathematics education researchers, Wassermann and Ham's teachers described differences in the amount of experimentation they had access to in their teacher education programs, and Beswick and Muir's pre-service teachers identified what they still needed to know as they observed video of an expert teacher and responded to predetermined prompts from their tutor. Chick and Pearce, on the other hand, drew attention to the increased statistical literacy needed to enable teachers to access information from national and international testing programs and teacher education programs that can support this type of learning. Despite the diversity in contexts and in areas of mathematical and pedagogical focus, these papers together draw attention to complexities associated with mathematics teaching, and stimulate reflections on how teacher education programs can support development of such complex expertise.

Kensington-Miller and Yoon's paper on 'Changing beliefs about teaching in large undergraduate mathematics classes' captures the unexpected large magnitude of change in the teaching practices of a traditional lecturer of large-group (350 students) undergraduate mathematics classes. The research team included this lecturer and two mathematics education lecturers interested in identifying how to use questioning to add an interactive element to these lectures in which students were passive participants. Data included written reflections, journal notes, and interviews with both students and the lecturer, and field notes and written reflections from other research team members. Over time, the lecturer's espoused and enacted beliefs changed from the lecturer as source of all mathematical knowledge to the belief that student discussion could contribute to greater learning than continual lecturer presented examples. This lecturer began to integrate these questions into the curriculum and to design, test, reflect, and

refine his lecturing to optimize this newly recognised learning approach. The study highlights pedagogical benefits attained because the lecturer was open to change in practice and was supported by inclusion (with mathematics educators) in the research team. The paper draws attention to a process in transition where the lecturer has not yet reconciled differences between his now espoused belief that students rather than the lecturer should consider and discuss student questions and his enactment of lecturer evaluation of these questions. The active role of the lecturer in this change process, the part played by ongoing feedback from opportunities to try new ideas in lectures, and the less prominent role of the mathematics education researchers supporting the process of change are useful to keep in mind when considering differences in the nature of the mathematics education programs discussed by Wassermann and Ham.

Wasserman and Ham's paper on 'Beginning secondary maths teachers' perspectives' draws attention to the on-going challenges associated with attracting and retaining high-quality candidates for secondary mathematics teacher education programs, and the pros and cons in providing different types of programs to attract such candidates. The findings have implications for recruitment strategies and for the design of pre-service education programs—especially opportunities for pre-service teachers to observe and experience teaching in the field. 'High-performing' graduates were drawn from a traditional (4 year undergraduate) and a fast-track training program (3 week plus on-going program) where 'high performing' was determined through evidence of strong mathematics content and pedagogical content knowledge and relevant personal attributes. The researchers investigated the most important attributes for successful transition to full-time teachers as perceived by these beginning teachers. Some findings that were not surprising were that these teachers brought with them the personal attributes of hard work and believing in all students, and that they perceived that important mathematics content knowledge was learned before and during the program and continued to be learned as teachers. Of more significance were these teachers' perceptions about mathematical pedagogical knowledge (in particular practicing inquiry-based learning and employing practical tools such as technology), and the capacity to contextualise learning for the particular school and student cohort. Teachers from the traditional program perceived they were provided with more opportunities to experience inquiry-based learning themselves and to see it in practice whereas teachers who had participated in the fast-track program perceived they relied on readings and did not get to witness inquiry based learning often enough. Alternately the teachers from the fast-track program, with the majority of their teacher education occurring on-the-job as beginning teachers, perceived they had been provided with more realistic opportunities to learn about their students, culturally, personally and mathematically. Wasserman and Ham's findings confirm the value of pre-service programs that provide extended opportunity to observe and experience inquiry-based learning of mathematics and those that value opportunity to be teachers in the field with students in schools where they are likely to be employed. These researchers point

to the need for further exploration across a more representative sample of graduating teachers (rather than only high performing graduates). We note that retention of capable beginning secondary mathematics teachers is also a matter of urgency and suggest an important area for further study is: Are the attributes identified as necessary for transition to beginning teacher sufficient for retention? The vicarious exposure to classroom practice enabled through video stimulated discussion in Beswick and Muir's paper may be useful to those considering how to increase exposure to teaching practice in the fast-track program.

Beswick and Muir's paper on 'Making connections: Lessons on the use of video in pre-service teacher education' examines primary pre-service teachers' interactions with video excerpts of a local teacher working with small groups of students in class. These excerpts captured teacher interactions with groups of Year 8 students who the teacher found had a 'shaky' understanding of place value and decimals. During pre-service teacher observation of the video, their tutor paused the video and asked questions that stimulated discussion (using the tutor observation protocol). These pre-service teachers completed a survey during their observations (with time to complete it just after the session if required). Surveys showed these pre-service teachers valued their discussions of questions posed, and wanted to know more about how to develop students' mathematical understandings of place value and decimals, and why the teacher had decided to change his intended lesson plan. It was recommended that in the future, further prompts be added to the video observation protocol to deepen pre-service teacher reflections, and shift them to more evidence-based rather than opinion-based discussions. Although the researchers pointed to limitations in the survey method and recommended pre-service teacher interviews be added to the research design, they pointed to the sufficiency of this study in pinpointing areas where change in the program could be desirable and in doing so raised questions for future study. This study draws attention to the need for better pre-service teacher understandings of place value and decimal notation. This raises questions about how much pre-service teachers' limited understandings of decimal notation contribute to Chick and Pearce's findings that many teachers require greater statistical literacy.

Chick and Pearce's paper on 'Statistical literacy needs of teachers' draws attention to governments and education authorities' assumptions that their professional employees can interpret the statistical information they provided. These professional employees include teachers and principals in all sectors, and education bureaucrats who require statistical literacy skills to interpret assessment data reported by national and international testing programs to inform policy and practice in schools and systems. Chick and Pearce's previous studies have demonstrated that the task of interpreting statistical data presented in graphs in various reports was indeed challenging for teachers. Their study published in this edition provides important information for designers of pre-service and in-service teacher education and leadership programs to develop such skills. In their paper Chick and Pearce analyse the statistical literacy needed to interpret graphs commonly used in the Australian National Assessment

Program - Literacy and Numeracy (NAPLAN) reports for schools and in so doing develop a framework of professional statistical literacy for teachers, education professionals and policy makers. Their three-step framework is strongly related to other recognised frameworks in the statistical literacy literature. They draw attention to the complexity of statistical literacy in the highest level of their framework that is required to successfully interpret graphs. Such interpretations are required if these data are to be used as intended—to inform policy and practice at the system, school and classroom level. These researchers argue that this framework of statistical literacy should inform professional learning programs for teachers and school leaders and should be included in pre-service education programs for future teachers.

These papers accent key ideas that are already recognized as important in mathematics education literature including that active involvement and experimentation can stimulate and support change as evidenced by the tertiary lecturer who focused more on change once he became aware of the quality of learning his students displayed (Kensington-Miller & Yoon). The papers also highlight the problem of insufficient time for supported experimentation in fast-track teacher education programs (Wassermann and Ham), and provide an alternative to consider in the virtual exposure to classroom situations that can provide useful but different opportunities for learning (Beswick & Muir). The importance of theoretically framing the understandings we want to develop to increase the likelihood of achieving this is also highlighted (Chick & Pearce). This edition provides a useful example of how much we can learn by exploring beyond the levels of mathematics education in which we usually engage.