

YuMi Deadly Maths Program – efficacy and collaboration

Dr Bronwyn Ewing, Dr Grace Sarra and Prof Tom Cooper – YuMi Deadly Centre, Queensland University of Technology, Queensland, on teaching maths to indigenous students

Historically, perceptions about mathematics and how it is taught and learned in schools have been mixed and as a consequence have an influence on self efficacy. There are those of us who see mathematics as logical and an enjoyable subject to learn, while others see mathematics as irrelevant, difficult and contributing to their school failure. Research has shown that over-represented in the latter are Aboriginal and Torres Strait Islander, low SES and ESL students. These students are the focus of YuMi Deadly Centre (YDC) professional learning and research work at the Queensland University of Technology in Brisbane.

The YuMi Deadly Maths Program

The YuMi Deadly Maths Program (YDM) was originally designed for Aboriginal and Torres Strait Islander students, but has been adapted to benefit low SES students including migrant and refugee students, and those at risk of disengaging from learning. With a focus on big ideas, an emphasis on connecting mathematics topics, and a pedagogy that starts and finishes with students' reality, it has been shown to be effective for all students.

In 2009, YDC refined the initial program with a focus on indirectly influencing students' achievement in mathematics through teacher training. This approach aims for the highest level of mathematics understanding, through activity that engages students, their teachers and involves parents and community.

Since 2010, the YDM program has been successful in over 100 Education Queensland schools, empowering teachers to go beyond their initial teacher and professional development training and taking control of planning and designing sequences of mathematics lessons, and explicitly demonstrating the evidence of these processes. Of importance is the application of the RAMR model – reality, abstraction, mathematics and reflection.

Briefly, drawing on a pedagogic approach of reality, abstraction, mathematics and reflection, the intention is to support teachers with the teaching of mathematics, and then, the learning of their students (Matthews 2008). Reality, indeed “society can... be understood as a vast argumentative texture through which people construct their reality” (Laclau 1993, p.341) in contexts such as classrooms. That context can

include factors such as the material setting, the teachers and students present and what they know and believe, the language that is used, the social relationships of the people involved and their identities, as well as historical, cultural and institutional factors (see for example, Ewing, Cooper, Baturo, Matthews & Sun 2010). It also includes the observations of mathematics taken from a teacher's or a student's perceived reality (Matthews 2008). The focus is on how teachers and students produce their realities of mathematics in everyday life, as well as what the activities of everyday life. It is a process of co-construction. The teacher and students contribute to the construction of a particular shared reality in the learning context. From that reality, the teacher supports the students to create abstract representations of their realities using materials, language and signs and symbols.

Abstraction refers to some kind of lasting change, that is, the result of abstracting enables the learner to recognise new mathematical experiences as having the similarities of an already formed experience (White & Mitchelmore 2002; Matthews 2008). Through this process, negotiation of mathematical meaning becomes a necessary condition for mathematics learning, the signs, symbols and language (Voigt 1994). As teachers and students negotiate, reflect and communicate in that context and articulate their thinking, their developing conceptual understandings take on a reality of their own because they are made more explicit within the context. Through this ongoing interplay students give shape to their experiences and meaning for mathematics learning thus increasing their understanding of the initial reality from which the mathematics emerged, their efficacy and enjoyment of the subject. This process also allows teachers to engage in deliberate reflective analysis to try and understand and improve their practice (Gabriele, *et al.* 2007).

The YDM professional learning program requires teachers to engage in action research processes to report on the implementation of the program. This structure serves several purposes: 1) teachers can see explicitly the evidence and impact of their teaching on student mathematics

learning, 2) the Centre analyses the evidence to determine the effectiveness of its program in schools and, 3) funding bodies receive reports on the effectiveness of the Centre's program and the schools' implementation and maintenance of YDM.

What the evidence is showing

In 2012 the YDM program was implemented in a further 50 schools across Queensland and Victoria, with positive results. There are three particular pieces of evidence from the YDM Victorian project that have been encouraging.

First, where principals have been involved in the leadership component of the YDM program, there was strong support for its implementation and maintenance in their schools.

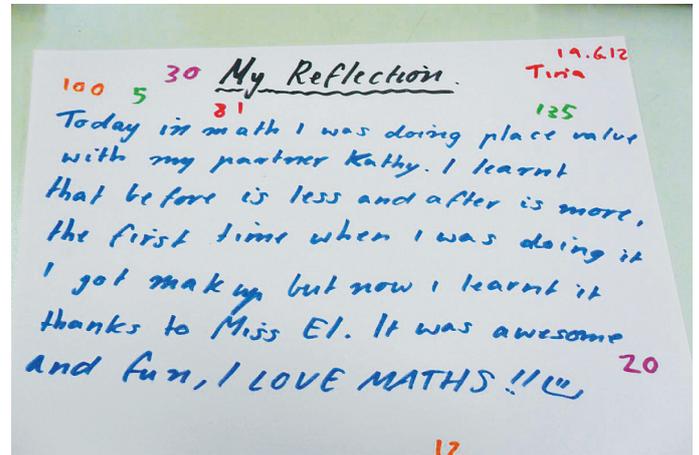
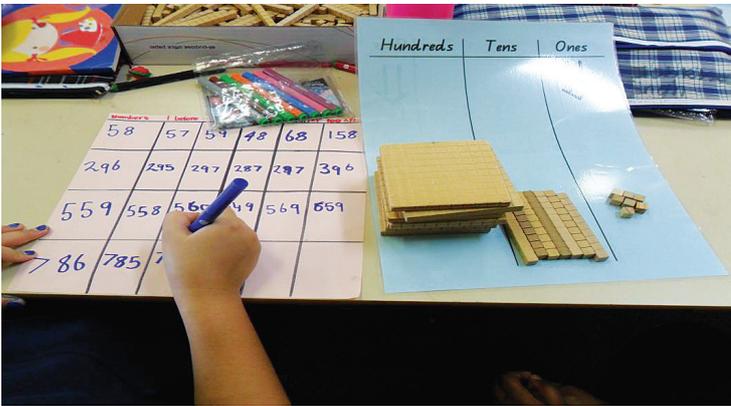
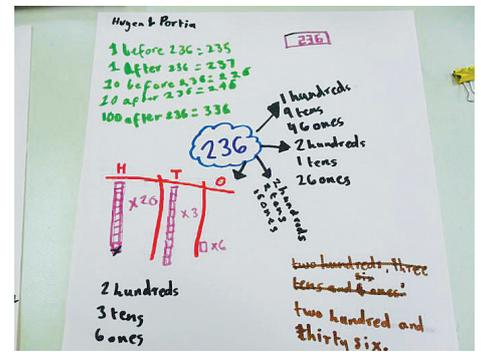
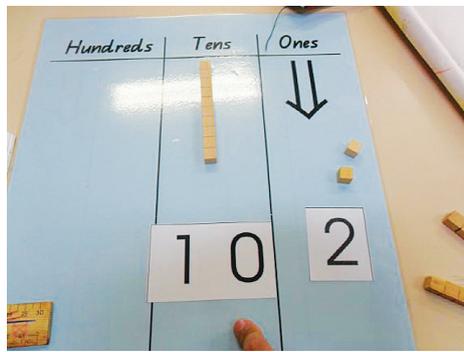
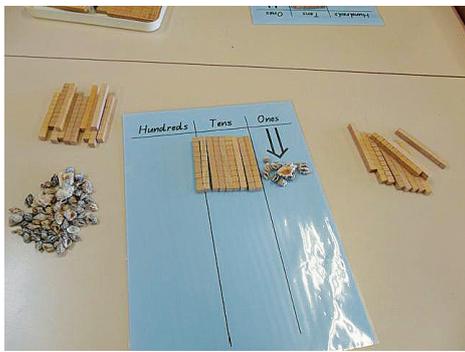
Second, where schools had to secure funding from their own budgets to implement the program, a very strong ownership and valuing of the program was identified with a range of processes implemented to ensure the program's success and sustainability across individual schools and in some instances within regions and networks.

As 'Dione', a numeracy coach from the Victorian project explains, “the elements that made the project really good were that the school leadership were trained. There was the partnership between the school and the network in the funding so National Partnerships funded some of the project and schools still had to put money in and that's an important element I believe, because it had to come out of their budget, so they had to actually value the project.”

Third, professional learning teams were identified as critical to this ownership and valuing as Dione further explains, “I decided to begin a professional learning team, to enable teachers to come along and just be focussed, all they're going to talk about when they come is YuMi.

“Often within schools and within the daily running it's hard to actually get that opportunity to have that conversation. We decided that the professional learning team was going to be a way that would support the teachers and ideally that idea of sustainability, continuing beyond just while they're being trained.

Abstracting enables the learner to recognise new mathematical experiences as having the similarities of an already formed experience



Figures 1–5: Place value sequenced lessons

“I think while you’re being trained there’s enough to have the momentum going but it’s that component beyond that. So we knew that for curriculum change to happen, there had to be changes in teacher practice. We knew that there had to be changes in beliefs about learning and teaching and we knew that there had to be that actual research and professional discussion and that’s where the professional learning team was going to be able to help and support them.”

The interconnectedness of leadership, funding and learning teams on teacher and student efficacy

The interconnectedness of training principles, finding funding and professional learning teams has been found to have a positive influence on teacher efficacy, student efficacy and professional collaboration. This influence was identified from reflective portfolios submitted by participating teachers who engaged in action research processes as part of their training and development in the program. Of particular interest is how they implemented reality, abstraction, mathematics and reflection (RAMR model) into their teaching.

Increasing teacher efficacy

A teacher’s efficacy is a critical factor identified as playing a key role in changing practice (Gabriele, *et al.* 2007). Described in various ways, teacher efficacy is referred to as the motivation that teachers expend on effort to implement a program, a willingness to set challenging goals and the persistence to see them through (Gabriele, *et al.* 2007). From this perspective, teacher efficacy influences their determination and adoption of new ways of teaching by increasing their willingness to take

risks and persist with difficulties and setbacks that come with the implementation process (Gabriele, *et al.* 2007).

Reflection is a critical element in the development of teacher efficacy. In the Victorian project involving 12 schools and 48 teachers, teachers were asked to reflect on their implementation of the YDM program.

‘Aderley’ interprets her performance with implementing a sequence of lessons on place value. “Through this place value sequence of lessons, I have learned that to engage the students fully, you must include a relevant reality that is based around student interests and new ideas.

“When introducing the idea of an odometer, the students were excited to explore what an odometer was and how it worked. I also identified that it important to have the sequence of lessons blend together, rather than be seen as separate lessons. Maintaining the consistent idea of an odometer really supported my ability to keep the students engaged for the entire unit.

“It is critical that you don’t rush through the concept and skills being taught. Teacher enthusiasm is critical. The students feed off us as teachers and it is necessary that we present as excited to be successful in engaging our students. I have also learned that I don’t need to fake enthusiasm if I take the time to create a RAMR model that meets my goal: engage students and improve student learning.”

Evident in Aderley’s reflection is her ability to reflect on and interpret their past performance. Previous experience planned and enacted by the teachers has been perceived by them as successful thus raising their self-efficacy. In doing so, the evidence of their past successes will strongly influence their expectations about themselves and the program in the future.

As they make sense of their teaching, take ownership and manage the implementation processes in their own ways, student efficacy has the potential to be influenced positively.

Increasing student efficacy

An implication of teachers modifying or changing their teaching practice is the potential to increase student efficacy. When teachers take an interest in and notice students’ thinking during maths lessons, deep and sustained transformations occur in teachers’ and students’ efficacy.

As ‘Elizabeth’ explains, “once most of the students were showing understanding in renaming, they moved on to the *mathematics* stage of the RAMR model. I decided to use Mind Maps as a way of students showing their understandings of all the work they had covered so far. I was pleasantly surprised by the richness of their learning” (Figures 1–5).

She explains further, “working sequentially from reality through to reflection was very beneficial for my students. My students worked in mixed ability groups, encouraging peer support and assistance, and this proved to be so helpful for the students who were displaying some difficulties.

“As lots of concrete materials were used during the *abstraction* time, lots of discussions and connections were being made with the language and symbols. Repetition was very important as was clear, explicit instructions.

“The most challenging aspect of the RAMR model for me was thinking of a *reality* for my students so that it is something from the student’s world. I thought it had to be far more sophisticated than it actually was. I found using the RAMR model very logical and flexible.

“As a teacher, having to plan sequentially and

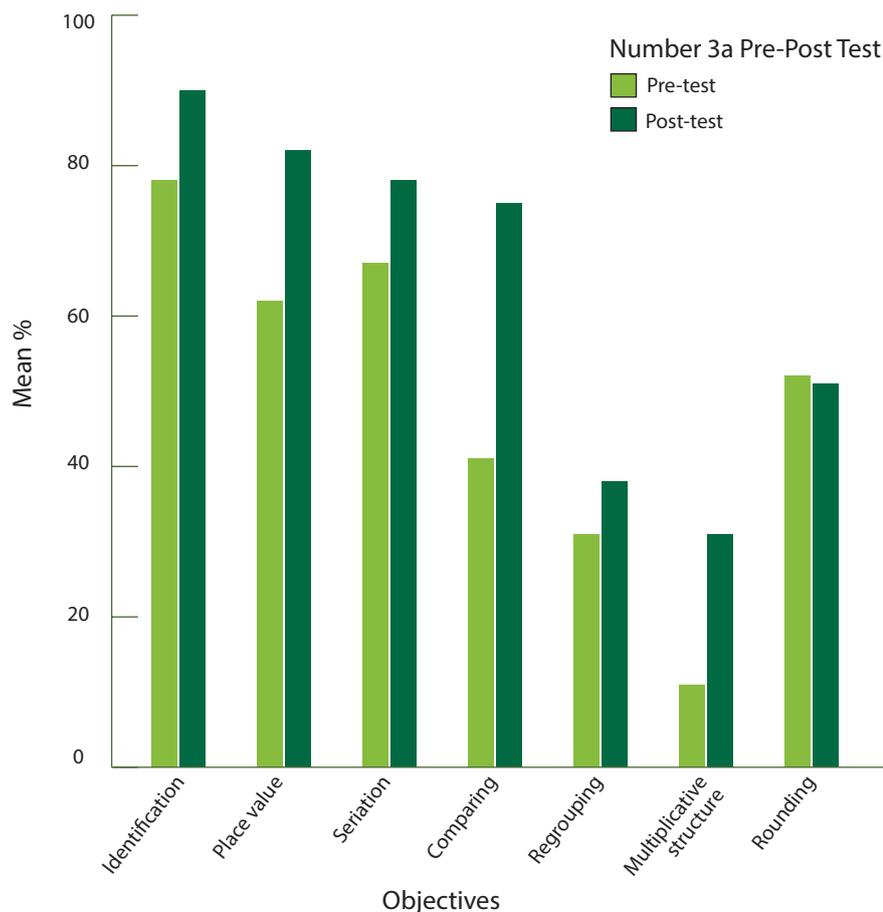


Figure 6: Pre- and post-test results

logically has deepened my understanding of core maths ideas, and consequently has helped me to modify and extend my instruction. It was essential that the language I used was consistent and that my teaching was very explicit.

“I learned not to assume that students know maths concepts. My initial question to my students was, ‘What is place value?’ Thankfully, more students are able to answer this question, and able to show evidence of their understanding.”

Further evidence of students’ increasing efficacy is shown in the pre- and post-test results (Figure 6).

Professional collaboration

Professional collaboration is critical to the success of implementing the YDM program in schools. Through this process, teachers have opportunities to share their ideas, provide examples of students thinking about maths problems, their questions and concerns with their colleagues.

The reactions of other teachers can often be positive and reassuring as ‘Sally’ explains, “at the beginning of this journey, the YuMi team at Shearbright Primary School met to discuss how we were going to implement the program after the initial three days of professional learning in March. We had many questions about the program and as a result we developed the following questions to guide our thinking in the implementation:

- How am I going to implement YDM into my classroom?
- How am I going to measure its success?
- How do I know it’s better than what we are already doing?
- What are my observations throughout the series of lessons?
- How does the RAMR framework fit into the WMR numeracy lesson structure?
- Do we need a warm-up?
- How long does the cycle take?

“As the school-based numeracy coach I was also using these questions to begin thinking about a whole-school implementation. During our discussion, all team members voiced their interpretation of YDM from the booklets and from the professional learning.

“There was an active discussion about how we were going to implement it into our classrooms with many questions being asked and answered throughout. As a result we took one idea based around place value and differentiated it across the Grade 1/2, Grade 3/4 and Grade 5/6.

“During the planning stage, the team decided to have the series of lessons occur over 4–6 days to develop our ideas of the program and build up some confidence in what we had planned within the RAMR framework. We didn’t want the lessons to go over a longer period of time until we felt we had a sense of what we were doing.”

This reflection highlights the importance of professional collaboration when implementing

a new program. By coaching one another as they work through a new approach, teachers are building their repertoire and providing one another with constructive feedback and ideas, thus increasing their efficacy.

Conclusion

In conclusion, understanding the interconnectedness of training principals, finding funding, establishing professional learning teams, increasing teacher efficacy, increasing student efficacy and professional collaboration, is critical to the implementation of the YDM program.

Highlighting the links during PD is critical for understanding how the program can be successful when viewed holistically with these key elements. Conversely, neglecting the linkage may result in the PD being a costly exercise where there a little long term benefits.

By adopting a strong collaborative approach, it is likely that teachers will benefit from a focus on interpreting experiences during the implementation and maintenance phases of the program. As teachers notice and focus on student thinking during lessons, they are provided with efficacy information that sustains the motivation to keep teaching the kinds of lessons that are successful and increasing student efficacy.

The YDM program is a comprehensive program that provides teachers with a theoretical basis for the application of the RAMR model in mathematics classrooms. However, the success of the program is contingent on the interconnectedness of the elements discussed in this article.

References

- Ewing B, Cooper T, Batur A, Matthews C, Sun H. Contextualising the teaching and learning of measurement within Torres Strait Islander Schools. *The Australian Journal of Indigenous Education* 2010; 39: 11–22.
- Gabriele A, Joram E. Teachers’ reflections on their reform-based teaching in mathematics: implications for the development of teacher self-efficacy. *Action in Teacher Education* 2007; 29 (3): 60–74.
- Laclau E. Politics and the limits of modernity. In: Docherty T, editor. *Postmodernism: A reader*. London: Harvester, Wheatsheaf; 1993. pp 336–52.
- Matthews C. 2008. Stories and symbols: Maths as storytelling. Accessed 24/08/09 from http://www.aeu-vic.labor.net.au/professional/files/PV_Mathews_6_3.pdf.
- Voigt J. Negotiation of mathematical meaning and learning mathematics. In: Cobb P, Yackel E, editors. *Learning mathematics: Constructivist and interactionist theories of mathematics development*. Dordrecht: Kluwer Academic Publishers 1994. pp 171–94.
- White P, Mitchelmore M. Teaching and learning mathematics by abstraction. In Tall D, Thomas M editors. *Intelligence, learning and understanding in mathematics: A tribute to Richard Skemp*. Flaxton: PostPressed; 2002. pp 235–56. **ET**