n Ian Pegram’s class, who gives a ‘tinkers’ about how many people you need in a room to have a good chance of having two with the same birthday? I suggest pretty much nobody. You will never need to know that fact. But, on the other hand, who gives a ‘tinkers’ about the Birth Month Paradox investigation? Well, for a start, and apparently unexpectedly, all of Ian’s Year 10 and 11 classes!

First give me an interesting problem also works in primary school. I will let Jacki Healey, Margate Primary School, tell this story of Poly Plug Values as it unfolded in her class. It is recorded in the Calculating Changes section of Mathematics Centre.

I was working with Place Value with my Grade 2 class and I wanted to do something to extend their understanding. I decided to use Poly Plugs. The first time I introduced the Poly Plugs I told them it would be interesting to use them to represent numbers. How could they do this?

Initially I used low numbers, eg: 14, 17, etc. I discovered that given low numbers, most children would assign each Poly Plug a value of 1, ie: 1 to 1 correspondence.

The challenge lay in giving them larger numbers to represent, eg: 96, 43, 85, 74. Large numbers and odd numbers were harder, and required more ingenuity to represent. At the end of the first one hour session, some children had considered giving, for example, a red plug the value of 1, a yellow 2, a blue 5 or 10.

...all the way to 48. But what will this last one be??

Over the next 3 weeks I repeated the exercise, giving each group the opportunity to swap partners and share ideas. It was tremendously exciting to watch as the children’s confidence and ingenuity increased each week.

They were also asked to record their ideas, so that they could share with the whole group. By the end of the month the children’s ability to ‘skip count’ in 2s, 3s, 4s, 5s, 6s and 10s was amazing. Some children even assigned value to the empty places in the plug board. They also thoroughly enjoyed the whole process.

Jacki is using a teaching method here that has been devised by teachers in the Calculating Changes network (HREF4). It is called Threading.

The yellow is worth 2. We are counting by twos....
adoption is possible, independent of any externally impressed curriculum force.

**Sphinx**

This task is the most extensively documented of any (HREF5, 6, 7). However, some may not be familiar with it, so a quick background. In the original form, students were given four wooden pieces, shaped as shown, and challenged to arrange them into a larger ‘Sphinx’ shape.

As it stands the task is a spatial challenge of moderate difficulty. At a teaching day in 1996, which initiated the project to trial the use of tasks in an urban Indigenous situation, two Year 5 Aboriginal and Torres Strait Islander students, Tyler and Michael from Norris Road School, accepted the challenge. They solved it quickly, but then were challenged to investigate further into the iceberg.

Their solution showed that the base, height and side lengths of the new Sphinx were twice as long as the corresponding lengths in a single Sphinx shape. The boys’ teacher pointed this out, and asked them to relate this ‘2 times’ information to the fact that the new Sphinx was made of four original ones. The discussion led to recognising a growth pattern Size 1, Size 2, Size 4... and led to the boys asking: ‘What happened to Size 3?’

Their teacher did not know the answer and, at this stage, did not even know if was possible to solve this extension of the problem. The boys were invited to take on this new challenge, made all the more difficult by the fact that only four wooden shapes were available. They found a large sheet of paper and set about tracing. This can be a frustrating approach because, once traced, the drawing can’t be picked up and rotated, or reflected, like a wooden piece can. But, the boys persevered. In fact they stuck at the task for about 45 minutes and were still trying when time ran out.

This teaching day was held at a central location and included students from several schools. Michael and Tyler had to return to their own school. They chose to take their incomplete work with them. Weeks later their solution to this quite difficult task was delivered to the project organisers.

Significantly the boys had claimed their solution by superimposing a drawing of the Aboriginal flag on their nine piece solution.

What is of primary importance here? Is it the fact that 4 funny shapes fit together to form the same funny shape? The fact that the growth pattern leads to work in topics of patterns and powers, area and perimeter, prime and composite numbers, algebraic generalisation, symbolic representation and more. Or, how those boys felt about themselves?

**Adventure of the Sphinx**

One part of the Sphinx story is not told through the references. It is told in a video one class made to publish the results of their investigation, just as a mathematician would.

Dani and her class, with the support of teacher Pamela McGifford, made this video in 1999. In March 2009 Dani, whom I have never met, wrote to me out of the blue asking if I knew where she could get a copy.

I used to be a student at Cressy District High School where we studied the Sphinx problem in depth with our teacher Pam McGifford. As I’m sure you are aware, we recorded a video detailing our discoveries. I am currently in the process of trying to track down a copy of this video (I don’t think I ever actually watched it!), and was wondering if you would be able to help me with this.

That started a conversation, which included:

How has the Sphinx influenced my life to present? Well I will admit I have never been a mathematically minded person. Far from one in fact! However at the time it was a fantastic learning experience. I have always been a good student and achieved high marks but mathematics was always a foreign language to me, so I didn’t have any interest in that area. Studying the Sphinx problem sparked my interest, and got me actively involved in something I could piece together and
Dani continued the email conversation with:

We had Pam McGifford for Maths and John Bradbury for science, although I think he used to fill in for Pam from time to time and take our maths class. I’m not sure what to say about them, apart from how fantastic they are! They are both excellent teachers with that essential (well I think it is anyway) ability to relate to the students on a personal level whilst still maintaining the student-teacher order and respect. I only hope that when I complete my studies one day I can be half as good as them.

Pam and John were both involved in the INISSS professional development research with 40–60 secondary teachers (HREF8, 9). INISSS stands for Improving Numeracy for Indigenous Secondary School Students, and it provides research evidence, which confirms the stories I have been telling. Both a descriptive and a more formal outline of the research can be found in the References. In summary, this was a four-year research program based around professional development intended to shift teachers’ attitude towards learning to work like a mathematician.

The outcomes were:

- Students had better problem solving skills...
- Students had better content skills...
- Students had better literacy skills...

...than equivalent cohorts whose teachers had not been involved in this professional development programme. More importantly, the programme was stimulated by a desire to improve learning outcomes for Indigenous students. Through helping teachers shift their vision of mathematics education, by Year 10, the Indigenous student group, who were significantly ‘behind’ non-indigenous students when entering secondary school in Year 7, had essentially reached parity with their classmates. All previous evidence was of the gap widening over these years, not narrowing, and certainly not disappearing.

So, is mathematics of primary importance? No.

- **Why we teach** is of primary importance.
- **Learners** are of primary importance.
- **How we teach** learners is of primary importance.

The mathematics itself doesn’t really matter - but learning to work like a mathematician in a best practice classroom does matter. In this context, many, many, many teachers have found that there is nothing mysterious, puzzling, or difficult to understand about mathematics education. We know how to do it and do it well. Therefore mathematics education is not an enigma.

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References

HREF1:
Mathematics Centre, Black Douglas Professional Education Services, Australia (Crosses task)

HREF2:
Mathematics Centre, Black Douglas Professional Education Services, Australia (Fried Rice task)


HREF3:
http://www.maths300.esa.edu.au
Education Services Australia (Birth Month Paradox is a members’ lesson)

HREF4:
Mathematics Centre, Black Douglas Professional Education Services, Australia (Calculating Changes Network – Poly Plug Values is from the Members section)

HREF5:
Mathematics Centre, Black Douglas Professional Education Services, Australia (Sphinx task)

HREF6:
Mathematics Centre, Black Douglas Professional Education Services, Australia (album of Sphinx information)

HREF7:
Mathematics Centre, Black Douglas Professional Education Services, Australia (Michael & Tyler’s story)

HREF8:
Mathematics Centre, Black Douglas Professional Education Services, Australia (INISSLSS research)

HREF9:
Mathematics Centre, Black Douglas Professional Education Services, Australia (evidence from Cressy District High School)
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